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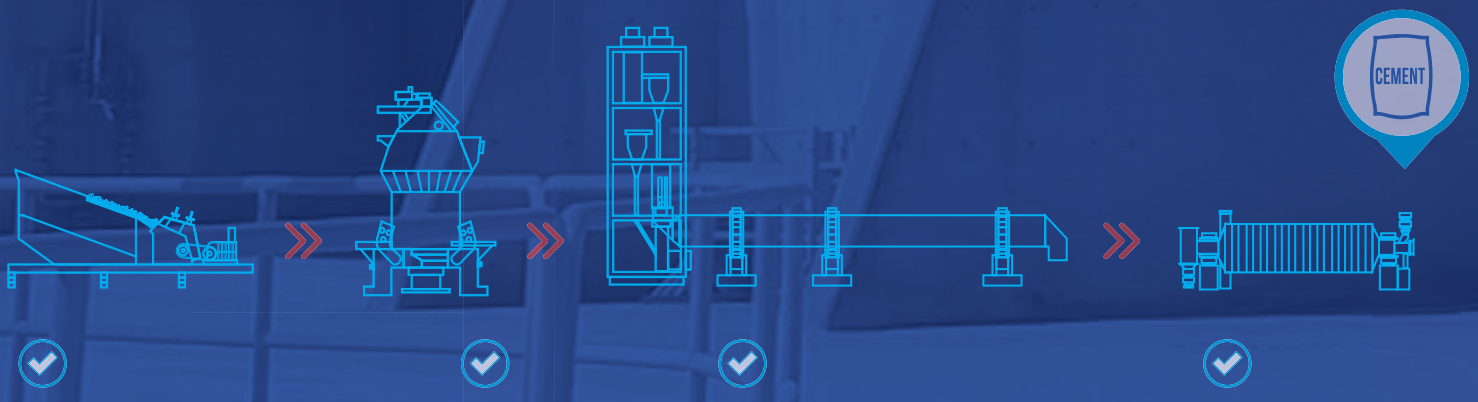

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Dear readers,

Welcome to the May 2018 issue of *Global Cement Magazine* - the world's most widely-read cement magazine! As in April 2018, this issue is a busy one that will be taken to conferences in the US and the UK.

The first and larger of the two events is the *IEEE-IAS/PCA Cement Industry Technical Conference* in Nashville, US. Now in its 60th edition, the event is *the* annual meet-up for those involved in the cement sector in North America. As in previous years, we again feature interviews with the PCA's President Michael Ireland (Page 58) and its Chief Economist Ed Sullivan (Page 61). We also carry a plant report from the Cementos Argos Roberta plant, a short drive across the state line from the conference into neighbouring Alabama. The plant is looking to increase its alternative fuel substitution rate with a new shredder and recently took part in a carbon capture and utilisation (CCU) trial as part of a CARBON X-PRIZE consortium. Turn to Page 64 to read more about the plant and to Page 68 for more from its X-PRIZE partners.

The second event at which this issue will be distributed is the 2nd *Global CemProcess Conference & Exhibition* on low-capex upgrades, de-bottlenecking and optimisation. Taking place in London, UK over two days, it also includes a plant visit to the Breedon Cement Hope plant in Derbyshire on the day after the main conference. The plant has undergone significant investment in efficiency projects under its current and previous owners, including a recent kiln feed upgrade, alternative fuels projects and a wide-ranging de-bottlenecking study that seeks to identify the 'true capacity' of the upgraded plant. A full review of *Global Cement*'s recent visit to the plant can be found on Page 38. Delegates from cement plants enjoy favourable conference fees and there is still plenty of time to register. See: www.CemProcess.com.

We hope that you enjoy this issue of *Global Cement Magazine!*

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Dirk Schlemper & Thomas Bergmans, INFORM GmbH

Beyond the hype: AI in cement logistics

Depending on the story, Artificial Intelligence (AI) will either be the future or destruction of humanity. But beyond the hype and horror, a practical form of AI has made its way into the logistics workplace. To escape the sensationalism, this article takes a look behind the technology and reveals how AI can solve logistics nightmares in the cement industry...

"*You are my creator, but I am your master.*" These chilling words from Mary Shelley's novel Frankenstein were first published on 1 January 1818, during the First Industrial Revolution, a period of great social and technological change. Considered by many to be the first work of science fiction, the story influenced not only literature, drama, and film but also the public's perception of science itself.

2018 marks Frankenstein's 200th anniversary. Now, at the dawn of the Fourth Industrial Revolution, the myth of creature turning on creator seems more relevant than ever before. Having escaped the laboratories of many tech companies, Artificial Intelligence (AI) is poised to change our society for good. While human-level AI is not yet close, we constantly carry some form of AI in our pockets today. The irony is that Siri, Alexa, and Cortana, while comparable to Frankenstein in so many ways, aren't perceived to be frightening characters. Rather, these AI enhanced assistants have become an ordinary, if not integral part of our lives and workplaces.

The brains behind AI

AI is an area of computer science that is concerned with building systems that demonstrate intelligent behaviour. Most people find it difficult to agree on a precise definition of intelligence, and so the view of what AI means also tends to diverge. For most people, when they hear the term Artificial Intelligence they think of a General AI, or human-level AI, that can mimic all aspects of human intelligence. The simple truth, however, is that today, AI is far away from this. Instead, AI vendors have succeeded in building niche, or so-called Narrow AI systems that know how to do reasonably specific things very well, be it playing chess, translating between languages, understanding natural languages or driving autonomous vehicles. It is these Narrow AI systems that are now making their way into many industries at a rapid pace as part of the Fourth Industrial Revolution.

In contrast with General AI's goal of mimicking human intelligence, Machine Learning platforms (ML) use algorithms to iteratively learn from and adapt to data, enabling computers to find hidden

Right: Artificial intelligence is already helping cement sector logistics.

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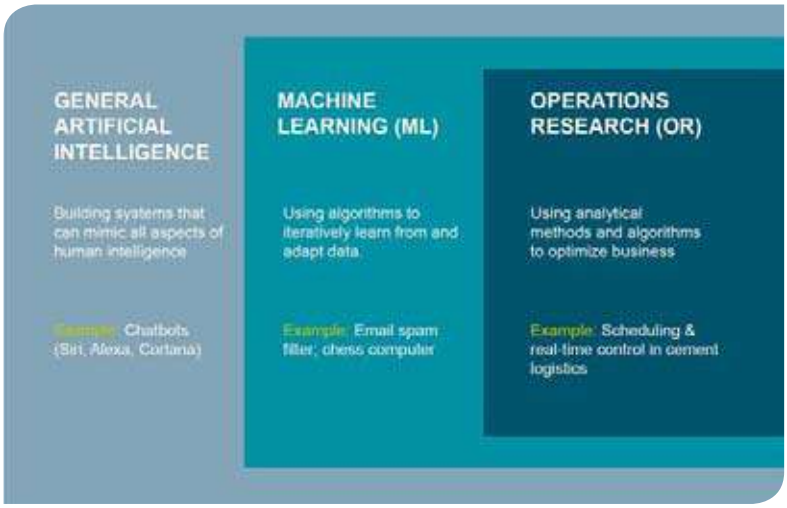

Above: The brains behind AI.

insights without being instructed where to look. A beginner's example for this can be found in your email inbox: spam filters. Simple rule-based filters are not very effective against spam, since spammers can quickly update their messages to work around them. Instead, ML enhanced spam filters continuously learn from a variety of signals and tailor themselves to the email needs of the individual user.

A hidden champion of AI is Operations Research (OR). It uses analytical methods (mathematical optimisation, heuristic methods, etc.) to analyse and consider vast amounts of data to optimise the planning and real-time control of processes. From a classical research perspective, OR and AI are two separate disciplines that have independently developed intelligence-based computing techniques. However, if you take the broad definition of AI, with building systems that demonstrate intelligent behavior, Operations Research could be classified as a part of Artificial Intelligence.

In contrast to the latest AI developments, cement producers around the world have been using OR based tools that are powered by algorithms, real-time information, and automated decision-making since the early 2000s. For example, Hanson Australia, part of the HeidelbergCement Group, has been using the authors' planning software to manage and optimise its continent-wide fleet of trucks for nearly 18 years. As a side effect, the use of data-driven transport planning in cement logistics generates more data than one can actually make use of. This is where AI and Machine Learning techniques can help.

The Modern Prometheus

The subtitle of Mary Shelley's Frankenstein novel is *'The Modern Prometheus.'* In Greek mythology, Prometheus was not only a symbol of limitless ability but also the god of forethought. Forethought is a much needed skill among dispatchers and planners in the cement industry. Their customers can be 'moody monsters,' placing *ad-hoc* orders, cancelling orders on short notice, changing time windows for deliveries, etc... Pending or unscheduled 'will call' orders, where customers pick up loads at the cement producer's plant, may block gates and loading resources and subsequently add more complexity to the planner's equation.

OR-based planning tools allow operators to make incredibly complex, time-critical decisions with ease. Powered by algorithms, these tools analyse a virtually endless number of scheduling decisions in real-time and identify those that are ideal for minimising costs and maximising service quality – based on the business criteria defined. What's more, the decisions made take into account a larger range of variables than the human mind can, resulting in better overall decision quality.

To further enhance the decision-making quality of OR-based tools, a Machine Learning platform can be connected to the planning system. Looking at huge amounts of data from the past, ML can analyse the order behavior of each individual customer and identify patterns: when and at what time did the customer confirm or cancel the order? What was the additional volume that the customer ordered? What is the likelihood of cancellation and what is the typical lead time before cancellation?

Any findings and correlations are presented by the ML in an easy-to-digest dashboard to create insights for human planners and dispatchers. The overall goal of this exercise is to fine-tune the truck capacity planning (pre-planning) for the upcoming shifts and days: At which plants will I need more trucks? Where should I reduce the fleet capacity? This avoids idle trucks and excessive delays due to insufficient resource capacities.

Thunder and lightning

Throughout the Frankenstein novel, Mary Shelley uses storms and bad weather to foreshadow the terrible events that will soon hit the lives of its characters. Today, weather is a strong driver of consumer spending habits and the correlation between sun and product demand can be seen across many sectors including the construction industry and DIY stores. The rise or fall in temperature by a few degrees or a fear that it's going to rain can have significant knock-on effects on the supply chains of a wide range of products.

A Machine Learning platform can predict, in granular detail, how buying patterns change with external factors like weather. When combined with the customer order behaviour analysis, dispatchers and planners in the cement industry will approach a point where they can predict follow-up orders with high accuracy.

However, the silver lining doesn't end there. Some cement producers have already combined their conventional inventory planning strategies with intelligent transport optimisation software to integrate

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real-time information from the trucks on the road into the stock level replenishment schedule. This Material Replenishment Process (MRP) represents a closed loop control system that helps making synchronised decisions, avoids risking stock-outs, and prevents excessive stock levels or wasting inbound transport capacities. Adding intelligent forecast tools to this setup makes the entire MRP process even more accurate.

Teaching the monster

One of Dr Frankenstein's gravest errors was to neglect his creation. He fled from its presence, giving up the opportunity to supervise, nurture and educate his invention. Supervised learning is a term that is often used in conjunction with Machine Learning. Similar to the way a child learns from a teacher, supervised Machine Learning finds patterns where we have a dataset of 'right answers' to learn from. For example, an algorithm will learn to identify dogs after being trained on a dataset of images that are properly labelled with the name 'dog' and some additional identifying characteristics.

All the examples described above, however, use a technique called unsupervised learning. Unlike supervised learning, there are no correct answers and there is no teacher. Algorithms are left to their own devices to discover and present interesting patterns in the data.

However, purely algorithmic extraction of rules from data is prone to creating spurious correlations. As it turns out, US crude oil imports from Norway track nicely with the number of drivers killed in collisions with railway trains. This is one of the many spurious correlations that Tyler Vigen has published on his website - *www.tylervigen.com*. Just because the movements of two variables track each other closely over time, doesn't mean that one *causes* the other.

With this in mind, any insights from a Machine Learning platform can be fed automatically into the OR-based planning software. There are many cases where this set-up works absolutely fine. Example: The planning software uses average or historical values to calculate an optimised delivery schedule, e.g. 20 minutes for loading a bulk truck. But loading times may vary over the course of a business day. They may vary on different weekdays. They may vary on different product volume quotas. They may vary on different haulier assignments. They may even vary on different truck types and/or drivers. Insights from the ML may be fed back automatically into the software where they replace previous average or historical values.

However, when the ML outcome is used to fine-tune the models and rules that are encoded in the planning software, findings and correlations are better presented in easy-to-digest dashboards to create insights for humans. These insights form the basis for expert discussions to avoid spurious correlations.

Frankenstein redux?

In the riveting laboratory scene when the monster is brought to life, Dr Frankenstein shouts, *'Look! It's alive!'* Two hundred years later, we find ourselves at a prologue to a new Frankenstein story. AI can solve many problems in cement logistics, but it will not replicate the human brain anytime soon. The aim of any development should not be to make 'it' better than us, but rather to make 'it' beneficial to us. The question is not whether we should use AI or not, but rather, *how* we should use it and if we, as an industry, will be well prepared or caught off guard when we realise that AI is here. As Mary Shelley wrote, *'Nothing is so painful to the human mind as a great and sudden change.'*

Right: Adding Machine Learning to the supply chain environment.

Interview by Peter Edwards, Global Cement Magazine

In discussion: Ventilatorenfabrik Oelde GmbH

Global Cement recently visited the renowned cement process fan manufacturer Ventilatorenfabrik Oelde at its headquarters and main production facility in Oelde, Germany. Managing Director Thomas Gandt, Sales Manager Peter Herrmann and Marketing Manager Inge Teich were keen to talk about the company's history, growth, manufacturing methods and markets.

***Global Cement (GC):* Can you please provide a quick introduction to the company Venti Oelde?**

Thomas Gandt, Managing Director (TG): Venti Oelde is a family-owned company, established in 1930. It originally made fans, cyclones and filters to remove sawdust from the inside of furniture factories. Over the years the company has always looked for new customers and industries to deliver its fans to. In the 1960s it moved into the cement industry, which is very significant in this area of Germany. It was often asked by the local major equipment producers for advice on industrial fans and air transport.

Peter Herrmann, Sales Manager (PH): The company manufactured small and medium size fans for the cement sector initially, before moving into larger pieces. Initially we worked closely with Polysius, supplying clinker cooler fans and airslide fans. Now our cement sector business is mainly concerned with large process fans. We employ 265 people here, 50% in administration and 50% in fabrication and engineering. There are around 70 engineers working to develop our products to keep up with future demands.

***GC:* Does the company have any production bases other than in Oelde?**

GC: We manufacture the major rotating parts of the fans in Germany only but also manufacture fan casings and other less complicated parts in partner facilities around the world. These are licensee companies authorised to produce our parts for us.

***GC:* How important is the cement sector to the company today?**

PH: The cement sector is 35-40% of our total order intake. It is our largest sector, the second being steel and the third being chemical processing. We also supply to around 6-8 other sectors, for example power and wood pulp and paper.

***GC:* What are the most common requests from cement producers?**

Right: From left to right: Thomas Gandt (Managing Director), Inge Teich (Marketing Manager), Peter Herrmann (Sales Manager) and Peter Edwards *(Global Cement)* in discussion at Venti Oelde's headquarters.

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CHRISTIAN PFEIFFER

Right: An impeller being balanced on the Schenck balancing machine in the factory.

Right: An impeller headed to a cement sector client in Algeria.

PH: The main fans we make are the main process fans, which have to deal with high temperatures and abrasive environments. These days a typical order is for a fan in excess of 3000mm in diameter with a drive rated at more than 1MW rotating at 740-1500rpm. We supply fans of 800-4100mm to the cement sector. We make up to 100 cement fans in a good year.

In quality terms, what the customer is looking for is a long lifetime with high performance and high efficiency. Low noise is an increasingly important factor too.

GC: **How do your 70 engineers improve the fan with time?**

TG: First we look to the process, because a mill fan is not the same as a kiln fan. Once we know the type of fan that is needed, we use CFD calculations to see what might work well for the exact system in question. We can then choose the best and refine them in our testing lab using scale models. We enter the calculation figures and use our software to extrapolate from a 500mm diameter fan up to a fan that is 5000mm in diameter. It is important to combine the calculations with our near 80 years of experience.

PH: Using this experience and modern technology we can see the critical areas for heavy wear or build up of material. It might be a case of changing the blade angle or altering the speed, the air velocity. It's about 50/50 experience to calculation.

GC: **Once the fan is designed, how is it produced?**

PH: We start with a blade sheet and cut them out, bend everything according to the design and weld it together. Then the impeller goes for stress relieving in a big oven. After that, we machine it and balance it on the shaft, which is forged material from elsewhere. We then add the bearings and may also add the casing here, if it is not being produced at one of our partner factories. The finished product is then put in a container and sent to the client. We send out most of our fans via ship.

From cutting the blade to sending out the finished item takes around 3-6 months, depending on the size of the fan. It is not often that we get the same order twice so everything is a 'one-off.' I don't think two fans we have made have ever been the same.

GC: **Does Venti Oelde test the product before it is sent out?**

GEBR. PFEIFFER

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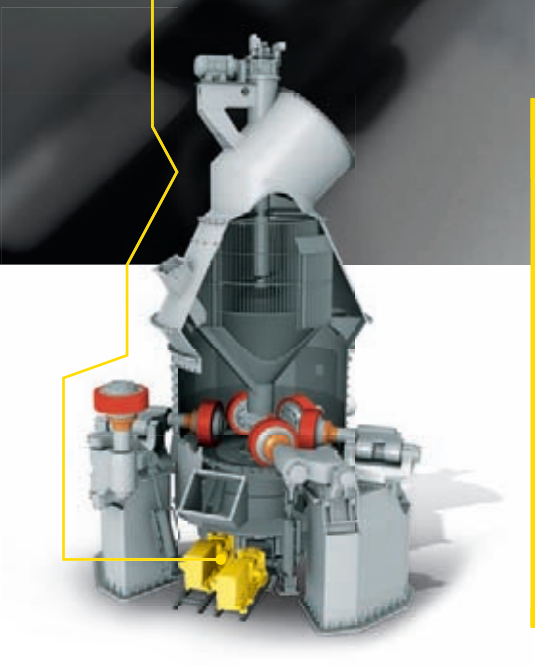

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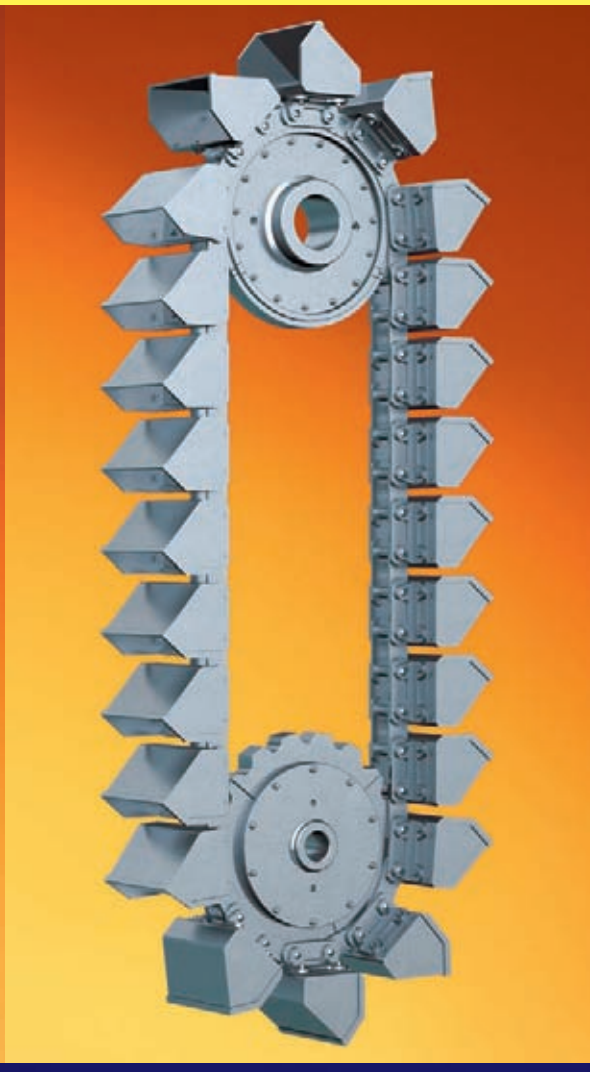

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Left: Welding an impeller section. The company is looking to automate some welding with the purchase of a robotic welding machine later in 2018.

PH: It is not common that a cement sector client would request testing before delivery, although we have that capability. Usually we provide guarantee figures and test on site following installation.

TG: We have delivered hundreds of fans and each time we check the accuracy of our figures against the real test. They match to 1-2% in every case.

***GC:* Which parties are responsible for installation at the client's site?**

PH: The client is usually responsible for installation because we usually deliver as part of a larger project by one of the large original equipment manufacturers (OEMs). They are responsible for incorporating the fan into their system. We then come to site to perform cold and hot commissioning. Sometimes we also perform performance tests if the client requires. We might also be asked to be present during some of the installation steps.

***GC:* Where are the most orders coming from at the moment?**

TG: Africa is big at the moment but we also have strong recent orders from the Middle East. It varies year-on-year though. 2017 was big for Egypt in particular but that probably means that 2018 won't be. We listen hard to the OEMs and read the news in *Global Cement Magazine* to position ourselves well for future trends.

On the other end of the spectrum we have places like Europe, where there is only the occasional upgrade order. It is also hard to sell in China but that is due to the prevalence of local suppliers and the dominance of cost in purchasing decisions.

***GC:* How have client demands changed from a technical standpoint over the years?**

PH: The technical demands are not as strong as before because our main customers are now the OEMs rather than individual plants. The OEMs include the fan as part of a much larger whole and are under price pressure. They have simplified the demands placed on the fans and want them to be lighter (i.e. cheaper).

***GC:* Does that mean that the fans are less interesting for your engineers?**

TG: On the contrary. We are being asked to do more with less and run closer to the edge with respect to the tolerances. This is *more* interesting for us. A fan is typically 80-85% efficient. Achieving this is harder with less material and simpler designs. To improve performance requires subtle changes to the designs, as well as more accurate production techniques.

***GC:* Does the company have anything new in the pipeline for OEMs and / or cement plants?**

PH: We will continue to offer a wide range of fans to both categories of customer and we are also taking steps to reduce our costs. This is very important at the moment. We will buy a new machine to weld the fan impellers automatically, although we will still retain highly-skilled welders to ensure the quality of the most difficult welds.

We have also changed our production system to reduce the number of man-hours required per fan and are looking at new wear protection systems to upgrade older fans and protect them against wear.

***GC:* Are there any plans to expand production?**

TG: We are always looking to extend our capabilities. The robotic welding will be a big step. There is quite a lot of space still available here, even though we have already expanded our production areas by 50% in the past decade.

***GC:* Thank you for your time today!**

TG/PH/IT: You are very welcome indeed!

Left: Parts are painted, checked to ensure quality and then packaged for dispatch, primarily by ship.

Les Williams, Dunlop Conveyor Belting

Invisible conveyor belt destroyers

How ozone and ultraviolet light are dramatically shortening the working life of your cement plant's conveyor belts...

There are an awful lot of things that damage conveyor belts in cement plants. The constant abrasive action of material being loaded at speed onto the belt and then being accelerated across its surface at the discharge point; the hammering that the belt surface and its carcass takes as aggressive materials (often sharp and heavy) are dropped onto it; the ripping and tearing that occurs when rocks or foreign objects become trapped; the softening and distortion of the rubber caused by oils and resins; the hardening and premature ageing of the rubber caused by heat. The list goes on and on.

All of these factors are, of course, very well known to operators of conveyors. The fact that conveyor belts can be engineered to significantly limit the amount of damage each of these factors can cause is also pretty common knowledge. However, what is definitely not common knowledge within the world of industrial conveyor belts is that there are also two other 'invisible' and inescapable factors that cause very serious damage on a daily basis. During operation of the belt they rapidly shorten its operational life. They are ozone (O_3) and ultraviolet light (UV).

If you type *'The effects of ozone on rubber conveyor belts'* into your search engine then only one belt manufacturer's name appears - Dunlop Conveyor Belting in the Netherlands. This article explains the little known effects that O_3 and UV have on conveyor belt lifetimes, their vastly underrated consequences and how to avoid them.

From protector to destroyer

Ozone (O_3) occurs naturally in the upper atmosphere, where it is formed continuously by the action of solar ultraviolet radiation on molecular oxygen (O_2). At high altitudes, O_3 acts as a protective shield by absorbing harmful UV rays. Wind currents carry O_3 to the atmosphere at the Earth's surface.

At low altitude, O_3 becomes a pollutant. Ground level or 'bad' ozone is not emitted directly into the air, but is created by the photolysis of nitrogen dioxide (NO_2) from vehicle exhausts and industrial discharges. The effects are known as ozonolysis.

The variability of weather, airflow patterns, seasonal changes, vehicle and industrial emissions, geographical and climatic conditions such as higher altitudes and coastal areas mean that ozone concentrations (and therefore the level of exposure) can differ greatly from one location to another. That said, ground level ozone pollution is an ever-present fact of life that must never be under-estimated.

Even tiny traces of ozone in the air will attack the molecular structure in rubber. Ozone also increases the acidity of carbon black surfaces, with natural rubber, polybutadiene, styrene-butadiene rubber and nitrile rubber being the most sensitive to degradation. This can have several consequences such as surface cracking and a marked decrease in the tensile strength of the rubber.

Right: Ozone cracking accelerates heat damage.

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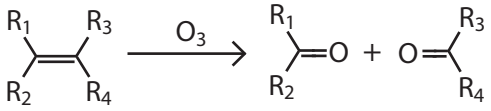
- Optimization of air-handling systems

Right: An EN/ISO 1431 test sample shows cracking caused by ozone.

Ozonolysis

Ozonolysis is the reaction that occurs between the double bonds in the molecular structure of the rubber and ozone...



The immediate result is formation of an ozonide, which then decomposes rapidly so that the double bond molecule is split. The critical step in the breakdown of molecular chains is when polymers are attacked. The strength of polymers depends on the chain molecular weight or degree of polymerisation. The longer the chain length, the greater the mechanical strength, including the highly important tensile strength. By splitting the double bond chain, the molecular weight drops rapidly. There comes a point when it has little strength remaining and a crack forms. Further attacks occur in the freshly exposed cracks, which continue to steadily grow until they complete a 'circuit' and the product separates or fails.

A partner in crime

To make matters worse, low-level ozone has a partner in crime that also has a seriously detrimental effect on rubber. UV light from sunlight and fluorescent lighting accelerates rubber deterioration because it produces photochemical reactions that promote the oxidation of the rubber surface. This also results in a loss in mechanical strength. The effect is known as UV degradation.

Unfortunately, the decline in the ozone layer in the upper atmosphere in recent decades now allows an increasing level of UV radiation to reach the earth's surface. Continuous exposure is a more serious problem than intermittent exposure, since attack is dependent on the extent of exposure. As one might expect, the problem is exacerbated in sunnier, hot climates but even in the most moderate of environments, the problem is nonetheless ever-present.

Hidden effects

Ozone cracks form in rubber that is under tension. However, the critical strain needed is only very small. Even a belt that is not fitted on a conveyor has a certain amount of intrinsic tension. The cracks are always oriented at right angles to the strain axis. Ozone attack will occur at the points where the strain is greatest and the rubber is flexing in use. Splice joints are particularly prone to stress concentrations.

At first glance, fine cracks in the surface rubber may not seem to be a major problem. However, over a period of time the rubber becomes increasingly brittle. Transversal cracks deepen under the repeated stress of passing over the pulleys and drums. The ozone continues to attack, so the cracks steadily grow until catastrophic failure occurs. Again, surface cracking may not initially seem to be a cause of concern, but there are often other potential risks such as scrapers catching on the cracks and tearing off parts of the cover. Re-splicing can also become more and more difficult as the adhesion properties of the rubber diminish.

Yet another 'hidden' problem is that moisture seeps into the cracks. This then penetrates down to the actual carcass of the belt. In multi-ply belts, the fibres of the weft strands of the plies expand as they absorb the moisture, which in turn causes sections of the carcass to contract (shorten) as the weft strands pull on the warp strands of the ply. This can often result in tracking problems that are difficult to pinpoint and for which no amount of steering idler adjustment can compensate.

There can also be significant environmental and health and safety consequences, especially when the belt is being used to carry materials such as cement, coal or other fuels, because fine particles of dust penetrate the cracks. This dust is then discharged on the return run of the belt.

Magnifying other causes of damage

Apart from the damage caused in their own right, the cracking of the rubber covers by ozone and UV exposure also play a major role in magnifying other causes of damage. As the rubber covers become more brittle and lose strength they also lose the ability to resist abrasive wear. Oil-resistant belts also suffer because

Right: Checking for cracks every two hours.

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the cracked surface allows the oil to penetrate much more quickly and deeply, leading to increased swelling and belt distortion. In heat-resistant belts the cracks allow heat to penetrate the carcass more easily. An increase of only 10°C in the core temperature of the belt carcass can reduce the life of the belt by as much as 50%.

Excluding accidental mechanical damage, unless they are being used to transport extremely aggressive materials, modern-day conveyor belts should be expected to last for many years. However, conveyor operators continue to replace belts months and years before they should have to, completely unaware that the need to replace has almost certainly been accelerated by the effects of ozone and UV light.

New technology

Several years ago, Dunlop Conveyor Belting was amongst the very first in the world to make use of new technology that enabled the effects of ozone to be tested and measured. It invested in the very latest ozone testing equipment for its research and development laboratory. Mandatory testing to EN/ISO 1431 international standards was introduced for all Dunlop belt products and comparison tests also applied to samples of belts made by other manufacturers.

As a direct result, special anti-oxidant additives that act as highly efficient anti-ozonants were introduced into all Dunlop rubber compound recipes to provide protection against the damaging effects of ozone and UV light, thereby further extending the working life of its belts.

Right: Some rubber literally disintegrates.

EN/ISO 1431 testing

To scientifically measure resistance to ozone in accordance with the EN/ISO 1431 test method, samples are placed under tension (20% elongation) inside an ozone testing cabinet and exposed to highly concentrated levels of ozone for a period up to 96hr. Every sample is then closely examined for evidence of cracking at two hour intervals and the results carefully measured and recorded.

Due to the sheer size of industrial conveyor belts, it is common practice for manufacturers and distributors to store rolls of belting in open-air storage yards. Belts can often be held in stock for long periods, sometimes for several years, before they are eventually despatched to their final destination and ultimately put to use. During that time they are vulnerable to the effects of ozone and UV radiation. A number of conveyor belt users have reported that surface cracking was apparent at the time of delivery.

Right: Splice joints are prone to stress concentrations.

No hiding place

The importance of having conveyor belts that are resistant to ozone and UV light can no longer be ignored by those that use them. Unless conveyor operators start insisting on ozone and UV resistance then belt manufacturers and suppliers will continue to ignore the issue. You will hardly ever find a belt manufacturer or supplier that even mentions ozone or UV. This is because the anti-ozonants required to create the necessary resistance cost money upfront. They do, of course, appreciably extend the operating life of the belt supplied.

It may sound cynical but the reality is that it is not really in the best interests of belt manufacturers (or traders and service companies for that matter) for conveyor belts to run and run and run, particularly if they are trying to compete on price, which is a common approach. This is especially so when you consider that a huge proportion of belting is directly or indirectly imported from Asia. Dunlop rarely tests a competitor's belt (and never an Asian import belt as far as the author knows) that has survived the EN/ISO 1431 test specific conditions without cracking. In many cases the rubber literally disintegrates.

For all buyers of rubber conveyor belts there must now be two absolute pre-requisites when choosing any type of belt. Firstly, regardless of type, the rubber covers must always have good resistance to abrasive wear and, just as importantly, they must be fully resistant to the effects of ozone and UV light. Without these all-important properties the belt will not provide genuine value for money because it will need to be replaced far sooner than necessary.

Dunlop Conveyor Belting's advice is to always insist on certification provided by the actual manufacturer that confirms that the belt ordered is fully resistant to ozone and UV in accordance with the EN/ISO 1431 test method.

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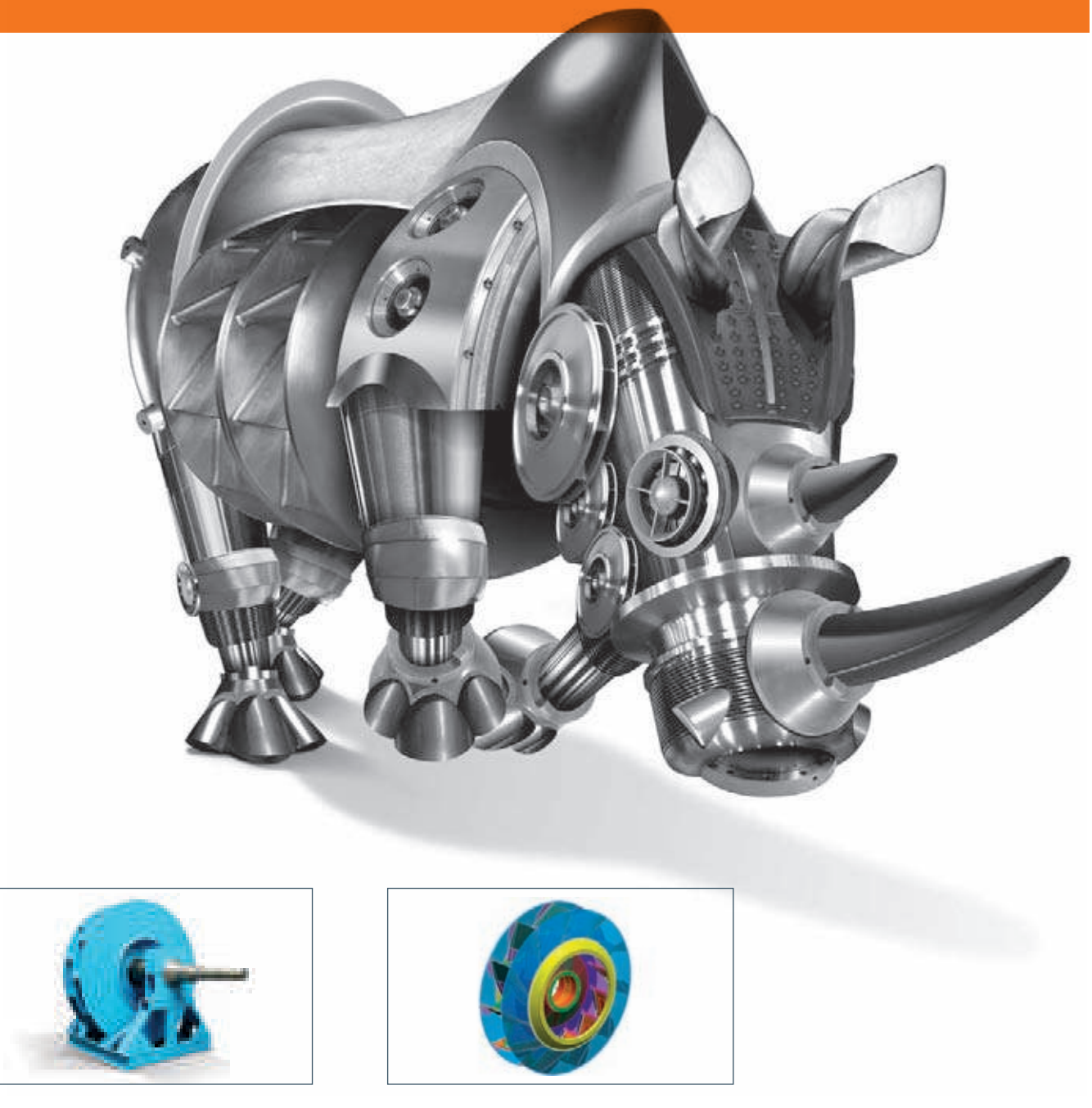

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KOBO USA

State-of-the-art reclaimer technology

Reclaimer systems have become a standard application in many industries, including the cement sector, where they are used for materials like limestone, gypsum, clinker, coal and lignite, as well as other additives and fuels. Since 1894, KOBO, as one of the leading chain suppliers worldwide, has been a key developer of reclaimer machinery.

KOBO is a high-quality manufacturer of chains for reclaimers, active since 1894. More than 100 reclaimer machines rely on KOBO chains worldwide. The company produces: Engineered chains and sprockets; Reclaimer chains with metric or imperial pitches; Engineered chains with inside or outside mounted rollers; Engineered chains with special sealing technology.

Due to the fact that chains and sprockets are the heart of every conveyor system, reliable products and maintenance are crucial for every plant.

The continuous articulation of chain joints and sprockets causes friction, which results in wear and tear in the joint. This wear generates the so-called 'elongation' of the chain. The difference between a 'good' and a 'bad' chain is only the longer lifetime caused by less wear over time. Therefore, it is important to understand that wear is not preventable, only reducible. Predictable wear is contradictory to a sudden breakdown of the machine due to chain failure. Preventative maintenance helps to avoid catastrophic chain failure and breakdown of the machine. The worst-case scenario would be a plant shutdown.

To avoid this, KOBO provides site visits and surveys with lifetime calculations for chains and sprockets and works with local maintenance teams. These site visits help KOBO to develop innovative ideas. Its engineers constantly work on new solutions like optimising the material combination of pin and bushing in the joint.

Depending on the application and the conveyed material, corrosion resistant materials or high alloy steels can be chosen for the joint. Besides this, increasing the size of pins and bushings minimises the surface pressure. It is to be understood that a bigger joint under the same working load is creating less

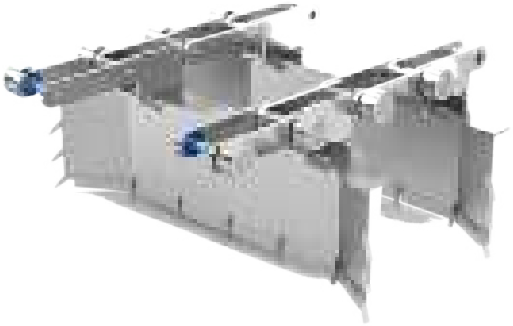
Overleaf: A reclaimer chain with grease fittings, special sealing technology, outside lifetime lubricated rollers and attached scraper blade.

Left: A reclaimer chain with inside roller and sprocket with noise and vibration reduction system.

force per unit area. Less force leads to less friction and therefore less wear.

Multiple field tests with comparisons of standard chains versus chains with bigger joints have proven an extended lifetime of 30-70%, depending on the surrounding factors.

In addition, deeper hardness penetration on both pins and bushings extends the lifetime of the chain. Since chains on reclaimer machines are always in contact with fine or coarse materials, KOBO increases the area between the pin and the bushing to allow the contaminate to enter but also, crucially, to *leave* the joint. This minimises the risk of the contaminate seizing the joint and breaking the chain. All these solutions are options to minimise wear and to extend the lifetime.



Besides the optimisation of the joint itself, KOBO has developed special sealing technologies. These sealings are designed to sit between the link plates with or without special sealing covers. Many projects with these sealings have proven their success due to less contamination and less wear in the protected area.

These sealed chains can be designed with or without grease fittings. Grease is pushed from the grease fitting through a bore inside the pin to the area between pin and bushing. Multiple designs with or without grease fittings were developed and manufactured over the past decades with OEMs and end users.

European manufacturers of reclaimer machinery in particular tend to use chains with outside mounted rollers. These rollers are equipped with two ball bearings and are sealed for life. The advantage is that worn rollers can easily be replaced in a few minutes. In addition, rollers can be changed without replacing the entire chain. The constant rotation of a running roller on the track is transmitted from the inner width of the chain to an extended pin. This saves the plant cost, labour and a great deal of time.

KOBO manufactures all types of custom-made conveyor chains, regardless of the reclaimer chain's application and design. With its engineers KOBO consults plants and end users worldwide to improve the lifetime of chains and sprockets.

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US: Lindner shredders for Vexor

Vexor Engineered Fuel of Indiana has opened a new fuel processing operation using Lindner shredders in Gary, Indiana, just south of Chicago. Capable of producing 0.25Mt/yr of the branded fuel 'Vexor Engineered Fuel,' Vexor relies on a Jupiter 3200 for primary shredding, which is unaffected by foreign objects and 'undaunted' by even the most difficult materials. A Komet 2800 HP, used for secondary shredding, is very strong. Two additional rows of cutters and the powerful high-performance engines make sure that up to 50t/hr of waste is processed into <25mm high-quality fuel.

Hungary: FLSmidth completes Vác upgrade

Duna-Dráva Cement has completed a Euro22m upgrade to its Vác plant. The project included modernising filter systems and further adapting the kiln for the use of alternative fuels, according to the Napi Gazdaság newspaper. The unit's electrostatic precipitator system was replaced by bag filters in a project that started in mid-2016. FLSmidth worked on this part of the upgrade. Previously work on the upgrade saw the replacement of two cyclone heat exchangers and the flue gas conduit, in addition to the partial modernisation of the clinker cooler. A new calciner tower, bypass and a 32m silo were also built. Germany's IKN also worked on the project.

Algeria: Djelfa project resurrected

China's CBMI has signed a contract with ASEC Cement to build a 4500t/day clinker production line at ASEC Cement's Djelfa plant in Algeria. The unit was originally partially built by ASEC Egypt in 2008 and had completed 90% of civil work before it was suspended due to the financial crash. Local company ETRHB Haddad and the Algerian subsidiary of China State Construction Engineering Corporation (CSCEC) took control of ASEC Cement in 2017, allowing the Djelfa project to continue. Commissioning is now expected by the end of 2019.

Turkey: YD Madencilik orders line from KHD

YD Madencilik, part of Üstyapi Insaat Group, has ordered a 5000t/day clinker production line from Germany's KHD Humboldt Wedag. The plant will be built at Yiglica in the Marmara region. KHD will be responsible for engineering and equipment supply, as well as the supervision of erection and commissioning.

The new production line will consist of the following KHD core components: a six-stage preheater with PYROCLON LowNO$_x$ AF calciner, equipped with a PYROTOP compact mixing chamber, tertiary air duct and the PYROBOX calciner firing system; a three tyre rotary kiln, with a diameter of 4.8m; a PYRO-JET kiln burner; and a PYROFLOOR clinker cooler equipped with a PYROCRUSHER system.

After commissioning, KHD says that the YD Madencilik plant will operate its most efficient six-stage preheater in Turkey. It added that close to 70% of Turkish cement production units have been designed and installed by KHD. Commissioning of the plant is scheduled for the third quarter of 2019.

India: Wonder Cement orders mills from Gebr. Pfeiffer

Wonder Cement has ordered two vertical mills from Germany's Gebr. Pfeiffer for its Nardana plant in Rajasthan. The order includes a MVR 6000 C-6 mill for grinding slag cement and a MPS 3070 BK mill for grinding fuel. Deliveries are scheduled for early 2019 and mid-2019 respectively.

The MVR mill will feature a total drive power of 5820kW. Mixed cements will be ground to a fineness of up to 5% R 45µm. The grinding plant will be designed to process granulated blast-furnace slag with a target fineness of approximately 4500cm^2/g Blaine and blast-furnace cements with different proportions of granulated blast-furnace slag, fly ash and gypsum and different product fineness degree. Wonder Cement has requested the option to grind relatively hot clinker in the mill, while at the same time being able to reduce the cement temperature, and alternatively to use cold clinker from stockpiles.

The MPS mill will grind petcoke with a capacity of 40t/hr to a product fineness of 2% R 90µm. It will come with an SLS BK classifier, allowing both coal and petcoke to be ground in the mill, dried with process gases and then classified in the integrated classifier. Due to the high abrasiveness of Indian coal, the mill will be designed with appropriate wear protection.

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BUILDING TRUST

Greece: Titan turnover reduced in 2017

Titan Group's turnover fell slightly to Euro1.51bn in 2017. Bad weather, the devaluation of the Egyptian Pound and weakening of the US Dollar affected its operating results despite a buoyant US market. Its earnings before interest, taxation, depreciation and amortisation (EBTIDA) fell by 1.9% year-on-year to Euro273m in 2017 from Euro279m in 2016. Its net profit fell by 66.5% to Euro42.7m from Euro127m.

The cement producer's turnover grew by 9.9% to Euro873m in the US despite Hurricane Irma in September 2017 and other poor weather effects. In Greece it reported that build activity weakened further in 2017. It said that although export volumes remained high, its profit margins were hit by the lowering value of the US Dollar and increased fuel prices. Overall, the turnover of its Greece and Western Europe region fell by 4.8% to Euro249m. In Southeastern Europe turnover rose by 10.5% to Euro226m due to increased demand for building materials. Turnover in the Eastern Mediterranean region fell by 36.5% to Euro158m due to negative currency effects in Egypt and a fall in demand.

Poland: Fine upheld

The court of appeal has supported a decision by the Office for Competition and Consumer Protection (UOKiK) in 2009 to fine six cement producers for cartel-like behaviour. However, the total fine has been reduced by one third to Euro67m from Euro98.3m, according to the Polish News Bulletin.

Grupa Ozarow is to pay Euro22.1m, Cemex Polska Euro16.6m, Gorazdze Cement Euro12.3m, Dyckerhoff Polska Euro7.51m, Cementownia Warta Euro5.55m and Cementownia Odra Euro2.87m. Some companies had their fines reduced by the court of appeal. Dyckerhoff will pay Euro7.5m instead of Euro13m and Cemex Polska will pay Euro5.88 less than the original fine. Some of the companies involved are considering appealing to the Supreme Court.

Poland: Cement sales rise by 7%

Cement sales rose by 7% year-on-year to around 18Mt in 2017, according to the Polish Cement Association. The country has a cement production capacity of 24Mt/yr and the capacity utilisation rate is approximately 75%. The Institute of Economic Forecasting and Analysis forecasts that sales will grow by 8% in 2018 to 17.9Mt.

Ireland: Limerick to burn alternative fuels

Irish Cement has been granted planning permission by An Bord Pleanala for its plans to burn tyres and solid recovered waste at its Limerick plant. Local councils originally approved the project in 2017 but this was appealed to the national An Bord Pleanala following local protests. Environmental groups say they will continue to fight the plan.

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Ireland/UK: Breedon Group buys Lagan Group for Euro527m

Breedon Group has acquired Lagan Group for Euro527m. The deal will be financed from a new loan, extended credit and an equity placing. The purchase, which completed on 20 April 2018, sees Breedon Group enter the Irish market as it takes control of Lagan's production assets, including a cement plant in Kinnegad, nine active quarries, 13 asphalt plants and nine ready-mixed concrete plants.

"Lagan represents a unique opportunity to enter a growing market with immediate scale and excellent opportunities for expansion. It significantly strengthens our cement offer, adds to our mineral and downstream resources, brings us a bitumen import/export business and adds real weight to our contract surfacing operations," said Paul Ward, Breedon's chief executive.

Following the acquisition of Lagan, Breedon Group will operate two cement plants, around 70 quarries, 40 asphalt plants, 200 ready-mixed concrete and mortar plants, nine concrete and clay products plants, four contract surfacing businesses, six import/export terminals and two slate production facilities. The group will also employ nearly 3000 people. It says its strategy is to continue growing organically and through the acquisition of businesses in the heavyside construction materials market.

Turkey: First clinker at Limak plant

The first clinker has been produced at the 5000t/day Limak Anka Entegre cement plant. The flame was first lit in mid-March 2018. The US$115m plant was built by Sinoma and Sintek.

Spain: Alfa can extend quarry

Cementos Alfa, part of Cementos Portland Valderrivas Group, has received permission from the Ministry of Environment to expand its quarry. The quarry currently produces 0.6Mt/yr of limestone and marl that are used for clinker production at the neighbouring cement plant.

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France: Cem'In'Eu to open grinding plant in 2021

Cem'In'Eu is preparing to open a 0.24Mt/yr cement grinding plant at Montreuil-Bellay in Maine-et-Loire in 2021. The aspiring cement producer submitted planning and environmental permit applications in March 2018, according to the Le Moniteur des travaux publics et du bâtiment magazine. The company hopes to obtain authorisation for the project in the first half of 2019 and start construction work in 2020. Cement from the plant will be marketed under the 'Val de Loire Ciments' brand and targeted to central and western France.

Cem'In'Eu
Cement Innovation in Europe

Switzerland: Schmidheiny to leave LafargeHolcim board

Thomas Schmidheiny has decided not to stand for re-election for the board of LafargeHolcim. In recognition of his years of service to LafargeHolcim and its predecessor company Holcim, the board of directors has decided to name Schmidheiny honorary chairman of the group. He will remain one of the group's main shareholders. Fellow board member Bertrand Collomb has also decided to stand down.

"For almost 50 years Thomas Schmidheiny has made a significant contribution to the success of Holcim and later LafargeHolcim. He was instrumental in successfully expanding into promising growth markets and has made Holcim one of the leading companies in its industry. On behalf of the board and all employees I would like to thank Thomas Schmidheiny for his exceptional contribution to our company," said Beat Hess, chairman of the board of LafargeHolcim. He also thanked Collomb for his contribution to Lafarge and then LafargeHolcim.

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Photos courtesy Stephen Elliott, Hope Cement

GLOBAL CEMENT NEWS: *EUROPE*

Bosnia & Herzegovina: TCK revenue grows in 2017

Tvornica Cementa Kakanj's (TCK) sales revenue grew by 13.3% year-on-year to Euro48.5m in 2017 from Euro42.8m in 2016. Its sales volumes of cement rose by 12.3% to 0.49Mt from 0.43Mt. Its earnings before interest and taxation (EBIT) rose by 12.5% to Euro8.89m from Euro8.09m. It attributed the growth to a strong domestic market.

Russia: Emissions protest

Local residents have protested against a cement plant being built at Zueovo near Novgorod. Over 800 residents demonstrated against the project and sent a letter to the regional governor, according to the Kolmovo newspaper. The protestors object to potential health concerns related to the plant such as poor air quality due to dust emissions.

Switzerland: Sika Q1 results

Cement additive manufacturer Sika has announced sales growth of 11.9% in the first quarter of 2018 to Euro1.31bn. It reported growth in all regions, backed up by the opening of one factory, the establishment of a national subsidiary and the acquisition of another company. When compared to 2017, the fact that the Easter holiday period fell early in 2018 had a negative impact on organic growth in the first quarter of 2018.

Sika CEO Paul Schuler said, "The good development of business in the first quarter indicates that we will be able to grow strongly once again in 2018, and to further implement our strategic targets for 2020. We are looking to increase sales by more than 10% for the year as a whole, and thereby break through the CHF7bn (Euro5.88bn) sales mark for the first time."

Interview by Peter Edwards, Global Cement Magazine

Breedon Group's Hope Cement plant

Global Cement recently visited Breedon Group's Hope Cement plant in Derbyshire, the largest cement plant in the UK, ahead of the visit by delegates of the *Global CemProcess Conference & Exhibition* on 25 May 2018.

The Breedon Group Hope cement plant began making cement in 1929. Initially with a capacity of just 50,000t/yr, it expanded to include five wet process lines by the 1960s before being extensively overhauled by former owner Blue Circle Cement in 1969-1970. Blue Circle installed two new dry process lines with preheaters from KHD and kilns from Polysius, which it operated until Lafarge took over the business in 2001.

Following more than a decade of extensive investment by Lafarge, Mittal Investments took hold of the plant in January 2013, rebranding the plant as Hope Cement (part of the newly-created Hope Construction Materials group) and injecting further capital. In August 2016 the plant once again changed hands when Breedon Group acquired the business from Mittal. Since 2017 the plant has operated under the Breedon Cement brand, which has continued to invest in process optimisation, efficiency and debottlenecking.

The plant continues to be known by the name Hope Works among locals and the wider UK cement industry. Due to the significant recent investment, the plant may now have a capacity in excess of 1.5Mt/yr, when fully optimised. Breedon Group is still in the process of optimising the new configuration.

Interviews with management

***GC:* Please could you take us through the production process used at the Hope plant?**

Keith Rowland, Quarry Manager (KR): It all starts in the quarry, where we have two main sources of limestone: high-silica limestone and low-silica limestone. The upper beds have more of the high silica limestone due to their high chert content. Further down in the quarry we have lower silica limestone. We treat them as different materials and stockpile them accordingly. We currently have 13 operational benches in total.

We have our own shot-firing team, although we use an external drilling firm. We have two 90t excavators (1 x CAT 390F, 1 x Liebherr R976). There is also a CAT 990 wheel loader for back up and a smaller CAT 345 for quarry development. A fleet of four CAT 775 G dump trucks takes material from the blastpiles to the crusher in 60t payloads, which works out at 1000t/hr.

Right: The Breedon Group Hope plant, as seen from the road to the limestone quarry.

Left: The Hope plant's limestone quarry, as seen from a very cold and windy look out point. The plant is located 300m down the hill from the bottom right of the image.

Steve Groves, Production Manager (SG): The primary crusher is from Fuller Traylor, now part of FLSmidth. It was installed in 1952. It operates at 1200t/hr and is followed by twin line secondary and tertiary crushers, all are Sandvik H6000 Hydrocone crushers with pre-screens. The final limestone size is below 30mm, which is driven by the raw mill requirements. It is stored in a linear enclosure that has a storage capacity of around 25,000t.

From the raw stone store, the material splits in two for the two identical KHD kiln lines. Each line has a single chamber air-swept raw mill from Humboldt with static classifiers. They date from 1970 and have been upgraded with mill internals and a new drive system on line 2. The feed consists of limestone (85%) and shale-like materials or pulverised fuel ash (PFA) (15%).

After the raw mills, there are two blending silos and four storage silos with a combined storage capacity of 15,000t. The material from the storage silos is fed via a Claudius Peters kiln feed system. This was recently commissioned as part of a major project to improve the process at Hope. The raw mix is still fed pneumatically but now enters via a de-aeration system and air-slides into the top. This project released the kiln feed bottleneck when it was completed in May 2017.

Plant profile: Breedon Hope Works

Location:	Hope Valley, Derbyshire, England
Part of:	Breedon Group
Production began:	1929
Kiln 1 & 2 (Polysius):	1970
Cement capacity:	~1.5Mt/yr

Left: Removal of the old kiln inlet section ahead of the KHD inlet section installation.

Far left: Map of the UK with Derbyshire and Hope plant location highlighted.

Left: Installing the KHD lower inlet section.

Trevor Harrison, Projects Manager (TH): The kiln feed project was part of a wider capital expenditure project to increase capacity that was started under Hope Construction Materials. We knew that the existing feeding system was a bottleneck and we installed a de-aeration system at the top of the preheater towers for each kiln as part of that project, There is also a common standby system shared between the two kilns.

Right: The temporary chimney to facilitate main chimney repairs

SG: The material enters the four-stage through-air preheater from KHD, also installed in 1970. During the Blue Circle days, we upgraded the riser section to facilitate tyre chip firing at the back end. In the last 2-3 years we have also upgraded the kiln inlet section of the riser to reduce the hearth velocity, increase capacity and mitigate some of the build ups we had seen following the introduction of alternative fuels.

The two kilns are from Polysius, also from 1970. Again, they are identical, both 4.8m in diameter and 70m long. In the past two years we have installed MAS burners from Unitherm. They worked very closely with us to design a special burner that can operate both clockwise and anti-clockwise. This is because the two kilns rotate in opposite directions and we needed a common spare that could be deployed on either of them.

The clinker coolers are originally from Fuller, now part of FLSmidth, although we upgraded with the help of IKN in the mid 2000s. We now have a hybrid system that helps to break down the snowmen seen previously. The clinker heads to a traditional tent-style clinker storage with up to 60,000t of capacity. If you were to design it these days, you'd build large vertical clinker silos or a dome.

There are two identical cement mills, which, by virtue of coming after the clinker storage, are shared by the two lines. These are FLSmidth / Fuller designed dual chamber compound ball mills. The cement onsite storage is around 20,000t and we have a relatively large depot system, so that also provides total cement storage capacity of 64,000t.

GC: **What types of cement are made?**

SG: There are two main types of cement, PC and PC Plus. They are both 52.5 N CEM I cements and they represent almost 90% of all the cement we make. There is also a CEM I 52.5 R cement and two CEM II A/LL 32.5 R bagged products for general purpose and trade use.

GC: **Is the plant running at full capacity?**

SG: Yes it is, to within practical limits. There are still some upgrades that we are only just starting to exploit however, so it has the potential to produce more. We are not quite sure how much we will be able to increase capacity before we find the next bottleneck. If we look back over the past few years, the plant has been running as much as it could in any given year, since about 2007.

GC: **What major projects have been undertaken recently?**

TH: As well as the kiln feed project, we undertook a process optimisation study to critically review the combustion line.

In 2015 we also had an internal survey of the main flue carried out by an external company during a rare period when both kilns were down. The company pointed out some internal problems with the brickwork but we didn't want to stop both lines for a long time. We therefore thought 'outside the box' and installed a temporary stack in close discussion with the Environment Agency and local stakeholders.

During the kiln shutdown periods, we successfully rerouted exhaust gas from the kiln lines into the temporary chimney. This allowed the main stack to be repaired over a three month period while maintaining full production on both lines. The temporary structure has since been taken down.

On Kiln No. 2, we put in a new kiln tyre in 2015 after it showed signs of wear. It had also been deforming the kiln shell. We replaced the tyre and a section of kiln shell. We also installed a feeding system for solid recovered fuel (SRF) with Saxlund and FLSmidth in 2016. It is fed up an inclined drag conveyor into an FLSmidth Pfister weighfeeder and is then dosed to each kiln.

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Right: A new kiln shell section on kiln line 2.

Far right: One of two new MAS burners from Unitherm. The burners offer a wealth of opportunities for flexible alternative fuel firing.

***GC:* When was the last plant shutdown and what work was completed?**

John Mulryan, Maintenance Manager (JM): We had a shutdown in January 2018 for 23 days with quite significant work and was fully compliant with Construction Design and Management (CDM) regulations. This is about increased planning and organisation with respect to health and safety. This involved a larger degree of planning and supervision of sub-contractors than in the past. The shutdown saw a total of 35,000 man hours of work, 24/7, with a peak workforce of around 300 but there were only a few minor health and safety incidents. The weather was a challenge, as was maintaining momentum in the project.

One of the biggest challenges was installing and optimising the autobalancer on the preaheater fan, a similar system to a Sikorsky helicopter. It enables us to balance the fan on the fly and maintain production when the fan becomes unbalanced due to process build ups. We installed and commissioned this during the shutdown and there was no room for errors or wasted time.

***GC:* What is the most difficult part of the plant to maintain on an ongoing basis?**

JM: The clinker coolers are always a challenge because you can't see what state they are in for 11 months of the year, until you get in there. There's always the potential for surprises. If you ever want to make a change to the cooler, you have to be absolutely sure of what you are doing.

***GC:* What parts are relatively straightforward?**

JM: The dispatch areas are easier to maintain because they operate at far lower temperatures, there are more days available to maintain things and you can see what's going wrong as it goes wrong.

***GC:* What is the most cost-effective repair that you have carried out?**

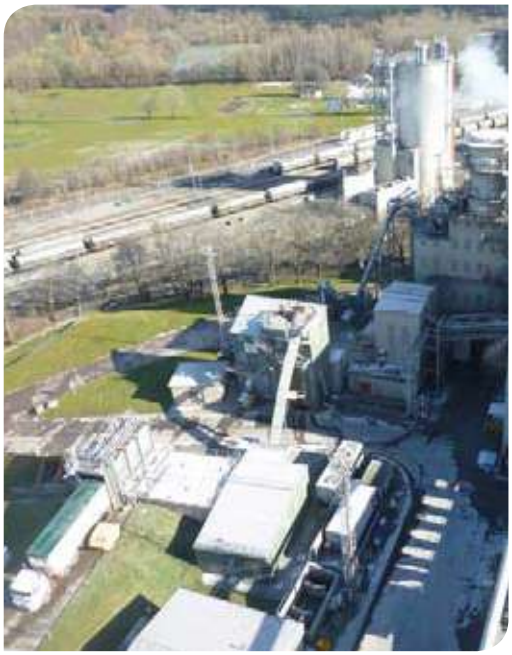
JM: The smallest spends can give you the biggest impacts. We have a clinker breaker at the end of the cooler. If that trips out, the whole process would need to be stopped. We installed a Predator belt on the breaker of the type used in the recycling industry for turning scrap metal into cubes. It has vastly increased the reliability of a very critical part of the plant.

***GC:* What part of the plant keeps you up at night?**

JM: The plant is solid and, if it goes wrong, we can engineer our way out of it. I am more concerned by the fact that some of our maintenance staff are due to retire shortly and we may lose a degree of their experience. However, we have a good apprentice programme that will help to replace experienced workers over the same period.

To help us to work smarter in light of this, we have started to use oil analysis and vibration analysis equipment more effectively to head off problems before they affect production. We also use ultrasonics and thermography instruments on the kilns.

***GC:* How will maintenance roles look in another 10 years given the increase in technology?**



Right: Looking down on a range of alternative fuel feeding equipment and expanded rail infrastructure from the pre-heater tower.

JM: The way we would use technology will be to monitor equipment before it has a problem. We could also look at how to remove staff from hazardous tasks, for example by automating some welds as we have done when replacing kiln shell sections.

***GC:* From where does the plant source its additives?**

SG: Due to the chemical composition of the limestone, we actually don't need any additional bulk raw material additives other than gypsum for the finish mills. Once the material is blended correctly, the chemistry is ideal for cement manufacturing. The gypsum comes from British Gypsum's Fauld Mine in Staffordshire (75km).

***GC:* What fuels does the plant use?**

SG: The plant uses around two thirds coal, all of which is from the UK, mainly Wales. There are also alternative fuels in the form of tyre chips at the back end (15-20%), solid recovered fuel (SRF) (8-12%), which is fed to the main burner and there is also a small proportion of two types of plastic waste. These are co-fired with the coal.

In the past the plant has also used dried sewage sludge. It also used meat and bone meal (MBM) until November 2017. We stopped using MBM for economic reasons. In the future we need to optimise and fully exploit the new investments. By gradually ramping up the plant, we hope to be able to reach up to 50% alternative fuels in the future. We are regularly approached by suppliers offering new fuels but we don't have any plans to change the mix right now.

***GC:* What emissions abatement systems are used?**

SG: The main stack has a bag filter from Lodge Cottrell, which was installed in the late 1990s. On the cooler end we have electrostatic precipitators, although they have been kept in good condition and operate well within authorised limits. For NO_x we have a selective non-catalytic reduction system from 2006 from ABC&I. It uses a 24.5% ammonia solution. For HCl abatement we use hydrated lime. In the future there are no big changes planned to these systems but we do want to lower the amount of sulphur entering the system.

***GC:* What other future projects are there?**

TH: The plant has been very well invested in by all of its recent owners. We now have a 10 year plant plan that looks at what needs to be invested for the good of the plant as a whole. The first project is to replace the drive on raw mill one, as this is still from the 1970s and the motor is showing signs that it is coming to the end of its useful life. The other raw mill drive has already been replaced.

Furthermore, we are looking to improve the lifting equipment for the two new kiln burners to help the maintenance team. It is a fairly complicated structural task that we are keen to get on to.

Alongside this we have been replacing the old compressor air systems to improve the electrical efficiency of the works. We want to further consolidate the systems and control of the system, that will also give maintenance benefits.

We are also working on a clinker store bypass to enable us to manage stock more effectively.

***GC:* What is the most cost-effective project the plant has implemented in the past 10-20 years?**

TH: The best low-cost investments have been in the abatement systems for NO_x and HCl. This is because it is reliable, low cost equipment that enables us to comply with legislation.

On the higher end of the cost spectrum, the new rail infrastructure, installed in 2008, has enabled us to transport far more cement to the south east of England than before. This has helped with sales and reduced the amount of cement transported by road, which helps the plant and our immediate neighbours.

***GC:* What piece of equipment would you change at the plant if you could, if money were no object?**

TH: What would be good is to make better use of our waste energy. We already switch off non-essential equipment during energy demand peaks. It would be ideal to be able to continue running that equipment using our waste heat. Solar power energy stored in some kind of battery would also be a great benefit. One plant in the UK, at Ketton, already uses solar power.

Right: The Hope plant's cement preheater building.

***GC:* Where are the main markets for the Hope plant at present and how are they served?**

Edward Cavanagh, Works Manager (EC): Throughout the transition from Hope Construction Materials to Breedon we maintained our network of distribution terminals. These are at Dewsbury (West Yorkshire), Walsall (West Midlands), Theale (Berkshire) and Dagenham (Greater London). We supply these four depots by train with around 1Mt/yr of cement. The split is not completely equal between the sites and it flexes to meet demand accordingly.

Of late, distribution from Dagenham has grown as we ramp up the use of the site. It was only commissioned fully in 2016. We also bag cement in Dagenham, unlike everywhere else, where sales are in bulk only. The proportion of bagged cement is growing gradually over time and is currently around 5-10% of all distribution.

The remainder of our output is distributed by road, although we are limited to 586,000t/yr, the capacity of the former wet kilns. However, we are not close to that limit at the moment. The local market has been stable for the past few years or so, perhaps with slight growth.

We seek to optimise output to as much rail as possible because it is more efficient, takes vehicles off the local roads and reduces our carbon footprint. Breedon has also invested in more efficient tractor units for its road distribution. In general the Group invests in its own distribution network rather than lease or use sub-contractors.

***GC:* How is the plant's health and safety at present, especially with respect to the change of ownership?**

EC: We have not seen any negative changes as a result of the change of ownership, either from Lafarge to Hope Construction or from Hope Construction to Breedon. Loss of safety performance is a risk when the plant has weak procedures, but our procedures are strong and they underpin everything we do. We have had no lost time incidents since autumn 2016, which was a low-level incident. However, it was still treated seriously.

We put quite a focus on health as well as safety because it is recognised that there is a lot more time lost to illness than injury. This is reflected in things like our on-site gym and golf course, which is built on a former shale quarry.

***GC:* How does the plant benchmark itself against other facilities now that it is a 'standalone facility?'**

Quality Control

Quality Manager Joanne Cantwell took *Global Cement* around the Hope plant's control centre and quality laboratory where a team of nine works seven days a week to keep the plant up-and-running.

The plant has a sophisticated automatic sampling system from 10 points in the cement making process, including - but not limited to - raw mix, kiln feed, hot meal, clinker and after the cement mills. These operate at different sampling frequencies and the system processes over 200 samples per day.

Samples are prepared in a grinder and press to check for oxide composition by X-ray fluorescence (XRF) spectroscopy. This is complemented by X-ray diffraction (XRD) spectroscopy. There is also a back-up XRF machine. The plant will shortly upgrade with a new XRF spectrometer later in 2018. The automatic system is also equipped with an in-line particle size analyser.

"What we do is a mix of automatic analysis and traditional wet chemistry as we have to back up the automated results with periodic manual samples," explains Cantwell. "On the automatic side, we are constantly looking at the data to see if we need to make changes in the feed materials or other parameters. Sometimes changes are small and the system automatically makes them for us. Sometimes the changes are more major and we might, for example, call the quarry so that we can make changes to the limestone coming down the hill. At the end of the day, we try to keep everything consistent. Get the raw mix right and everything else becomes easier." As well as the samples from the plant, the laboratories analyse cement samples received back from Breedon's various depots, to check the integrity of the supply chain.

BSI (UK verifying body) comes to site every two months to verify the laboratories. Samples are taken jointly and split into three. One is analysed at Hope, one is tested by an independent third-party laboratory and one is kept back as a reference. This verifies that the lab is sound and compares well with the independent laboratory.

The laboratory also analyses mortar prisms in a physical laboratory for compressive strength as well as initial set testing and water adsorbtion.

The plant is in the process of developing capabilities to check incoming fuels using a bomb calorimeter. "Alternative fuels can be more variable and we want to be able to compensate for those changes," explains Cantwell.

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Right: One of three new Claudius Peters X Pump 300 for feeding the kilns.

This article was written before Breedon took over Lagan Group, including its cement plant in Ireland, on 20 April 2018.

EC: While we are the only cement plant in the group, we do still maintain a network because it has historically been part of a much bigger whole. We also network with and visit other independent plants, sharing best-practice examples between us. There is also a number of consultants that help the independents with different projects, plus the engineers from the major equipment suppliers.

***GC:* How has the prospect of Brexit affected the business so far, if at all?**

EC: The only effect seen as a result of Brexit so far is that it is a technical drain. There have been a lot of difficult discussions regarding what might happen, especially in the spheres of energy, emissions trading and other regulatory areas. We have to send members of the technical team down to London for several days at a time to discuss aspects of Brexit to prepare ourselves as best as we can. The result is that they cannot perform their day-to-day tasks as easily. Time is being lost to lobbying rather than performing their usual tasks.

***GC:* What are the biggest threats facing the plant in the future?**

EC: Some large-scale changes to emissions regulations as a result of Brexit would disrupt our entire industry significantly. However I don't think that is likely and, in any case, Hope has consistently been ahead of the curve with respect to environmental performance.

Elsewhere, I would say that we would be really exposed right now if we had not prepared the plant's succession planning for future growth. We saw a few years ago that if we didn't plan ahead, we would face a lack of expertise due to the retirement of experienced workers. It takes up to three years to train a control room operator and then they gain further experience on the job itself.

***GC:* What is the biggest opportunity for the plant going forward?**

EC: The biggest opportunities are related to the high cost of fuel and electricity. If we can find additional efficiencies, the plant can make significant savings. This may involve reopening long-mothballed project ideas like waste heat recovery, which may be becoming economical for a plant such as Hope.

Right: Walking between the kilns.

Cement granules magnified x100.
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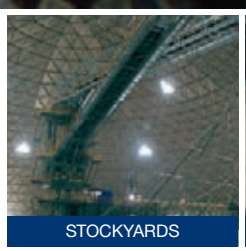
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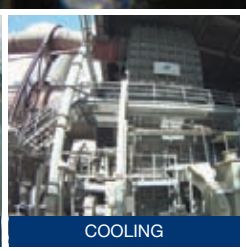
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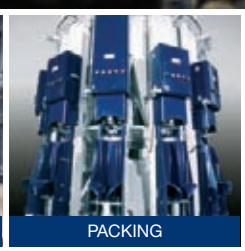
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Peter Edwards, Global Cement Magazine

Preview: 2nd Global CemProcess Conference

The 2nd *Global CemProcess Conference & Exhibition* on process optimisation, de-bottlenecking, production maximisation and troubleshooting will take place at the Radisson Blu Edwardian Heathrow, London, UK on 23-24 May 2018. The event includes an optional field trip to the Breedon Cement Hope plant in Derbyshire on 25 May 2018. Here we present the confirmed presentations and exhibitors. Register at *www.CemProcess.com*.

Confirmed presentations as at 12 April 2018

'Building the roadmap for Industry 4.0 – A case from the cement industry,' Fabio Barros de Carvalho & Vicente de Paula Amancio, Accenture; Gabriel Boranga Iera, Votorantim Cimentos.

'Data and model-driven optimisation of calciners and preheaters,' Matthias Mersmann, aixergee GmbH.

'The good, the bad and the ugly: Connecting cement production, yard and distribution,' Thomas Bergmans, INFORM.

'Continuous mercury emission monitoring and the effects of plant operation and mitigation measures on mercury emissions,' Felix Bartknecht, SICK.

'Process optimisation through secure, automated and reliable systems,' Oliver Kurtnacker, Axians Industrial Applications & Services GmbH.

'A giant step towards 'green and clean' production by replacing conventional fuel (petcoke and coal) with nearby available lignite,' Anurag Tiwari, UltraTech Cement Ltd.

'Successful exchange of a 2nd generation separator into a 3rd generation separator in Tunisia,' Olaf Michelswirth, Intercem Engineering GmbH.

'Emission control and de-bottlenecking: Start in the quarry!' Arnaud Pujol, apbp consulting GmbH.

'Energy-saving and low-maintenance retrofit solution for pneumatic conveying of highly abrasive materials in the cement industry: Coperion state-of-the-art wear protection,' Klaus Leidenberger & Scott Coley, Coperion GmbH.

'KilnCooler: A case study from J K Lakshmi Cement, India,' Dirk Schmidt, KIMA Echtzeitsysteme; Co-author from J K Lakshmi Cement.

Right: The 2nd *Global CemProcess Conference & Exhibition* features an optional field trip to the Breedon Cement Hope Works on 25 May 2018. Read more about the plant on Page 38 of this issue. **Credit:** Stephen Elliott, Breedon Cement.

'Global benefits with transparent open gear lubricants,' Olivier Lerasle, Total Lubrifiants SA.

'New wear-resistant welding technology for Vertical Roller Mills,' Nick Sutherland, Welding Alloys Group

'Project to use a new alternative fuel based on dried sugar beet pulp: Case study at NIC cement plant, Egypt,' Mohamed Hamada Ali, Mohamed Elsayed Mohamed & Ahmed Ali Ibrahim; NIC cement plant.

'Proactive failure prevention and optimised mill performance by DALOG process monitoring,' Dirk Woldt & Christoph Muschaweck; DALOG Diagnosesysteme GmbH.

'Improving plant performance with low-cost good housekeeping activities: Two case studies from Iran,' Amir Kakuei, Espandar Cement Investment Co.

Exhibitors as at 12 April 2018

- DALOG Diagnosesysteme GmbH
- Intercem Engineering GmbH
- KIMA Echtzeitsysteme GmbH
- HUCK TEK
- aixergee GmbH
- Axians
- ENOTEC GmbH
- Inform GmbH
- Total Lubrifiants
- Whitmore

Right: *Global CemProcess* Exhibitors as at 12 April 2018.

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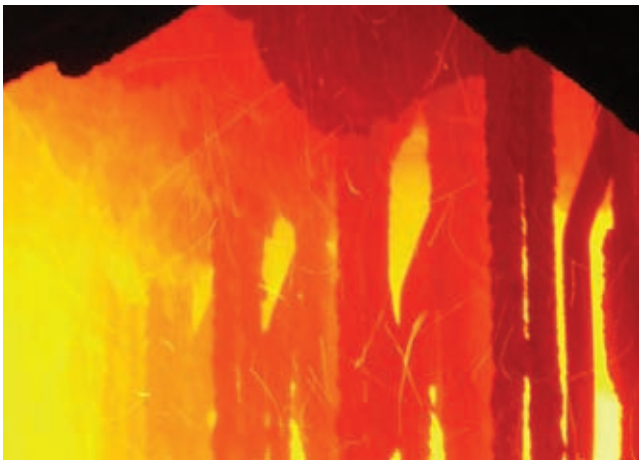

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David Perilli, Global Cement Magazine

Innovations in industrial carbon capture

On 7-8 February 2018 the LEILAC (Low Emissions Intensity Lime And Cement) Consortium hosted the inaugural *Innovation in Industrial Carbon Capture Conference* near Liège in Belgium. The event also featured the ground breaking event for a new carbon capture pilot project at the CBR Lixhe cement plant. *Global Cement* was in attendance...

The *Innovation in Industrial Carbon Capture Conference* was built around the various carbon capture initiatives with which HeidelbergCement is involved. The LEILAC Consortium also launched a project at the Lixhe plant that will test Australian company Calix's direct CO_2 separation process for two years at a pilot level scale. The Calix technology works by keeping the process CO_2 separate and capturing it. Previously the technology has been used in the magnesite calcining sector in Australia. Now it will be trialled at 10t/hr of raw material for cement production and 8t/hr of ground limestone in a 60m tall direct separation reactor that is about to be built next to the cement plant's pre-heater tower.

The process has a target to capture up to 95% of process CO_2 emissions. Construction is scheduled to be completed in 2018 and will then be followed by two years of operation and testing until the end of 2020. At this point the current Euro12m funding ends. However, the next steps, if agreed, would be to test the process on a commercial scale for lime production and a large scale demonstration at a cement plant by 2025. Full scale commercial application at a cement plant would then happen by 2030.

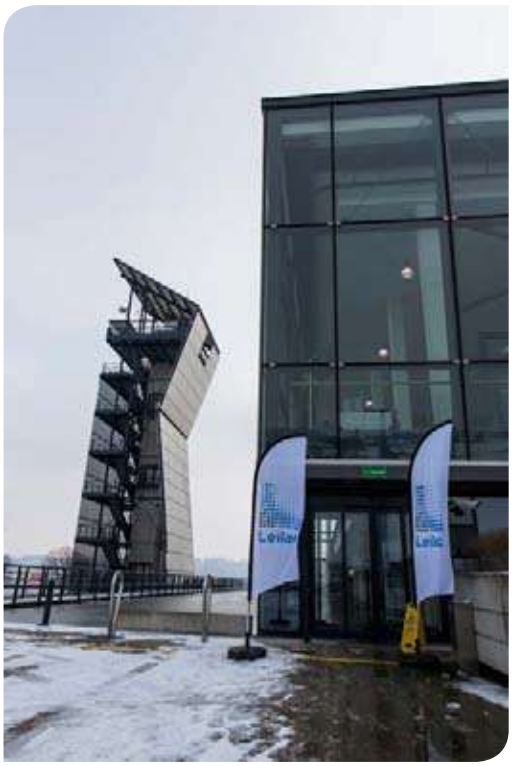
The other big pilot is the oxyfuel project that HeidelbergCement is running with LafargeHolcim and the European Cement Research Academy (ECRA). As ECRA's Volker Hoenig explained, this project is now set to move to the pilot scale at two cement plants in 2020 at a cost of Euro90m. The plants, in Italy and Austria, have been chosen so that the testing can start at a 'simple' plant and then move to a more complicated one. The Italian site at Colleferro has a spare unused kiln that doesn't use alternative fuels, making the testing less complicated. The Austrian site at Retznei, does co-process alternative fuels and it also has a kiln bypass system. It's worth noting that Calix's direct separation process is intended to be compatible with an oxyfuel kiln.

Other technologies were also previewed at the conference such as the Cleanker calcium looping project, the CO_2MIN mineral carbonation project, the Carbon8 process to make aggregates from flue gas and HeidelbergCement's experiences with growing microalgae.

The event to mark the start of the pilot project at Lixhe was an optimistic one but the cement and lime producers like Jean Marbehant of Lhoist have no illusions about the cliff-face-steep challenge of meeting the CO_2 emissions reduction targets demanded by the Paris agreement. A lime producer, he mischievously described his product as CO_2 with lime as a

Right: Delegates from the various partners of LEILAC signed a poster as part of the ground-breaking event.

Far right: Rob van der Meer of HeidelbergCement (left), moderates the panel on key challenges for EU industry to contribute to reaching climate change targets with (left-to-right): Director Artur Runge-Metzger of EC DG Clima, Jonas Helseth of Bellona Europe, Jean Marbehant of Lhoist/EuLA, Simon Bennet of IEA and Albert Scheuer of HeidelbergCement.



Left: The Industrial Carbon Capture Conference took place at the Liège-Oupeye waste water treatment plant, which has commanding views of the River Meuse.

uct was concrete and he explained just how much cement and concrete everyone uses in their lifespan.

One speaker at the LEILAC event used the phrase 'no silver bullet' to describe how industrial CO_2 emissions could be cut and how Carbon Capture and Storage (CCS) might be used. Perhaps more tellingly though has been the emergence of a new acronym that seems to be doing the rounds at the European Parliament, of 'Carbon Capture and Something.' That 'something' here is of critical importance as it can either increase or decrease the price that carbon capture will add to cement production. Industry and researchers have lots of ideas of how the captured CO_2 can be used and these are being investigated as this conference showed, but the legislators need to steer away from vague terms that don't address the full scale of the problem.

The challenge for cement producers in this kind of environment is deciding how far they should go towards exploring CO_2 reduction strategies while governments remain unclear about how they intend to meet *their* targets. Going first might bring an innovator advantages if the legislation toughens up, but the by-product, to reinforce the integral nature of CO_2 release to the calcination process. Later on, Marbehant showed that the CO_2 marginal abatement cost for carbon capture is Euro90/t. However, since the European Union (EU) Emissions Trading Scheme currently places the cost of CO_2 at Euro9/t the real question about the future of carbon capture is: *'Who will pay?'*

Albert Scheuer, a board member of HeidelbergCement, made it clear how his company thinks the cost should be divided when he said that its end product was concrete and he explained just how much cement and concrete everyone uses in their lifespan.

Left: The site where the pilot plant will be built is directly across the road from the Lixhe plant's preheater tower.

Left: View of the Lixhe plant's preheater tower and kiln.

initial cost is high. HeidelbergCement and others are definitely hard at work, but commercial applications are at least a decade away at current funding levels. And that timescale doesn't include rolling out the new technologies across the entire industry. Despite this it was reassuring to hear the director of the European Commission's Directorate-General for Climate Action say that his organisation didn't want to reduce cement production, only CO_2 emissions. This was 'something' cement producers will be happy to hear.

Brazil: Votorantim under the cosh

Votorantim Cimentos' sales fell by 7% year-on-year to US$3.24bn in 2017 from US$3.48bn in 2016. Its adjusted earnings before interest, taxation, depreciation and amortisation (EBITDA) fell by 26% to US$515m from US$693m.

The company blamed the continued decline on the poor market in Brazil. Outside of Brazil, Votorantim Cimentos reported positive markets in most territories, apart from Tunisia. Overall the group's sales rose by 5% to US$7.95bn from US$7.59bn.

Above: Inside the Votorantim Cimentos headquarters in Sao Paulo, Brazil.
Source: Votorantim Cimentos website.

Paraguay: INC plant reports damage from poor power supply

Industria Nacional del Cemento's (INC) Vallemi cement plant has suffered damage to its equipment due to problems with the local electricity supply from state energy company ANDE. Issues included low voltages that damaged the main electric motor of the plant's cement mill and other equipment at the site, according to the ABC newspaper. Consequently, cement is not being despatched from the Vallemi plant. Normal production had been expected to resume in mid-April 2018. INC's Villeta cement grinding plant has increased its despatches to compensate, increasing its deliveries to 80,000bags/day of cement from its normal level of 50,000bags/day.

Uruguay: ANCAP's Minas cement plant shut due to union action

The Administración Nacional de Combustibles, Alcoholes y Portland's (ANCAP) Minas cement plant has been shut for two months due to union action. The cement producer has been forced to supply cement from its Paysandu plant instead, according to the El Pais newspaper. If the situation continues then ANCAP may need to buy cement from its competitor Cementos Artigas.

ANCAP's cement division has accumulated debts of US$207m since the early 2000s. Revenues have been reportedly lower than costs since 2004. ANCAP started a restructuring plan at the cement plant in 2017.

Chile: Bío Bío looking abroad

Cementos Bío Bío is considering expansion plans in Argentina and Peru, according to the El Mercurio newspaper. The plans are part of its 2021 strategy. It also wants to consolidate its leadership in its local market.

Argentina: Despatches rise by 13% in Q1

Cement despatches grew by 13% year-on-year to 3.08Mt in the first three months of 2018 from 2.72Mt in the same period of 2016. The Asociación de Fabricantes de Cemento Portland (AFCP) forecasts that despatches will rise by 6% to 12.9Mt in 2018.

Cuba: Nuevitas to develop LC3 cement

The Nuevitas cement plant in Cuba will test LC3 cement, according to the Adelante newspaper. LC3 is a blend of limestone and calcined clay that reduces the amount of clinker used. The plant is one of three units in the country earmarked for upgrades in 2018.

US: Cementir completes Lehigh White share purchase

Italy's Cementir Holding has completed its acquisition of an additional 38.75% of Lehigh White Cement. It paid US$107m for the purchase. Following the deal Cementir holds a 63.25% stake in Lehigh White Cement and Cemex holds the remaining 36.75%. Cementir said that the acquisition would allow it to directly manage assets in the US in the core white cement business.

GLOBAL CEMENT NEWS: *THE AMERICAS*

US: CalPortland awarded 2018 Energy Star Partner of the Year award

The Environmental Protection Agency (EPA) has awarded CalPortland the 2018 Energy Star Partner of the Year Sustained Excellence Award for continued leadership and superior contributions to Energy Star. CalPortland's accomplishment was be recognised by the EPA and the Department of Energy at a ceremony in Washington, DC on 20 April 2018.

Its key accomplishments in 2017 include: promoting energy management across the US cement industry through the chief executive officer's leadership of a trade association and an offer of the company's assistance to others in the industry; earning the EPA's Energy Star plant certification for two cement plants where one was recently purchased and required extensive upgrades and energy improvements to qualify in less than two years; and continuing to invest in operations through new plant hardware such as a high efficiency separator for a mill, efficient new equipment to improve raw feed processing, and computational fluid dynamic software to better manage process air and material flows. The company also developed innovative methods for training employees and motivating them to manage energy in their work. In its outreach work it informed employees and over 106,000 community members and schools, competitors and others about energy management and the Energy Star program.

US: HarbisonWalker obtains ISO certification for refractory panels

HarbisonWalker International has obtained ISO 9001:2015 certification for its Thomasville monolithic and precast refractory plant in Georgia and its South Shore refractory brick plant in Kansas. The refractory manufacturer now plans to achieve the new ISO standard at the rest of its plants by the end of 2018.

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US: PCA: Moderate growth

The Portland Cement Association (PCA) predicts growth of 2.8% in cement consumption in 2018 and 2019 in its Spring Forecast. Growth is then expected to climb to 4% in 2020 as impacts from potential federal infrastructure spending are likely to take effect. The analysis estimates cement consumption at 99.3Mt in 2018, 102.1Mt in 2019 and 106Mt in 2020.

Ed Sullivan, PCA senior vice president and chief economist, has attributed the forecast growth to a variety of positive economic factors including a strong economy, job market and anticipated increase in infrastructure spending. Read the full reasons behind the latest forecast on Page 61 in this issue of *Global Cement Magazine*.

US: Cemex settles Californian pollution lawsuit

Cemex has settled a lawsuit that accused it of discharging polluted storm water runoff from its West Sacramento cement terminal in California into the Sacramento River. The cement producer has agreed to implement an infiltration basin to treat runoff from its unit, according to the Sacramento Business Journal newspaper. It will also make a donation of US$40,000 in grants to environmental projects in the Sacramento-San Joaquin River Delta and pay the legal fees of the plaintiff, the California Sportfishing Protection Alliance. The alliance had originally sought US$88m from Cemex.

US: Plibrico appoints VP Sales

Plibrico has appointed Norm Phelps as its new Vice President of Sales. Phelps will be responsible for aligning sales strategy and objectives with Plibrico's long term vision and corporate goals. He will be based in Atlanta, Georgia and will report to President and CEO Brad Taylor.

Interview by Peter Edwards, Global Cement Magazine

In discussion: Mike Ireland, PCA President & CEO

Since the autumn of 2017, the Portland Cement Association (PCA) has had a new President and CEO in the form of Mike Ireland. *Global Cement* spoke with him ahead of the 60th *IEEE-IAS/PCA Cement Industry Technical Conference* in Nashville...

Above: Michael Ireland, PCA President and CEO since autumn of 2017. He joined the PCA in January 2017 as COO having previously held roles in the American Society of Mechanical Engineers and other engineering and construction-related non-profit organisations since the early 1980s.

***Global Cement (GC):* What are your main aims during your Presidency?**

Michael Ireland (MI): The PCA has already represented the cement and concrete industry for over 100 years. When I started in this role, my main focus was how the PCA continues to be viable in that role for the next 100 years. Even though we are a non-profit organisation we are relied upon by commercial companies and we have to ensure that we are living up to their expectations.

In the past the PCA did a wide range of things for its members. However, these days we have to focus on doing fewer things better. For me this boils down to improving out market intelligence, developing uses for concrete (particularly with reference to pavements and large buildings), developing our geotechnical services and, of course, advocacy.

Another thing that we are looking at is working more with other construction sector associations. There are over 20 concrete and masonry associations in the US and we can work more effectively when we work together. To give an example, we are in the middle of talking with a ready-mix and concrete paving group with the aim of a concrete and cement alliance. This would work out which party is developing which areas of the market, from the top-down 'public perception' message to efforts at the point-of-sale. There is no point in every organisation working in competition with each other in each area.

Elsewhere, we are looking to partner with the sand and gravel associations and even the asphalt associations, a traditional competitor to cement, on what we have in common. Concrete and asphalt players both benefit from developments in infrastructure, even if they are competing for the same work.

***GC:* Is that a change of tack for the PCA?**

MI: It is, but in a way we are just catching up with the industry itself, which has seen a lot of mergers and acquisitions. Several companies have expanded vertically and horizontally and they are now represented by two or more different associations.

***GC:* What has been the main advocacy 'win' over the past 12 months?**

MI: The most major thing, which we had been working on for many years, was the Tax Reform Bill. This is going to spur the economy onwards for companies and individuals alike. We actually brought in some special staff to help campaign for this. The Bill has presented a range of benefits, including a reduction in corporate tax rates to 21%, which will greatly benefit our members.

***GC:* Other than this, how has the Trump Administration affected PCA members so far?**

Right: America's highways and other infrastructure are in need of extensive renovation and expansion to meet present and future demands. Cement and concrete players stand to gain.

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"We are looking to partner with the sand and gravel associations and even with asphalt..."

MI: We looked at the Executive Order from the President that instructed Federal Agencies to review and either revise or withdraw a number of actions taken by the Obama Administration. Of relevance to the cement sector in particular is the Environmental Protection Agency's (EPA) Clean Power Plan. Our members have found it refreshing to have meaningful regulation that is not too onerous. The Administration has not scrapped the idea of regulations that help protect the environment but instead asked players like the PCA to contribute to the discussion on how we can achieve specific sustainability targets.

This has involved stepping away from the Waters of the United States (WOTUS) legislation to some extent. We also have a highly collaborative relationship with the Mine Safety and Health Administration (MSHA). We do not want to reduce safety measures but we do want to make sure that they are fair and equitable to PCA members.

GC: **Would you say that the Trump Administration has injected a dose of 'common sense' into the regulations for safety and the environment?**

MI: That is certainly our perspective. I think that they are common sense measures that allow us to protect health and safety and the environment while allowing our members to go ahead and compete fairly. It has reduced bureaucracy and allows people to focus on their day-to-day jobs more.

GC: **What are the PCA's advocacy aims for the next 12 months?**

MI: Our current President is a builder. He has repeated over and over again that we need to spend more on infrastructure and other countries do a lot better job of this than the US. We are glad that this is a major priority for the Adminstration and a lot of our work over the next year will be trying to increase the infrastructure spend as much as possible.

Obviously we have our own self-interest in this but the whole country stands to benefit. Given that, it is the end users that will be the most effective in 'campaigning' for this spending. That involves working with trucking groups and general highway users. Some even report that they will be prepared to pay for improved infrastructure through higher fuel taxes or even road charging. This is unusual in the US and highlights just how much the country is crying out for better infrastructure. We can help the campaign by looking at things like life-cycle cost. This is something we are looking at with the other associations that I mentioned earlier.

Left: Close-up of the US Capitol building in Washington, DC.

GC: **Does the PCA still 'face the public' as with its *Think Harder Concrete!* campaign from a few years ago?**

MI: We don't have a public campaign like that any more. Instead we're working with associations, advocacy and social media that targets those. If you have 20+ associations working separately it is hard to get a coherent message across. We need to collaborate to work out who needs to address whom with which messages.

GC: **What other challenges are there for your members?**

MI: The wood sector is making inroads into construction and, if we're not careful, cement players could lose out slightly. The wood sector has kind of co-opted the phrase 'sustainable,' allowing it to make gains in the public's perception.

However, its use of the word does not take into account the benefits of concrete over its true lifespan. We are currently working with the Massachusetts Institute of Technology (MIT) to properly define 'sustainability.' We anticipate that this research will help to highlight the benefits of using concrete for long-term durability and sustainability of structures. We see from the recent hurricanes that concrete structures are far more resilient to damage than other materials. We have a resilient and sustainable material and we need to develop that message.

***GC:* What is the biggest threat to the continued success of PCA members?**

MI: Tying in with my previous answer, there is a misconception surrounding cement and concrete that they are not sustainable. I think that part of this is down to the fact that concrete is so ubiquitous that people almost forget that it's even there.

This is a worldwide issue that we are looking at with other cement and concrete associations around the world. Our members, and theirs, are looking all the time to reduce emissions through traditional levers, and even looking at carbon capture and storage / utilisation (CCS / CCU).

***GC:* Are you working with either of the two new international cement and concrete associations?**

MI: We have been in contact with them and are interested to see how things will develop going forward. One of them in particular is very interested in advancing the sustainability agenda, which fits in very well with our own goals. They are also interested in working together to tackle other building materials. I can certainly imagine a world where the PCA works closely with one or both of these groups.

***GC:* We asked the above question on the 'biggest threat' to the PCA's Chief Economist Ed Sullivan. He said 'A trade war.' What's your take on that?**

MI: At the moment a trade war is still hypothetical and I don't want to speculate too much. What I will say is that a lot will depend on who does what to whom. If there are tariffs on steel imports to the US, the construction sector might suffer. If tariffs are on cement imports, our sector might stand to gain.

***GC:* What are the biggest opportunities for PCA members in the future?**

MI: In my mind 3D printing will revolutionise construction in ways we can't imagine. What could be more revolutionary than a zero waste, just-in-time production method building one-of-a-kind structures, where and when you need them 24/7 with advanced robotic technology? Only one thing; 3D printing with the world's most sustainable and most resilient construction material: concrete.

We started looking into this back in 2015 when we first participated in a workshop sponsored by the National Science Foundation. Since then our participation and engagement has accelerated dramatically. We've scheduled a plenary session on 3D concrete printing at this year's Professors Workshop. We've also reached out to assist the National Institute of Science and Technology (NIST) in their efforts towards a consortium centred around 3D printing.

PCA subsidiary CTLGroup is one of the top five finalists in the latest round for the NASA and the National Additive Manufacturing Innovation Institute 'America Makes' competition to design and build a 3D printed habitat for deep space exploration, including the agency's journey to Mars. We're also focused on supporting the innovators as they develop new concretes for use in 3D printing, particularly to ensure that the specifications, the standards and the codes are there. 3D printed concrete is poised to go mainstream. Whether that happens first in Manhattan or on Mars, only time will tell.

GC: Mike Ireland, thank you for your time today.

***MI:* You are very welcome indeed.**

1. https://www.theverge.com/2018/3/12/17101856/3d-printed-housing-icon-shelter-housing-crisis

Right: A house 3D printed using concrete in the US. "Scaled up, this approach has the potential to drastically benefit our sector," says Mike Ireland. "It's very exciting and this is only the beginning of this area." **Credit:** ICON.

Interview by Peter Edwards, Global Cement Magazine

In discussion: Ed Sullivan, PCA Chief Economist

Once again it's time for the IEEE-IAS/PCA Conference, this year in Nashville, Tennessee. As in previous years, Ed Sullivan, the Portland Cement Association's (PCA) Chief Economist, will present his eagerly-awaited forecast for the year ahead to the assembled delegates. *Global Cement* caught up with him in the run up to the conference...

***Global Cement (GC):* Thanks for talking to us once again Ed. How is the US cement sector looking at the moment?**

Ed Sullivan (ES): Growth in cement production was strong in 2017 at 2.5% year-on-year. Looking forward, we anticipate growth of 2.8% for both 2018 and 2019. Our forecast takes in an economy that is strong and one that will get stronger as the Tax Reform Bill kicks in. There is also the budget, which contains some provisions for infrastructure – in addition to the anticipated US$1tn Infrastructure Bill.

These fiscal stimuli are laid on top of the strong economic background. They are trickling down to construction activity already and will continue to do so in the rest of 2018 and 2019. Then, in the final quarter of 2019, we will see the start of the big Trump US$1bn Infrastructure Bill.

Region	Cement consumption (Mt)		Change (%)
	2016	2017	
New England	2.21	2.23	1.2
East South Central	4.57	4.55	-0.3
Mid Atlantic	6.98	7.15	2.5
Mountain	8.47	9.12	7.7
South Atlantic	17.50	17.73	1.3
West North Central	9.25	9.09	-1.6
West South Central	18.59	19.11	2.8
East North Central	12.14	12.00	-1.2
Pacific	12.23	13.34	8.2
USA	**91.93**	**94.24**	**2.5**

Above - Table 1: Regional cement consumption in the US in 2016 and 2017, with year-on-year changes. **Source:** PCA.

***GC:* How much growth will be down to the underlying economy and how much will be due to the Tax Reform Bill?**

ES: Around one third is momentum from the pre-existing strong economic conditions. Around two thirds is down to the Tax Reform Bill. We surveyed the major financial consulting groups as to what they thought the impacts of the changes would be on GDP. Once we got that data, we translated it through to construction activity, which is 6% of GDP, and then to cement sales based on an average cement intensity.

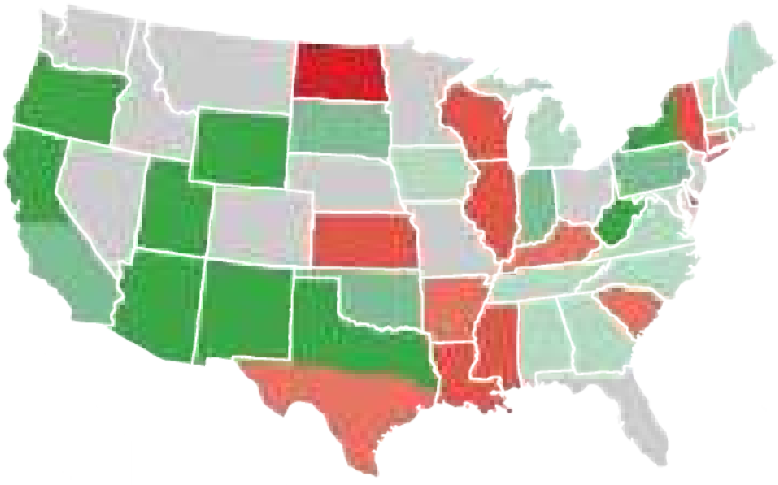
***GC:* How was the start to the year?**

ES: In January and February 2018 the winter was particularly harsh in some regions, which impacted on demand in those and on the nation as a whole. In the first two month sales were actually down 4% year-on-year. Of course, the first quarter is always a dubious indicator of the rest of the year. The volume is the lowest of all four quarters, which means that small changes appear as relatively large percentage changes. We expect things to pick up going forward.

***GC:* Which regions performed the best and worst in 2017 and why?**

Above: Ed Sullivan, the PCA's Chief Economist.

Below: US states, colour-coded by change in cement sales in 2017.



Source: Adapted from PCA data.

Above: Donald Trump's policies have already put the US cement sector on a rollercoaster ride. The next few years will reveal the destination.

ES: If you look to the west of the Mississippi last year, cement sales rose quite a bit, for example in the Pacific Coast and Mountain Region. These were the areas hit the hardest when the housing boom went bust. The wounds were deep and they are taking a while to heal. The same regions will grow the most strongly in 2018 too.

In the east, the State economies were most resilient to the housing bubble. They have stable, well established populations and have been generally less volatile as the national economy has contracted and grown once more.

GC: **Were there any states that surprised you?**

ES: The strength of growth in the far west was surprising. There was double-digit growth in some states, for example in Oregon, where sales were up by 13.3%. These numbers could have been even higher if construction had not been constrained by regional labour shortages. This is also a problem in the South, Texas for example, and the South East.

GC: **How has the extreme weather affected sales?**

ES: There have been some pretty severe events in the past 12 months with wild fires in California and hurricanes in Texas and Florida. These were large events that affected the local economies in the short term. However, the temporary disruption was made up for during other parts of the year. There will now have to be renovation of damaged buildings and infrastructure in the coming months and years, which will impact on demand.

As far as the severe winter in the north east goes, the north east does not consume a lot of cement in the winter months anyway. It's already very seasonal.

GC: **What have been the effects of the Trump presidency so far?**

ES: There have been many. On the positive side, the Administration has introduced tax reform that will stimulate the economy and stimulate demand this year and next. On the regulatory side, the industry will see reduced regulations. This will also help the rest of the economy to consume more cement. The Infrastructure Bill is also out there in the longer term. On top of this, there is a trend to increasing the efficiency of the tax dollars used on infrastructure. This means that concrete pavements may be preferred more, as they last longer than asphalt ones. There are clear advantages for the cement sector there.

On the risk side, there is the risk of a damaging trade war. If the issue with tariffs gets out of control and there is retaliation, the cost of all consumer goods will increase. This reduces demand everywhere in the economy as well as the areas that directly rely on the commodities with tariffs on them.

We have three scenarios for how the tariffs might play out. 1. They are imposed and nobody does anything in return. That has already not happened. 2. There is limited retaliation, which is what has happened so far, and, 3. A fully-blown trade war. If we reach that point, GDP growth will be knocked back from around 3.0% in 2018 to around 2.4%. We have the potential to lose 2Mt/yr of cement demand. This is not hyperbole!

Another threat is that we are stimulating an economy that already has only 4% unemployment. This risks increasing inflation and the Federal Reserve will have to respond by raising interest rates. The construction sector is interest sensitive and would then take a knock. A boom-bust scenario is a real threat in the medium term. Of course, raising interest rates will have the effect of strengthening the Dollar and making imports more attractive too. That means that cement producers may suffer from two angles.

GC: **Does the PCA have a long-term forecast for cement consumption?**

ES: For 2040 we have an estimate of 160Mt of cement consumed based on a rapidly-growing population and increased proportion of urban inhabitants. We update these figures every couple of years and will next look at this in the third quarter of 2018.

GC: **What is the number one downside risk to the short-term forecasts you provided earlier?**

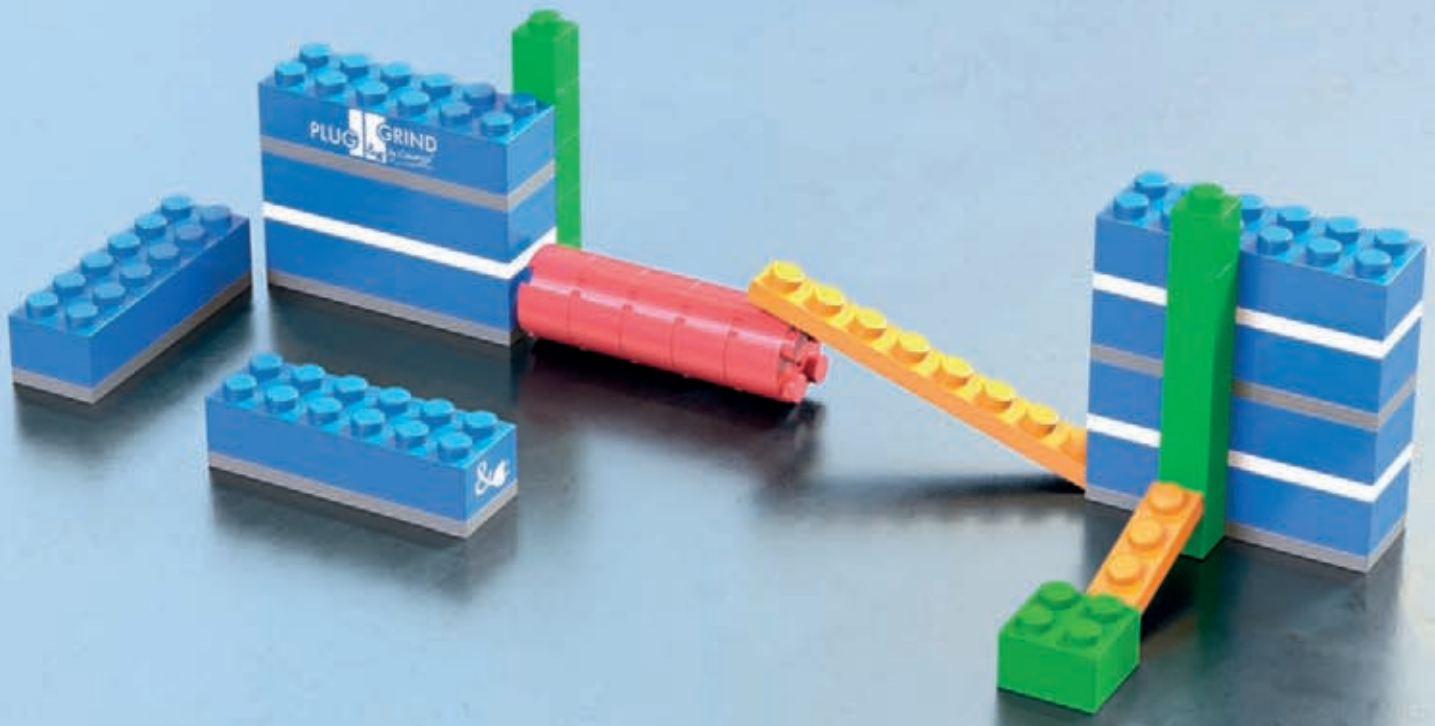
ES: The number one risk to all these forecasts is a trade war. We are not talking about risks to just the US economy but also to the global economy. The longer term risk is that the Federal Reserve has to react to the overheating in the economy and has to slow down growth.

One also has to remember that Trump is asking States and private firms to cover more than 80% of the funding for the Infrastructure Bill. The Federal Government has previously provided far more. The States will always pay Medicaid and Entitlement Programs over building a new road. In our view this way of funding the Infrastructure Bill will not work. Due to this, we have already massively reduced the impact of the Trump Infrastructure Bill in our 2018 forecast compared the forecasts we made in 2017.

GC: **Ed Sullivan, it's been a pleasure as always.**

ES: Thank you very much indeed!

PLAY & BIG



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Interview by Peter Edwards, Global Cement Magazine

Plant report: Cementos Argos Roberta plant

The Roberta plant in Calera, Alabama has been making cement for 75 years. Now owned by Colombia-based Cementos Argos, the plant is looking to increase innovation in all areas of operation. *Global Cement* recently spoke to the Roberta plant manager Anthony Perry, about the plant's history, production, markets and environmental performance, including efforts to increase alternative fuel use and its involvement in a CO_2 capture project...

***Global Cement (GC):* Can you outline the history of cement production at the Roberta plant?**

Anthony Perry (AP): The first activity at the Roberta site was actually not cement production but lime production, which started in 1912. The first cement was not made until 1943, by two short kilns, now long since removed. By the mid 1960s the plant had two long dry cement kilns and was operated by Martin Marietta.

In 1983 the plant was acquired by Blue Circle and in 2000 construction began on the plant's current configuration. It's now a 1.6Mt/yr capacity modern dry kiln from KHD, with a five-stage preheater. The new line was commissioned in 2002, shortly after Blue Circle was acquired by Lafarge. Now, the plant is one of the four cement plants that Cementos Argos has in the US.

***GC:* Can you take us through the production process as it stands today?**

AP: The quarry supplies three main customers with around 12Mt/yr of limestone. It supplies our cement plant, the adjacent lime plant operated by Unimen and an aggregate plant operated by Vulcan. Rock is mined alternately for these different uses.

For cement production, we blast limestone to 98% <120cm and deliver it via a fleet of nine 91t dumper trucks to a 2000t/hr Svedala gyratory crusher. This reduces the material down to <20cm. The limestone leaves the crusher, passes over a vibratory feeder and leaves towards the plant on a 1542t/hr belt conveyor. All limestone passes by a Sodern cross-belt analyser (CBA) that uses a neutron generator and detector to analyse the exact chemical composition. Based on the CBA readings, the unit directs the flow of lime-

Right: Overview of the Roberta plant, with (from right to left), raw meal silo, pre-heater tower, kiln, clinker cooler, clinker silos and cement silos.

stone to one of four sorted stockpiles. Then comes the secondary limestone crusher, a Hazemag system that reduces the material to less <10cm.

Limestone is placed in a 220m x 101m covered building that also accommodates fuels and additives. The BMH (now Claudius Peters) limestone / clay stacker-reclaimer can make two piles of 29,000t inside the building using a windrow formation. All of the raw material is once again checked using a Sodern CBA to keep the chemical composition of the stacks within preset limits.

After the storage there is a 340t/hr Gebr. Pfeiffer vertical roller mill with three rollers for raw meal grinding. Next is a 9000t BMH balloon silo for the raw mill, directly before our KHD five-stage precalciner and kiln, which is 4.8m in diameter and is 58m long, with two piers. It is rated at 4354t/day. The clinker cooler is from IKN in Germany.

After 48,000t of clinker storage there are two finish mills. One is from Polysius (95t/hr) and one is from KHD (120t/hr). These supply cement to a total of 48,000t of cement storage in silos from BMH. We mainly produce CEM I / II (around 90-95%) and two types of masonry cement, one type N and one type S (5-10%).

Left: Aerial view of the Roberta plant.

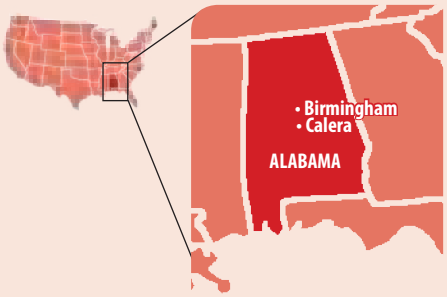
***GC:* From where does the plant source its additives?**

AP: Trucks haul all solid fuels and raw material additives (iron ore, sand, fly ash, bauxite) into the plant from local sources, within around 100km from the plant.

***GC:* What about the plant's fuels?**

AP: The plant is predominantly fired by coal (~78%), which is ground in a Gebr. Pfeiffer vertical roller mill, rated at 34t/hr. We also use around 22% of what we call alternative solid fuel (ASF), which comprises carpet, paper and plastic, as well as seasonal products such as agricultural residues. The coal we use is actually high in sulphur, although not more than petcoke for instance. We are well within our limits for SO_2. The fuels are fired 40% to the main burner and 60% to the calciner. The calciner burns all of the ASF.

Plant Profile: Cementos Argos Roberta



Owner	Cementos Argos
First cement	1943
Kiln	KHD 5-stage calciner
Capacity	1.6Mt/yr

Manager Profile: Anthony Perry

Anthony Perry began his career in 1994 with Blue Circle at its Atlanta plant as a process engineer. He transferred to the Lafarge Paulding, Ohio plant after Blue Circle was bought by Lafarge in 2001. He transferred to Cemex for one year at the Clinchfield, Georgia plant before returning to Lafarge at the Roberta plant in 2008. He has been plant manager since 2010.

Above: The Roberta plant's ASF handling facility.

***GC:* What currently limits the use of ASF?**

AP: The current constraint is the market. Finding viable quality material is proving difficult. Technically the plant could use well up to 40% ASF. We have a plan to buy a new primary shredder in 2019, which will help us up to 30% ASF. There are some fuels out there that we can't use with our current shredders.

***GC:* What about emissions abatement systems?**

AP: We have a continuous emissions monitoring system (CEM). Our SO_2 levels are not a problem, even with the high sulphur coal. We use SNCR with aqueous ammonia to reduce NO_x emissions during ozone season (1 May - 30 September) as required by the Alabama Department of Environmental Management's (ADEM) maintenance plan to sustain ozone attainment for Jefferson and Shelby Counties. As part of this maintenance plan, we are obliged to operate SNCR during the ozone season using good engineering practice.

We have to comply with the Commercial and Industrial Waste Incineration Units (CISWI) regulations as a user of alternative fuels. To do this we recently purchased and installed a dust shuttling system for US$2.6m. The installation of the project will allow the plant to operate within the EPA regulations for mercury emissions. Dust shuttling is a control strategy that will allow the removal of cement kiln dust (CKD), and add it into cement at 2-3% substitution. This lessens the amount of mercury in the pyro-process overall. We also have a baghouse for dust.

Right: The Roberta plant's preheater tower and calciner.

***GC:* What was the plant's experience of the recent carbon capture project?**

AP: Sustainability is one of the main pillars or our organisation. Moreover, as an organisation we invest a lot of resources within our Innovation Group and we are one of the leaders in our industry when it comes to research and development. As a plant we were excited to conduct the CO_2 trial. We understand that in order to stay competitive, companies must continue to seek ways to innovate.

Sustainable Energy Solutions (SES) came to the plant to collect CO_2 using its cryogenic CO_2 capture technology. It tapped into our system, using a fan to suck the gases in to its cryogenic CO_2 capture system. We helped them set everything up and make sure that it was going to be a success. Other than that we supplied the process and exhaust gas. Production was not affected and the plant was not otherwise affected in any way.

Markets and future

***GC:* To where does the plant supply cement and what transport methods are used?**

AP: Our markets are the majority of Georgia, all of Alabama, Mississippi, Tennessee, part of Louisiana, and the Gulf coast of Florida. Around 90% of cement leaves the plant in bulk, with 10% in bags. We have a 10-spout Haver & Boecker bag filling system that can fill 5 million bags per year. Around 70% of the bulk cement, more than 1Mt/yr, goes out by rail, with the remainder by road.

A lot of our bulk goes to our Atlanta terminal, from which it is dispatched by road to batch operations and customer sites. We send a train once a week.

***GC:* How has production changed over the past decade?**

AP: In 2007 we were sold out and 2008 was solid. However, due to the downturn, the plant operated at just 50% of its capacity in 2009. Since 2010 we have been ramping up. We made 1.1Mt of cement in 2017 and will make around 1.2Mt of cement in 2018. That's about 78% capacity utilisation.

As a producer focussed on efficiency, we had to look further afield when the economy was in the doldrums. We are now pulling the reins back in and concentrating on our immediate region.

Going forward residential has been the main driver of demand recovery. This will continue to be the case for the next five years, given that the inventory built up in the housing boom has now been used up.

***GC:* What might be the effects of the Trump Infrastructure Bill?**

AP: At the moment we don't have much visibility of the impact of the Trump government infrastructure plan. In general, the cement sector will benefit from the plan, directly from building or maintaining infrastructure, and indirectly from economic growth as a result of the plan.

***GC:* Anthony, many thanks for your time today.**

AP: It was great to talk with you!

Left: The plant has 48,000t of cement storage in BMH silos. The majority of cement, around 70%, is despatched via rail.

Interview by Peter Edwards, Global Cement Magazine

Project report: CCU at Roberta

The Cementos Argos Roberta plant in Alabama recently took part in a CO_2 capture and utilisation trial with its CARBON X-PRIZE partners Sustainable Energy Solutions (SES), Praxair and CarbonCure Technology. The successful trial, conducted in January 2018, captured CO_2 from the Roberta plant's main stack and used it in the production of concrete. *Global Cement* recently spoke to Robert Niven, founder of CarbonCure Technologies and John Kline, Kline Consulting, about the project...

***GC:* How did you become involved in the CO_2 capture project at the Roberta plant?**

John Kline, Kline Consulting (JK): After a period working for Lafarge in France and Western Canada, I came back to Montreal in 2008 to the Lafarge Technical Centre. There, I led a team that was looking at CO_2 reduction opportunities within Lafarge North America, from alternative fuels to energy-efficiency and carbon capture. It was clear that a lot could be done to meet the Cement Sustainability Initiatives 2020 and 2030 targets using existing technologies but that the more demanding CO_2 reduction targets would require carbon capture and usage (CCU).

Kevin Cail, who is now the Chief Technical Officer (CTO) of CarbonCure, was on the team with me. When he joined that company, he asked me to look into technologies that could be used to extract CO_2 from cement plants and advise on what looked most viable.

In 2013 Kline Consulting found out that the Department of Energy's National Energy Technology Laboratory (DOE-NETL) had just released grants to second-generation carbon capture technologies. Sustainable Energy Solutions was one of those companies. To qualify, the companies had to be able to capture CO_2 at less than US$25/t.

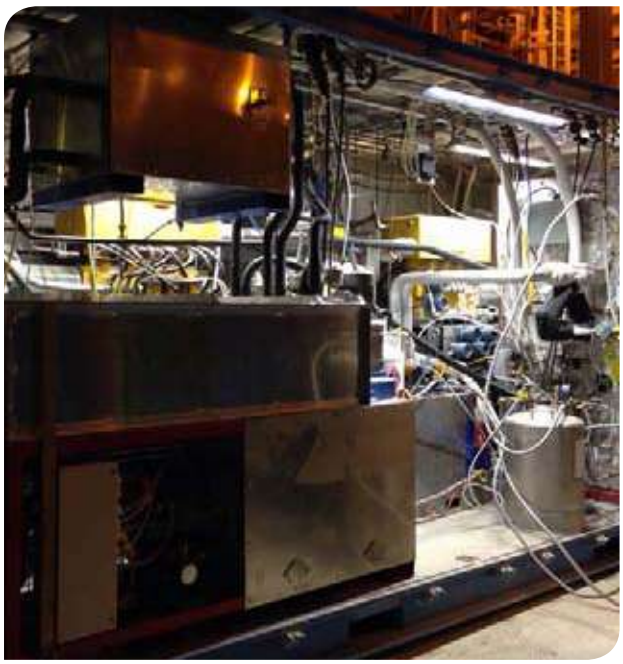
The first thing we tried to do was get a trial in Alberta, because that Province had a lot of resources to do so. We had permission at the local level but the senior management of our target cement company did not want to participate. In 2014 we managed to get a trial at a cement plant in the western US. That just collected the CO_2. SES set it up and ran the trial.

***GC:* How did Cementos Argos get involved with *this* trial?**

JK: I had previously worked with Cementos Argos in the US, doing training and environmental consultancy. The Roberta plant was identified on my recommendation. It was also just 30km from the US Carbon Capture Center and, as collaborators, we wanted to do the trial in the US. I had been to the Cementos Argos plants to do energy audits and knew them well enough to advise. Roberta was chosen because it was very stable operationally and had no major projects going on. It provided a good basis on which to work. Of course, it may have helped that Roberta is a former Lafarge plant!

***GC:* What major changes were made to the plant?**

JK: There were no major changes needed to the plant. The plant had to put a pipe on the outlet of the main baghouse fan with a valve on it. This withdrew a very small proportion of the flue gas at 10-12% CO_2.



Right: Inside Sustainable Energy Solutions' CO_2 capture test facility as used at the Roberta plant.

Left: John Kline has over 45 years' experience in the sector, primarily in senior project and operations positions for Lafarge in North America and Europe (1991-2012). He now runs Kline Consulting, an independent cement consultancy specialising in the fields of energy auditing and environmental performance and training. He became involved in the Roberta project after conducting research into viable CCS / CCU technologies in the early 2010s.

Right: CarbonCure Technology founder Robert Niven. "A 2016 McKinsey report shows that CCU is expected to be a US$0.8-1.0tn opportunity that could reduce CO_2 emissions by 7Gt/yr," he says. "This type of operation, certainly for our concrete industry clients, is now profitable. We treat CO_2 not as a waste but as a feedstock for materials be they fuels, plastics, chemicals or other products. The largest and earliest adopter will be the concrete sector."

Many plants might think that's quite low but Roberta loops its cooler gas back through the raw mill and main baghouse so there is a lot of dilution. SES was able to collect 97% of the CO_2 gas in that stream.

***GC:* How?**

JK: SES dries the gas, compresses it and freezes it to form solid CO_2 (dry ice). The solid CO_2 is then filtered / squeezed out of the liquid, which consists of liquid nitrogen, oxygen and other gases. There is a secondary step that purifies the CO_2 further and the finished product is then allowed to warm up, still under pressure, to give liquid CO_2.

***GC:* How much was captured?**

JK: The trial collected 450kg of CO_2, which was stored in 175kg Dewars under high pressure and low temperature. The pressure is continuously released through a valve, so that the temperature is maintained. The trial lasted around six days, capturing CO_2 over around three days in total.

Praxair provided the dewars and the liquid nitrogen to get everything down to temperature. Praxair is a full part of the project team and they are learning how to handle the technology, just like everyone else.

***GC:* How does CarbonCure's technology work?**

Robert Niven (RN): We retrofit concrete plants with technology that injects CO_2 into the concrete during the batching process. What this does is create nano-sized calcium carbonate crystals, which leads to higher strengths.

***GC:* Which companies used the CO_2 captured from the Roberta plant?**

Left: CO_2 that had been captured at the Cementos Argos Roberta plant was captured by Sustainable Energy Solutions, transported by Praxair and injected into concrete by Argos, completing the CO_2 loop in cement production.

Right: Over 20 guests were welcomed by the consortium partners to witness the CCU trial at the Cementos Argos plant in Alabama in January 2018.

RN: Argos' ready mix business in Atlanta used all of the CO_2 from this trial. It is just a short drive from the plant. Argos usually uses Praxair's CO_2 and it noticed no change between the suppliers. The CO_2 molecule is the same and the purity is the same.

***GC:* Is there a financial incentive to use flue gas CO_2 as well as environmental benefits?**

RN: The financial incentives in the longer term will be the cost benefit from using cheaper CO_2 rather than a commercial source. We can use a lower purity CO_2, rather than having to use a food grade one. There would be 99.9999% purity for food grade rather than >95% from a cement plant.

Our technology allows the producer to optimise its mix, reducing the amount of cement in the concrete for the same or greater performance. This offers a price advantage, helping it to compete with its rivals. The second advantage is that the product is more sustainable, which is an increasingly important aspect for specifiers these days. The value of the green building market is doubling every three years. The technology will also help concrete producers compete with other building materials.

We do not charge for the equipment to be installed and are paid using the savings that the technology provides for the concrete producer. CarbonCure creates the profitability that pays for the rest of the operation.

***GC:* How many installations are there at the moment?**

RN: We have around 100 installations supplied by Praxair and other large gas producers using CO_2 from waste sources. However from our point of view looking at the cement industry, there is a massive issue with CO_2 emissions. What if we could turn this CO_2 problem into a CO_2 asset? That's why we were keen to partner with SES and a cement plant on this most recent trial. This will help the industry hit its WBCSD targets but also close the loop on some of the CO_2 involved in the sector. Turning waste from the cement process and using it in the concrete made from the same cement is very attractive. We wanted to demonstrate a turn-key solution in which all parties made money while helping the environment. If we really are serious about these goals we have to set our standards high. We need to apply it today.

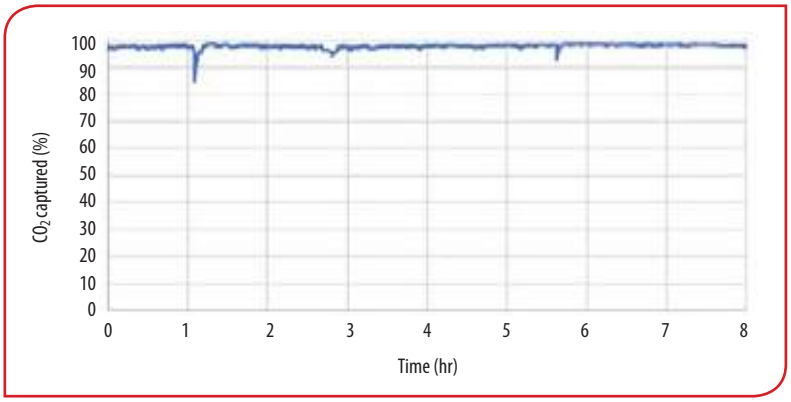
***GC:* What are the next steps for the project?**

JK: There is a discussion about starting another trial in Ontario with some of the cement producers and concrete manufacturers there. If the team is selected by the CARBON X-PRIZE, we will conduct a larger trial at a coal-fired or gas-fired power plant. SES is also continuing trials at power plants right now.

RN: For us the next step is to scale up to a 100t/day plant, with a modular system. We want to encourage other capture technologies because CarbonCure has the ability to consume a lot of CO_2 in concrete. We are agnostic as far as the source of the CO_2 goes.

***GC:* Thank you for your time today gentlemen.**

JK/RN: Thank you too!



Right: Carbon capture activities took place on 17-21 January 2018. A slipstream of flue gas was collected from a location on the discharge side of the main baghouse fan before the stack. A total of 1.42m^3/min was diverted to the capture system. The flue gas was cooled by an internal cooling system. The cryogenic capture approach is robust in the face of changing CO_2 composition and during these tests the CO_2 concentration fluctuated between 11-13% as the raw mill was put into and taken out of service. The CO_2 capture rate averaged around 97.5%. Capture data for an 8hr period is shown.

See the CarbonCure video below...

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John Kline talks CCS / CCU

***GC:* What is the biggest barrier to CCS / CCU in cement?**

JK: The biggest hurdle is cost. Nobody is going to do it unless they have to, for example unless the carbon tax is higher than the cost of implementation. Also CCS is just land-filling CO_2 - there is no benefit to the company sequestering it or to the wider economy. It may also store up problems for the future if it is released.

CCU technologies are potentially far more interesting, although they currently produce more CO_2 than they can make use of. Of these, algae / microbes is the most viable in my opinion, because you can use it to make plastics, fuels, food and a range of other useful and valuable chemical intermediates. That said, I don't think there is a lot of point making fuels with algae because fuels are not worth as much as the other products. There still needs to be a whole bunch of breakthroughs in this area. The CARBON X-PRIZE is a great way to make this area more interesting.

***GC:* If you had a 1Mt/yr cement plant, how big an algae / microbe plant do you need to capture all of the CO_2?**

JK: Bio-photoreactors are large! You would need 40 hectares of land to cover all of the output from a 1Mt/yr cement plant. This opens questions like, *'Can you use all the algae / microbes made or do you just dump it?'* If you don't use it or can't use it, algae systems could replace the CO_2 with another pollutant, potentially in massive quantities.

***GC:* What about using amines as sorbents?**

JK: Amines do the job well but there are other problems if we use them *en-masse*. I think that cement producers would be very reticent to suddenly have a very large volume of flammable sorbent on their property, when the existing process uses such high temperatures.

***GC:* Will CCS / CCU be commonplace in cement in another decade?**

JK: It is possible to do this and I don't see it as technically impossible. I suggest that if CCS has to be done, it would be prudent to separate the calciner and the kiln. The plant can then be CO_2 neutral if the calciner uses an oxycalcination process and the kiln uses 100% torrefied biogenic fuels. The plant would not have to have special clinker coolers, super kiln seals or fantastically-efficient burners. This simplifies the plant and enables you to capture the CO_2 in a more technically-feasible way than if you try to take the CO_2 from the entire plant. This, clearly, cannot be applied to all plants.

***GC:* Does that point to fewer larger plants?**

JK: It could do, or it could lend itself to a situation where CO_2 'producers' make cement as a byproduct. In that case things would get a lot more competitive and efficient. This situation is totally imaginable too! Maybe the major cement plant manufacturers are selling to the wrong people. Rather than selling to cement producers, perhaps they should be selling to concrete producers. They already have sand and aggregates (often limestone) on site. Why not get in some clay and gypsum and make clinker on site too?

***GC:* Some interesting points John. Thank you for your time today!**

JK: You are very welcome indeed Peter.

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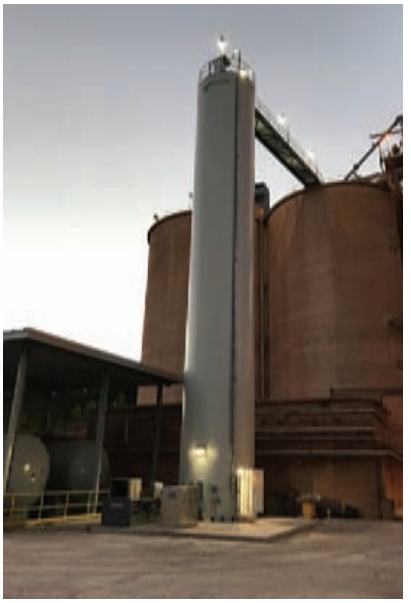

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Peter Edwards, Global Cement Magazine

A year in the US cement sector

Global Cement looks back at the past 12 months in the US cement sector to coincide with the 60th *IEEE-IAS/PCA Cement Industry Technical Conference* in Nashville, US...

Comment

After the 59th *IEEE-IAS/PCA Cement Industry Technical Conference* in Calgary, Canada in 2017, we reported that Ed Sullivan, the PCA's Chief Economist was in 'tubthumping mood.' At the time the PCA forecast cement consumption to rise by 3.5% in both 2018 and 2019. Sullivan's presentation was lively as always and delegates 'lapped it up.'

It will be interesting to see if there is a different response in Nashville. Since Calgary, data from the United States Geological Survey (USGS) has shown that shipments of ordinary Portland and blended cement rose by 'just' 2.4% year-on-year to 95.5Mt in 2017 from 93.3Mt in 2016. This came after a downward revision of the forecast for 2017 from 4.2% to 3.1% in late 2016.

In the 12 months since Calgary, the PCA has been forced, once again, to revise its forecast downward. This is partly due to the relatively low level of Federal money announced for President Trump's >US$1tn Infrastructure Bill, most of which will now have to come from the states themselves. Despite this, Sullivan remains sure of the strong fundamentals of the US economy. Indeed, things could even be going 'too well,' with the risk of over-stimulation of the construction sector and wider economy.

As reported on Page 61 in this issue, the current PCA forecast for cement sector growth in 2018 and 2019 has now slipped down to 2.8% for each year, rather than the 3.5% announced in May 2017. Sullivan points out that growth from the Infrastructure Bill will start to be felt only in late 2019, even at the lower-than-expected funding level. He stands by a forecast of 4% cement consumption growth in 2020.

While not as high as previous estimates, this still sounds great. If the forecasts are correct, US cement consumption will hit 99.3Mt in 2018, 102.1Mt in 2019 and 106Mt in 2020, reaching above 100Mt for the first time since 2007. This is still cause for optimism among delegates, as Figure 1 shows, but one suspects that the response to Sullivan's presentation in Nashville may be more muted than in 2017.

Financial headlines

In line with the increase in cement consumption in the US in 2017, most cement producers reported an improved picture. Revenues and other earnings parameters for 11 cement producers are outlined here:

Right - Figure 1: A 20 year roller coaster! Apparent US cement consumption, 2001 - 2017 (actual), and 2018-2020 (calculated). **Source:** USGS Mineral Surveys. PCA cement sector growth forecasts used for 2018-2020.

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2018 IEEE-IAS/PCA CEMENT CONFERENCE
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Right: Most cement companies saw an improved financial picture in the United States in 2017.

LafargeHolcim recorded sales of US$5.89bn in North America in 2017, a 1.4% increase compared to US$5.81bn in 2016. Its recurring earnings before interest, tax, depreciation and amortisation (EBITDA) came to US$1.54bn, an 11.1% increase year-on-year compared to US$1.39bn in 2016.

HeidelbergCement's North American operations recorded a revenue of US$5.36bn in 2017, a 7.9% rise compared to the US$4.97bn it took in revenue in 2016. Its earnings before interest and tax (EBIT) came to US$1.08bn for the year, a 24.1% rise from US$869m in 2016.

Cemex saw its US sales fall by 5% from US$3.67bn in 2016 to US$3.48bn in 2017. Its EBITDA fell by 2.4% to US$619m in 2017 from US$604m in 2016.

Buzzi Unicem saw consolidated net sales of US$3.47bn in 2017 a 5.1% rise compared to US$3.29bn in 2016. Its national EBITDA decreased by 7.7% year-on-year from US$678m to US$626m.

Cementos Argos recorded an income of US$1.71bn in the US in 2017, a 4.3% rise year-on-year compared to US$1.64bn in 2016. Its operating profit in the country was US$108m, a 17.3% rise year-on-year compared to US$92.1m in 2016.

Titan Group recorded revenues of US$1.08bn in North America in 2017, a 10.3% rise from US$979m in 2016. Its EBIT was US$157m for the year, a 10.3% fall from US$179m in 2016.

Grupo Cementos de Chihuahua's (GCC) sales grew by 23.6% year-on-year to US$925m in 2017 from US$749m in 2016. The group attributed this to strong demand in both the US and Mexico, as well as the integration of the operations acquired in Texas and New Mexico at the end of 2016.

Vicat recorded consolidated sales of US$484m in 2017, an 8.1% rise year-on-year compared to US$448m in 2016. Its EBITDA for the year was US$73.9m, a 1.9% rise year-on-year from US$72.7m in 2016.

Eagle Materials reported a record revenue of US$359.4m in the third quarter of its 2018 fiscal year (to 31 December 2017), a rise of 19% compared to the same period of the 2017 fiscal year. Third quarter gross profit improved by 8%, reflecting the financial results of the recently acquired cement plant in Fairborn, Ohio and related assets and improved net sales prices across most of Eagle's businesses.

Elementia's US sales fell by 7% US$231m in 2017 compared to US$249m in 2016. The company blamed this on the year being a 'transitional' period where it conducted regular maintenance works that interrupted production. It added Giant Cement's assets into the company during the year.

CRH, which bought Suwannee American Cement in 2017, reported that its like-for-like sales in the US increased by 4% in 2017. The company is also in the process of acquiring Ash Grove Cement. Once the deal is complete, no independent US-based cement producers will remain.

Other plant news

St Marys Cement suspended production at its Dixon plant in Illinois at the end of December 2017. The plant will continue as a grinding site until it runs out of clinker. This is expected in the summer of 2018.

Cemex USA officially launched a new railway terminal near Denver, Colorado in November 2017 after the site started operations in late September 2017. It is served by an existing rail line from the Lyons cement plant and has a silo capacity of 5000t.

Right: The Cemex Balcones plant near New Braunfels, Texas.

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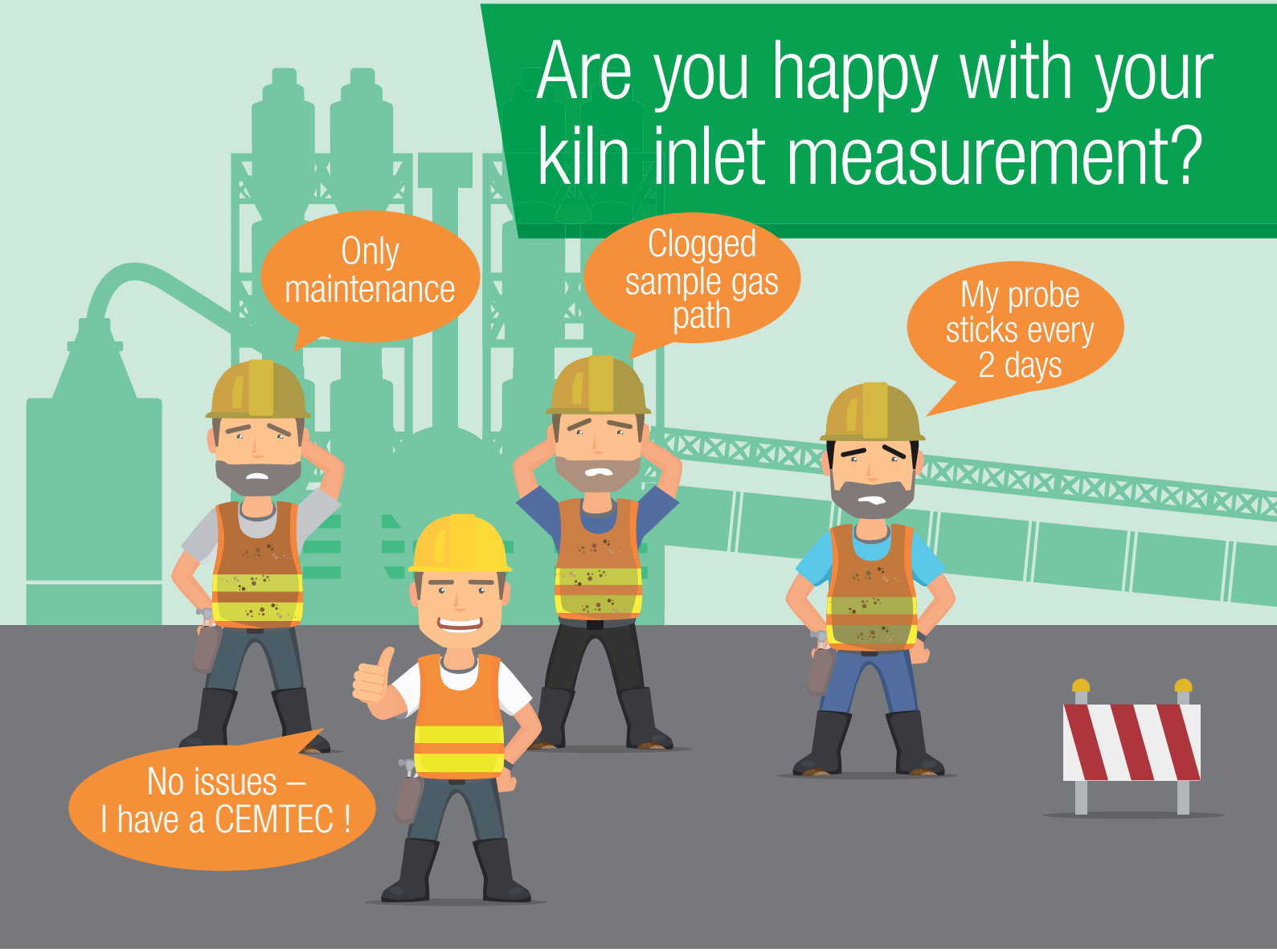

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Interview by Peter Edwards, Global Cement Magazine

Preview: 60th IEEE-IAS/PCA Cement Conference

The 60th *IEEE-IAS/PCA Cement Industry Technical Conference* will take place on 6-10 May 2018 in Nashville, Tennessee, US. Here we present a run-down of selected exhibitors...

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ATD Pressure Gas System 712
Aumund Corporation 706

Babcock & Wilcox - MEGTEC 910
Basecamp Process Components 111
Bayliss Machine & Welding 511
BOLDROCCHI North America 502
Borton, LLC 719
Bosch Rexroth Corp 723
BWF Envirotec 615 & 617

Right: View of downtown Nashville across the Cumberland River.

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Calderys 325
Calgon Carbon Corporation 400
CCC Group 707
CEMENGAL 218
CEM Specialities 306
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117,119
Cemtek Environmental KVB Enertec 1100
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Dal Teknik Makin Tic Ve San AS 813
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DI MATTEO Group 832
Dome Technology 1106
Domtec Technology 107
Dustex LLC 704
Dynamis 1014

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FCT Combustion, Inc 902
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G&R Minerals 310
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Ohio Lumex Co 903
OnSite Energy 302

PACIFIC SOWA Corp 405
Parker Hannifin / BHA 717
Pebco 406
Phoenix Industrial 914

Left: PCA Chief Economist Ed Sullivan presents at the 59th *IEEE-IAS/PCA Cement Industry Technical Conference* in Calgary, Canada in 2017. Read more about Ed's latest forecasts for the US cement sector on Page 61 in this issue.

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Renold Jeffrey 214
Rexnord Industries 412 & 414
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VIM Technologies 323
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India: Court blocks out-of-court offer for Binani

The Supreme Court has blocked an out-of-court offer by UltraTech Cement for Binani Cement. Banks had offered conditional support to UltraTech's bid, seeking indemnity from Binani Industries, the owner of Binani Cement, against any potential legal action, according to the Economic Times newspaper. A consortium led by Dalmia Bharat won an auction for Binani Cement with a bid of US$974m in early March 2018. However, UltraTech Cement then made a direct bid to Binani a few weeks later.

Binani Industries had deposited US$115m with HDFC Bank to show its commitment to the deal with UltraTech, along with a bank guarantee for nearly US$1bn. However, Dalmia Bharat had sent letters to all the banks involved saying that any settlement initiated by them would be a breach of trust as it had entered into a contract with Dalmia.

Above: The Indian Supreme Court in New Delhi.
Credit: TK Kurikawa / Shutterstock.com

China: Selected 2017 results

Anhui Conch's sales revenue grew by 35% year-on-year to US$11.9bn in 2017 from US$8.85bn in 2016. Its net profit nearly doubled to US$2.51bn from US$1.36bn. The cement producer said that it had, 'seized the favourable opportunities arising from the state's further deepening of supply-side structural reform and the promotion of off-peak season production.'

Meanwhile, China National Building Materials' (CNBM) revenue from its cement operations rose by 22% year-on-year to US$12.4bn in 2017 from US$10.1bn in 2016. Its adjusted earnings before interest, taxation, depreciation and amortisation (EBTIDA) rose by 27% to US$2.94bn from US$2.32bn.

Cement production volumes from the group's four main divisions – China United, South Cement, North Cement and Southwest Cement – remained stagnant at 258Mt in 2017. However, the group's cement production capacity for the four divisions was 411Mt/yr giving it a capacity utilisation rate of 63%. Overall the group said it had a cement production capacity of 525Mt/yr.

Huaxin Cement's sales revenue grew by 54% year-on-year to US$3.33bn in 2017 from US$2.15bn in 2016. Its net profit more than tripled to US$331m from US$72m. Cement production rose by 33% to 66.1Mt from 50Mt.

Vietnam: New line for Fico Tay Ninh

Fico Tay Ninh Cement (Tafico) plans to start building a new production line at its plant Tan Hoa, Tan Chau District in mid-April 2018. The US$212m project will have a clinker production capacity of 4000t/day, according to the Viet Nam News newspaper. The project is scheduled to be completed in 2020.

Meanwhile, Mai Tien Dung, the Minister and Head of the Government Office, has identified ways for the Vietnam Cement Industry Corporation (VICEM) to improve its operations. The minister wanted ways to increase VICEM's local market share, improve corporate governance, streamline its organisational structure, make environmental improvements and increase the quality and competitiveness of its cement products.

Indonesia: Indocement revenue drops in 2017

Indocement's sales revenue fell by 6% year-on-year to US$1.01bn in 2017 from US$1.12bn in 2016. The subsidiary of Germany's HeidelbergCement saw its operating income fall by nearly half to US$131m from US$255m. In HeidelbergCement's annual report it said that, although cement and clinker sales grew by 5.5% in 2017, prices fell due to excess capacity.

China: Anhui CCS pilot plant

Anhui Conch has spent over US$7.9m on a 50,000t CO_2 capture and purification pilot project at its Baimashan cement plant in Anhui province. The unit is scheduled to start operation in the first half of 2018. The group has started the project in order to participate in a new central government CO_2 emission reduction initiative.

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Pakistan: Capacity utilisation rate hits 94%

The All Pakistan Cement Manufacturers Association (APCMA) says that the capacity utilisation of the local cement industry reached 94% in the nine months of the local financial year to March 2018. Demand for cement has been bolstered by local demand and growing exports so far in 2018, according to the Business Recorder newspaper. Cement despatches grew by 14.7% year-on-year to 34.8Mt in the first nine months of the 2017 – 2018 year from 30.3Mt in the same period in the previous year. Despatches grew faster in the north of the country than the south.

Above: The DG Khan Khairpur plant in Pakistan.

India: Dondapadu plant to re-open

Kakatiya Cement, Sugar & Industries plans to reopen its 2.97Mt/yr cement plant at Dondapadu in Telangana following its closure on pollution grounds in October 2017. Following the installation of online SPM stack monitoring equipment and connections to the Central and State Pollution Control Board servers, the company was 'hopeful' that the plant will be able to restart operations by the end of April 2018. The cement producer is currently obtaining clearance from the Telangana State Pollution Control Board.

Bangladesh: Expansion for Kanchpur plant

HeidelbergCement Bangladesh and China National Heavy Machinery have signed a deal to expand the Kanchpur plant near Dhaka, according to ENP Newswire. HeidelbergCement Bangladesh operates two cement grinding plants in the country.

Indonesia: Order for Gebr. Pfeiffer

Semen Grobogan has ordered two MVR 5000 C-4 mills for cement grinding and one MVR 5000 R-4 for raw material grinding from Germany's Gebr. Pfeiffer. The package also includes an MPS 3350 BK mill for grinding lignite. The mills will be set up at the Grobogan cement plant near Semarang in Central Java. The order was placed by the Chinese general contractor Nanjing Kisen. Commissioning of the mills is scheduled for the first half of 2019.

Georgia: Raysut mulls 1Mt/yr plant

Oman's Raysut Cement has approved an initial study to consider building a 1Mt/yr cement plant in Georgia. The company's subsidiary Pioneer Cement Industries Georgia owns a limestone mine with reserves of over 30Mt about 60km from the capital Tiblisi. A final decision on the project is expected to be made by June 2018. Discussions have also commenced with possible partners for both equity participation and engineering, procurement and construction (EPC) contracting.

China: CNBM and Sinoma merger set to complete in May 2018

The merger between China National Building Material (CNBM) and China National Materials (Sinoma) is looking likely to be completed in early May 2018. The companies have issued a scheduled timeline for key events of the withdrawal of Sinoma shares and the implementation of a share exchange. This process is expected to be completed on or around 3 May 2018, with CNBM updating its business registration at the Beijing Municipal Administration of Industry and Commerce as soon as possible thereafter. The merger marks the conglomeration of the leading Chinese cement producer and equipment manufacturer.

India: Sagar Cement buys two hydroelectric power plants

Sagar Cements has acquired two mini hydroelectric power plants from Sagar Power in Andhra Pradesh. One has a capacity of 4.3MW located at Guntur Branch Canal, Narasaraopet, Guntur District and the other has a capacity of 4MW located at Lock-in-sula, Atmakur, Kurnool District. No amount for the transaction has been disclosed. The cement producer operates two integrated cement plants and one grinding plant.

Vortex

Vortex handles abrasive materials in Australia

Vortex's international sales network consulted with an Australian cement company to provide solutions for a new sand and slag drying plant. For this project, the cement company sought an effective solution for discharging dried blast furnace slag from a silo into open trailer trucks. The new plant was installed and began operations in 2016...

Blast furnace slag is an important ingredient in the cement blending process. It is also a challenging dry material with unique and complex characteristics. The challenges an Australian cement company faced when loading dried blast furnace slag included a moisture content of <0.5%, material being discharged from a 500t silo and a slag plant rated at just 60t/hr.

In this client's process, the bulk silo can either load out materials onto a belt conveyor to be transported to storage or to additional processing equipment, or it can load out materials into open trailer trucks. With considerations for employee safety and environmental concerns associated with dust emissions to the atmosphere, the client opted to source a Vortex Loading Spout for use in its open loading application.

The cement company sourced one Vortex Loading Spout with vertical travel distance of 3.35m and load-out capacity of 424.5m^3/day. It has a four cable lifting system, a three-piece, CNC-machined pulley system, centre mount motor, detachable dustless loading skirt and a 10-year warranty on lifting cables.

The Vortex Loading Spout was customised to meet the client's specified travel distance and load-out capacity. Although this spout will primarily be loading product into open vessels, this cement company wanted the adaptability to also load product to enclosed vessels, as offered by the Vortex Loading Spout. By simply attaching or detaching a dustless loading skirt, the Vortex Loading Spout ensures that dust will be contained when loading into either open or enclosed vessels.

Whether it be in open or enclosed loading applications, a Vortex four-cable lifting system can be the difference between continued operations and loadout shut-down. As each lifting cable has 180kg capacity, a four-cable system allows total resistance of 720kg, which provides a greater service factor and improved cable breakage resistance. With two- and three-cable lifting systems, if a cable is broken, the spout is imbalanced and thus, cannot be extended or retracted until the cable is repaired or replaced. However, if a cable is broken in a four-cable lifting system, three cables remain, allowing the spout to continue operations until maintenance can be conveniently performed.

The Vortex Loading Spout also features a unique pulley system designed to reduce the risk of spout misalignment, retracting imbalance and cable wear. The Vortex pulley system utilises three-piece, CNC-machined pulleys with chamfered radius edges and precision cable grooves. Because the pulleys are designed so that the grooves match the exact diameter of the lifting cables, the Vortex pulley system significantly reduces cable wear and backlashing as the spout extends and retracts.

Vortex is confident in the lifespan of its lifting cables and offers a 10-year cable warranty for wear, tear and workmanship, in comparison to the industry's standard one-year cable warranty.

The Vortex Loading Spout also features a centre mount motor. The drive unit is centre mounted beneath the main support pan assembly for better protection from the elements, and is easily accessible for service. As a standard, it features a premium motor/reducer drive unit with an integral braking system, as well as forged idler rollers with double sealed roller bearings. These are used in place of simple stamped rollers with bushings. The premium unit further prevents spout cables from error when spooling during the extension and retraction processes.

Peter Edwards, Global Cement Magazine

Event Review: AFCM 2018, Bandung, Indonesia

The 25th *ASEAN Federation of Cement Manufacturers' (AFCM) Technical Symposium & Exhibition* successfully took place in Bandung, Indonesia on 4-6 April 2018. Around 500 delegates heard 22 presentations and visited over 50 exhibitors over the three days. *Global Cement* was in attendance as event media partner and reports here on the highlights...

Delegates were welcomed to the 25th *AFCM Technical Symposium & Exhibition* by Widodo Santoso, President of the AFCM and Indonesian Cement Association (ASI), on the morning of 4 April 2018. Santoso welcomed all delegates to the event, stating that it was essential for the AFCM to bring its members together to discuss 'green' technologies for cement, especially the increased use of alternative fuels and raw materials. He stated that the ASEAN region, now with a cement capacity of 342Mt/yr, had an over-capacity in 2017 in nearly all countries, especially in Indonesia and Vietnam, the largest two producers. Exports of 28Mt/yr leave the ASEAN region as a result of this. Santoso concluded his opening remarks by thanking all presenters for sharing their knowledge and wished everyone a successful event.

After a lively demonstration of traditional West Javan dancing, Santoso officially opened the conference along with Lintong Soepandi, Representative of the Minister of Industry of Indonesia and Eddy M Nasution, representative of the Governor of West Java, by striking a gong.

Selected presentations

The first presentation was given by **Luigi Di Matteo** of Di Matteo Group. He spoke about the company's holistic approach to alternative fuels handling, dosing and feeding to fit in with the themes of the event, including the well-known ODM WeighTube®.

Andreas Hand of KHD Humboldt Wedag introduced solutions for low NO_x burning of fuels, including for the increased use of alternative fuels. He stated that the ASEAN market represented a great opportunity for higher use of alternative fuels. He introduced delegates to the PYROCLON® Low-NO_x calciner for higher alternative fuel substitution rates as well as the rotating PYROROTOR® combustion reactor, which provides high residence times for the burning of 'outsized' alternative fuels. The PYROROTOR®, a rotary drum burner (L = 10m, Ø = 3.5m), rotates above the kiln and allows material to fall down into the inlet chamber. Hand also spoke about the PYROSTEP2® clinker cooler.

Roger Hassold of Australia's FCT Combustion explained that his company introduced modelling to cement plant combustion in 1984. This involves a site survey to collect dimensions, clinker samples, temperatures and pressures. The data is then evaluated to generate, for example, mass balance calculations. FCT then models the existing situation to identify problems and possible solutions. Hassold provided a case-study of work conducted at a five-stage in-line calciner in Europe that was burning coal and refuse-derived fuel (RDF). A simple modification to the coal burner position allowed the RDF substitution rate to increase from 20% to 30%. Hassold also discussed the FCT Turbu-Flex™ burner, which can switch between 'normal firing' and 'AF Boost mode.'

Siam Refractory's **Pannawit Ngaichai** talked about maximising the life-span of refractory linings, not by buying more or more expensive refractory but by optimising conditions to prolong existing refrac-

1: BEUMER Group's Soravudh Chotivancih (left) and Markus Peitzmeier (right) on the company's stand.

2: Representatives of Haver & Boecker, IBAU Hamburg and Newtec Bag Palletising on the companies' joint stand.

3: Questions from local cement producer delegates on the AUMUND Asia / SCHADE Lagertechnik stand.

4: A large delegation from The Siam Refractory Industry.

5: Luigi Di Matteo (left) and Dominik Auf Der Heide (centre) of Di Matteo Group answer a question on the company stand.

6: KIMA's Dirk Schmidt provides information about his company's SmartFill system.

tory product life. His presentation offered a focus on solving process issues, including reducing the circulation of damaging volatiles, rather than needlessly replacing refractory too early. This approach stems from Siam Refractory being a subsidiary of the Thai cement major SCG Cement.

Arumugan Vijayanarayanan spoke about the new thyssenkrupp PREPOL Step Combustor for burning large pieces of alternative fuel. It has a combustion residence time of beyond 1000s. The combustor is shaped like a descending set of stairs, with combustion air provided from a cooler off-take. Fuel is introduced to the combustion chamber by feeder screws. Combusting fuel is then pushed slowly down the stairs using air cannons.

Andre Vos from Claudius Peters Projects spoke on the topic of the replacement of a clinker cooler with an ETA Cooler at the Donghae cement plant in South Korea. The company has also been involved in a kiln feed project at the Hope Cement plant in the UK, which is reviewed elsewhere in this issue.

Thorwesten Vent's **Berthold Bussieweke** highlighted the importance of installing appropriate explosion venting systems in coal and alternative fuel handling and storage systems at cement plants.

Palle Grydgaard of FLSmidth reported on a large upgrade by his company that is expected to result in a 33% increase in cement capacity. A new kiln drive, a new JETFLEX burner, an upgrade to the clinker cooler to a cross bar cooler, a preheater cyclone upgrade, an extension to the calciner, a coal mill upgrade, a new RAKM separator and a new roller press to enhance existing raw mill capacity are all being carried out, with re-commissioning expected in early 2019.

KIMA's **Dirk Schmidt** spoke about his company's SmartFill system for the smart control of ball mills in the cement sector. The Smart Control system uses fuzzy logic, which Schmidt said is robust and capable of handling multiple input streams. He said that microphone systems are vulnerable to interference from other sources and that vibration sensors are not accurate. To get around these issues, the SmartFill

7: GH Lee (left) and Igor Zlobin (right) of ball mill and diaphragm manufacturer Christian Pfeiffer.

8: Mogens Fons (left) of Fons Technology International answers a question from a cement sector delegate.

9: Representatives of German fan manufacturer Venti Oelde.

10: Discussions on the impressive thyssenkrupp stand.

11: ENOTEC's Suryadi Boesman (left) and Sean Turner (right).

12: *Global Cement* hospitality suite!

13. Discussions on the stand of additive producer PT GCP.

14. Loesche Indonesia's R Aditya Bagus Nugroho on the vertical roller mill producer's stand.

15. Standard Industrie's Borio Marco (left) and Benoît Pluchon (right) on the company's stand.

system is attached directly to the body of the mill. It can therefore monitor the entire circumference of the mill's operation as it rotates. This enables producers to keep fill levels to the optimum, offering increases in capacity with reduced power use.

Ibsen Barlongay of PT GCP (formerly Grace) stated that vertical roller mills (VRM) are good at throughput and energy efficiency but can also suffer from cement prehydration, due to spraying of water. This leads to lower strength of concrete at all ages and is estimated to cost the global cement industry US$300m/yr. He showed research that revealed that 19% of ball milled cement was prehydrated. By contrast, nearly 50% of VRM samples in the same study were prehydrated. This is primarily due to added water in the mill. To counteract prehydration, GCP's TAVERO VM additive allows producers to use less or even zero added water in their VRMs. Case-studies were provided from Brazil and China.

Gebr. Pfeiffer's **Caroline Woywadt** spoke about the company's record-setting 11.5MW VRM for clinker grinding in Brazil and the company's new versatile Ready2Grind modular VRM concept. The Ready2Grind system comes in standard container sizes and arrives pre-assembled. It offers capacities of up to 0.55Mt/yr with the MVR 2500 C-4, which only requires a footprint of 350m^2.

Moises Nuñez of Plug&Grind modular ball mill producer Cemengal introduced his company's system as 'the fastest way to first cement.' It requires no expensive and time-consuming structural steel as all equipment is supported by the structure of the containers it is delivered in. Nuñez highlighted the benefits of moving clinker compared to cement. Not only is clinker easier to move from a handling perspective, one needs to move less clinker to effectively move the same mass of cement. Nuñez highlighted that business models in which clinker is ground in separate mills away from where it is produced have particular application for the ASEAN region, which has many remote island markets.

Loesche's **Winfried Ruhkamp** also spoke on the topic of grinding, with an eye on the production of low-CO_2 cement. He highlighted that producers need flexibility to include supplementary cementitious materials in their cement products, including slags and ashes, all of which reduce the clinker factor and hence embodied CO_2. Ruhkamp ended by introducing Loesche's Compact Cement Grinding (CCG) plant as an option for quick market entry. As other presenters, he highlighted the benefits of modular grinding systems for remote markets as well as the benefits of VRMs.

Stefan Seeman of KHD Humboldt Wedag spoke on the topic of efficient grinding solutions, in particular about KHD's roller press circuits, providing a case-study from ACC Jamul (LafargeHolcim) in India, in which throughput, fineness and efficiency were all better than the guaranteed value. Seeman also discussed slag grinding with roller presses, a fairly common practice in the ASEAN cement sector. He showed the energy efficiency benefits of grinding slag with a roller press rather than a VRM.

16. Cemengal's Thomas Elveman (left) and Moises Nuñez (centre) outline the benefits of modular grinding systems to an interested delegate.

17. FCT Combustion's Roger Hassold presented on the topic of pyroprocess optimisation and FCT's TurbuFlex burner.

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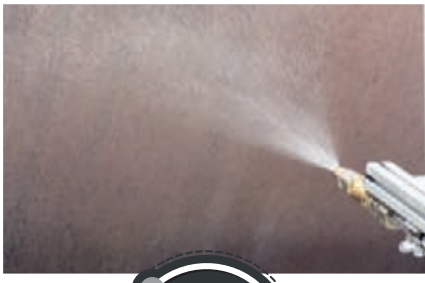

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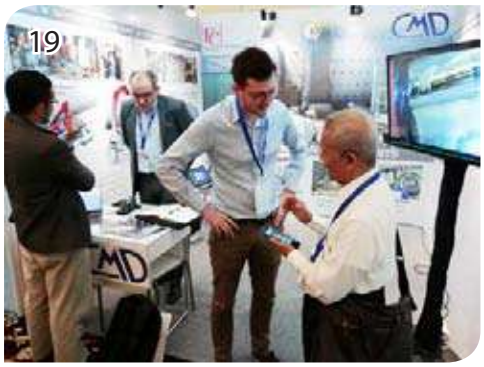
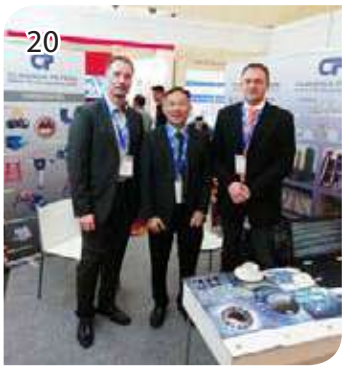
18. Christian Camin (left) and Luca Mastrorocco (right) of MDG Handlings.



19. Discussions on the joint CMD and Ferry Capitain stand.



20. Claudius Peters Projects' Frank Siebert (left), Loh Han Sen (centre) and Andre Vos (right).

21. Gebr. Pfeiffer's Caroline Woywadt presented on the topic of the Ready2Grind modular grinding system.

22. KHD's Jörg Bornemann answers a question from cement sector delegates.

23. Bertrand Licour (facing left) and Olivier Charmasson (facing right) of fan manufacturer Howden answer questions on the company stand.

24. Christoph Muschaweck (left) and Franz Muschaweck (right) of DALOG Diagnosesystme, producer of online condition monitoring systems.

Didier Bourbon of Fives FCB spoke on the subject of the FCB Horomill®, which is based on bed compression grinding. It offers particular advantages for places with high humidity such as the ASEAN region. Bourbon also highlighted the Horomill's low use of electrical energy and the fact that no process water needs to be included.

TAI & Chyun's **Dalan Liang** presented on the topic of improving electrostatic precipitator (ESP) performance by retrofitting high-frequency transformer rectifiers (HFTR). According to Liang, HFTRs give dramatically different control characteristics compared to the 'traditional' linear transformers and rectifiers used by the sector. The technology provides several benefits, including faster control response and a higher power factor, increasing the proportion of dust collected by the ESP.

Evonik India's **Aashish Maheshwari** presented on the topic of his company's P84® Filter Media as an alternative to membrane filter media. He provided a case-study from Zuari Cement's Yerraguntla plant, in which woven glass bags had failed in less than a month. Upon replacement with P84® Filter Media, the emissions from the stack were immediately reduced. The filter media has a very good liefespan. Even after 1.5 years there is no cement dust penetration into the felt cross section.

Anis Haider of ITECA showed how his company's graphite-based kiln seals can lead to enhanced energy efficiency for cement producers and lower costs due to reduced ingress of false air.

Christoph Muschaweck from DALOG demonstrated how his company's plant condition monitoring systems can help cement producers 'predict the future' and avoid expensive unplanned downtime through failures.

Simone Romano of FLSmidth Airtech compared the performance of ESP technology and baghouses. He showed that advances in fabric filter technology can help plant managers reach and maintain environmental compliance in the face of increasingly stringent dust emissions limits worldwide.

Remarks

Speakers enjoyed a well-attended auditorium and high level of interest from cement producers from Indonesia and across the ASEAN region. The exhibition area was busy, especially during the coffee breaks and at lunch. It appears that the conference was successful in its aim of enhancing the understanding and use of the latest cement sector technology in the region.

The 26th *AFCM Technical Symposium & Exhibition* will take place in Malaysia in 2018. The location will be announced in due course. *Global Cement* looks forward to seeing you there!

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Saudi Arabia: Sales fall by 11% in first quarter

Cement sales in Saudi Arabia fell by 11% year-on-year to 11.8Mt in the first quarter of 2018 due to a continued slowdown in the construction industry. Weak demand and high inventory levels have forced cement producers to sell their cement in other parts of the country and export to other countries, according to a report by Al Rajhi Capital. The report cited Yanbu Cement's export agreement, although it said that its low production costs give the company the advantage to export at lower prices than its competitors are able to.

Increased competition within Saudi Arabia has led to a price war. The report marked the central region as an attractive region for northern region cement companies due to the relatively bigger market. The sales market share for northern cement companies increased in the last six months. On the other hand, central region companies' market share decreased slightly during the same period.

Yanbu Cement signed a one-year agreement to export 1Mt of clinker and 0.5Mt of cement from April 2018. It is estimated that the deal with Yanbu Cement raised US$26.6m in extra sales revenue in 2018. Al Rajhi Capital estimates that the cement producer would be likely to renew the export deal in 2019, as its low margins are unlikely to aid earnings.

Tunisia: Contrasting fortunes

Production remains suspended at Carthage Cement due to a dispute between NLSupervision and the plant's staff. The management of NLSupervision, a subsidiary of Denmark's FLSmidth, which has a contract to operate the plant, and union representatives have met several times to try and resolve the matter, according to the Tunis Afrique Presse. On 4 April 2018 NLSupervision shut down the plant for 60 days.

Meanwhile, Ciments de Bizerte has restarted exports of clinker and cement after a hiatus of 10 years. A shipment of 25,000t of clinker disembarked from the cement producer's port to Cameroon in early April 2018. The local cement industry has an overcapacity of 1Mt/yr.

Uganda: Hima plant to start in May 2018

Hima Cement's new US$40m grinding plant at Nyakesi in Tororo District is expected to start production in early May 2018. Originally the 0.8Mt/yr plant was scheduled to open in June 2018, according to the East African Business Week newspaper. Opening early is dependent on the subsidiary of LafargeHolcim receiving a government mining licence.

Uganda: Producers suffer power outages

Tororo Cement and Hima Cement have blamed falling production on reduced electricity supplies. Morgan Gagranihe, the executive director of Tororo Cement, said that production from the company's plant at Tororo had fallen by half to 0.6Mt/yr from 1.2Mt/yr, according to the Daily Monitor newspaper. Local power company Umeme has rejected the claims.

Egypt: Arabian Cement plant opens

Khaled Fahmy, the Minister of Environment, has opened a new production line at Arabian Cement Company's Ain Sokhna plant in Suez. The line uses FLSmidth's Hotdisc combustion device to allow it to use high levels of alternative fuels.

The opening was attended by Muhammad Shehab Abdel-Wahab, chief executive of the Egyptian Environmental Affairs Agency, Nahed Youssef, head of waste management organisation, as well as a number of representatives of the financiers, and the director of the European Investment Bank.

Syria: Further charge in IS probe

Sonia Artinian, Lafarge's human resources director from 2013 to 2015, has been charged with 'endangering the lives of others' during operations in Syria. However, she avoided being charged for financing a terrorist organisation instead being granted 'assisted witness' status, according to the Agence France Presse. LafargeHolcim is being investigated in France over claims that Lafarge Syria had paid extremist groups, including the Islamic State group (IS), to keep its Jalabiya cement plant operational after the outbreak of war in Syria. Six former Lafarge executives have so far been charged with financing a terrorist organisation.

Kenya: Bamburi turnover falls

Bamburi Cement's turnover fell by 6% year-on-year to US$357m in 2017 from US$380m in 2016. The subsidiary of LafargeHolcim attributed the decline to poor weather, a prolonged election period and lower construction activity, especially in the individual home builder segment, in Kenya. In Uganda it described the market as 'broadly flat' for both domestic and export sectors. The cement producer's profit fell by 66.5% to US$19.6m from US$58.4m.

Kenya: Funding for National Cement

The International Finance Corporation (IFC) has committed US$96m to invest in National Cement towards upgrading a cement plant and building new grinding plants. National Cement's chairman and chief shareholder Narendra Raval is also expected to invest US$102m into the expansion project, according to the Daily Nation newspaper. The company intends to build two grinding plants in Kenya and Uganda and a new 5500t/day clinker production line at its existing integrated plant in Merrueshi in Kenya. It also plans to build a 8MW captive power plant at Merrueshi.

Kenya: EAPCC selling off land

East African Portland Cement Company (EAPCC) is relying on a US$100m land sale to the government to remain solvent. The company is in discussions to sell over 14,000 acres of land to the Special Economy Zones Authority funds. The cement producer has seen its production halted, cement stocks depleted and staff salaries delayed over the last two months. It reported a loss of US$9.58m in the second half of 2017 from a loss of US$2.45m in the same period in 2016.

Zambia: WEYE submits 1Mt/yr plant plan

WEYE Construction Materials has submitted plans to the Zambia Environmental Management Agency to build a 1Mt/yr cement plant in Chilanga district. The investment for the proposed project, including quarry and full clinker production line, has been set at the low value of US$45m.

According to the application the project will build a raw material mill single–stage cyclone pre-heater, a coal-fired rotary kiln and a packaging unit. Bag filters will be used for dust recovery at the bagging facility and material transfer points. Electrostatic precipitators will be installed for gas cleaning to avert nuisances from the kiln. WEYE added that the project would also create 555 jobs.

WEYE Construction Materials is owned by two Chinese shareholders: Zhang Yiwei and Lu Qiang. It is a subsidiary of China's WEYE Construction Group, based in Jiangsu province and established in 1999.

Nigeria: Lafarge Africa sales up 36%

Lafarge Africa's sales rose by 36% year-on-year to US$835m in 2017 from US$613m in 2016. Its recurring earnings before interest, taxation, depreciation and amortisation (EBITDA) nearly doubled to US$161m from US$81m. Michel Puchercos, the chief executive officer of Lafarge Africa, attributed the strong margins in its Nigerian business to cost initiatives and higher prices.

Morocco: Cement consumption falls

Cement consumption fell by 6.9% to 3.31Mt in the first three months of 2018 from 3.55Mt in the same period of 2017. Consumption decreased particularly in the Dakhla - Oued Ed-Dahab, Fès - Meknès and Béni Mellal - Khénifra regions according to Ministry of Housing data. It also dropped sharply in March 2018 by 15.1% to 1.24Mt.

Morocco: De l'Atlas' income rises

Ciments de l'Atlas' (CIMAT) income rose by 1.27% year-on-year to Euro51.1m in 2017, according to Le Boursier. Its sales rose by 5.7% to Euro239m. The cement producer operates two cement plants at Ben Ahmed and Beni Mellal.

Below: The Atlas mountain range in Morocco, from which Ciments de l'Atlas takes its name.

Arab Union for Cement and Building Materials

23rd Arab International Cement Conference and Exhibition (AICCE23)

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Philippe Fonta, Managing Director, Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD)

The updated Global Cement Technology Roadmap outlines the path to implement the Paris Agreement

Concrete is the world's largest man-made product and cement is the essential binder that makes it. It is estimated that 9.8 billion people will inhabit this planet by 2050 and that 60% of the essential infrastructure needed to house this number, to provide them places to work, to educate them, to provide clean water, to give healthcare and to transport them still has to be built. Consequently, the demand for concrete is anticipated to significantly increase by 2050. The challenge to the cement industry is clear, we must increase the momentum that the sector has built up in reducing its CO_2 emissions....

Above: Philippe Fonta, Managing Director, Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD).

Goal 13 of the *United Nations 2030 Agenda for Sustainable Development*, adopted by world leaders in September 2015, calls for urgent action to combat climate change and its impact. The Paris Agreement, negotiated in December 2015, aims to limit the rise in global temperatures this century to less than 2°C above pre-industrial levels. To anticipate this movement and to build a longstanding collaboration, in 2009 the International Energy Agency (IEA) and the Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD), partnered to develop the *Global Cement Technology Roadmap (www.wbcsdcement.org/technology)* through to 2050 - a significant milestone in that it was the first industry-specific Roadmap.

Recently the CSI, again in partnership with the IEA, has released an updated version of the Roadmap. The analysis for this updated Roadmap is based on a compilation of performance data and

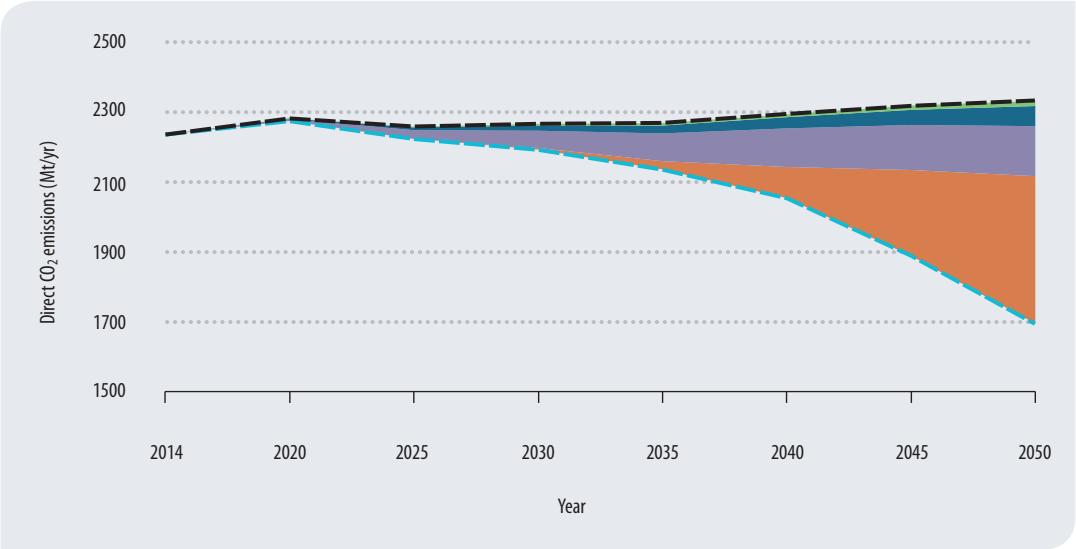
The Reference Technology Scenario (RTS) serves as a baseline scenario for this roadmap. It considers energy consumption trends, as well as commitments by countries to limit carbon emissions and improve energy efficiency, including nationally determined contributions pledged under the Paris Agreement. The RTS represents a considerable shift from a 'business as usual' approach with no meaningful climate policy response. Efforts made under the RTS would result in an average temperature increase of 2.7°C by 2100, at which point temperatures are unlikely to have stabilised and would continue to rise.

The 2DS sets out an energy system pathway and a CO_2 emissions trajectory consistent with at least a 50% chance of limiting the average global temperature increase to 2°C by 2100 (IPCC, 2014). Annual energy sector CO_2 emissions will be reduced by around 60% from current levels by 2050, with cumulative carbon emissions of around 1170GtCO_2 between 2050 and 2100 (including industrial process emissions). To stay within this range, CO_2 emissions from fuel combustion and industrial processes must continue their decline after 2050, and carbon neutrality in the energy system must be reached by 2100.

The 2DS represents an ambitious and challenging transformation of the global energy system that relies on a substantially strengthened response compared to current efforts.

The scenarios are based on technologies that are commercially available or at demonstration phase. Industrial technological shifts are a result of the minimisation of overall costs of production among available technologies as they reach successful commercialisation over time. The scenarios assume that non-technical barriers to the deployment of new technologies are overcome, including social acceptance, ineffective regulatory frameworks and information deficits. The analysis does not assess the likelihood that these assumption will be fulfilled, but it highlights that ambitious CO_2 emissions reductions can only be realised with the collective contribution of all stakeholders: governments, industry and society.

These scenarios are not predictions. They are internally consistent analyses of cost-optimal pathways that may be available to meet energy policy objectives, given a set of techno-economic assumptions.



Left - Figure 1: Global direct CO_2 emissions reductions between the 2DS and the RTS by mitigation lever. **Source:** *CSI-IEA Technology Roadmap: Low-Carbon Transition in the Cement Industry*, 2018.

Note: Percentages provided refer to the contribution of each carbon emissions reduction lever to the total direct CO_2 emissions reductions cumulatively along the modelling horizon.

information related to cement production from the best available data sources worldwide, a key source being the *Getting the Numbers Right* (GNR) database *(www.wbcsdcement.org/GNR)* of externally verified energy consumption and CO_2 emissions, managed by the CSI, as well as other sources. It is based on an energy system pathway and a CO_2 emissions trajectory that are consistent with at least a 50% chance of limiting the average global temperature increase to 2°C by 2100. The Roadmap uses a 'bottom-up' approach to explore a possible transition pathway based on a 'least-cost technology' analysis. The outcome for the cement industry is a pathway to reduce its direct CO_2 emissions by 24% below current levels by 2050.

Today, the cement sector is the third-largest industrial energy consumer in the world, responsible for 7% of industrial energy use (10.7 exajoules [EJ]), and the second largest industrial CO_2 emitter, with approximately 7% of global man-made CO_2 emissions. As a consequence of the forecast increase in demand for concrete, it is expected that by 2050 direct CO_2 emissions from the cement industry will increase by 4% globally under the IEA Reference Technology Scenario (RTS), despite an increase of 12% in global cement production in the same period.

Hitting the targets of the 2°C Scenario (2DS) despite the expected increase in global cement production requires a reduction of 24% by 2050 of the global direct CO_2 emissions from cement manufacture, compared to current levels. This represents a cumulative emissions reduction between now and 2050 of 7.7Gt of CO_2, compared to the RTS.

The outlined transition for this scale of reduction is ambitious, and the changes must be practical, realistic and achievable. With that purpose in mind, and building on the same successful partnership as for the 2009 exercise, the European Cement Research Academy (ECRA) provided essential input to the development of the Roadmap, including the development of related technical papers, which contain the description of energy saving and CO_2 reduction technologies, their costs in typical future cement plants, their level of energy saving and CO_2 reduction potentials, boundaries and limitations, and the timeline for implementation. 52 technology papers as well as seven so-called state-of-the-art papers summarise the expected development in the major technological fields, as follows:

- Improving energy efficiency: deploying existing state-of-the-art technologies in new cement plants and retrofitting existing facilities;
- Switching to alternative fuels (fuels that are less carbon intensive than conventional fuels): promoting the use of biomass and waste materials in cement kilns to offset the consumption of carbon-intensive fossil fuels;
- Reducing the clinker to cement ratio;
- Increasing the use of blended materials and the market deployment of blended cements.

Using emerging and innovative technologies that:

- Contribute to the decarbonisation of electricity generation by adopting excess heat recovery technologies;
- Support the adoption of renewable-based power generation, and;
- Integrate carbon capture into the cement manufacturing process for long-lasting storage.

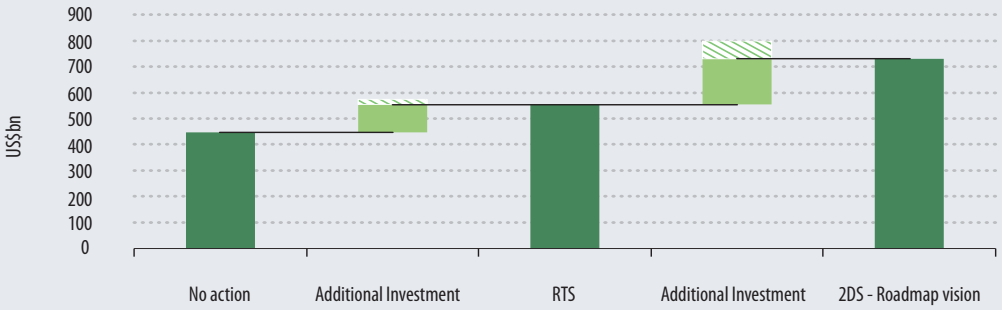
The RTS already integrates a considerable shift in terms of energy and CO_2 emissions reductions in the cement industry, in response to already implemented and announced policies and pledges. For instance, the thermal energy intensity of clinker is reduced by 8% and the electricity intensity of cement is reduced by 9% by 2050 below current levels in the RTS globally. The contribution of fossil fuels to the global cement thermal energy mix drops by 12% in the same period.

Right - Figure 2: Overall cumulative investment needs by scenario by 2050.
Source: *CSI-IEA Technology Roadmap: Low-Carbon Transition in the Cement Industry*, 2018.

Net additional cumulative investments high-bound cost

Net additional cumulative investments low-bound cost

Overall cumulative investment



Note: Net cumulative additional investment numbers are assessed considering low- and high-bound sensitivity ranges for specific investment costs. Overall cumulative investments displayed in the above graph refer to the low-bound cost range.

Key Message:
US$107-127bn is estimated as cumulative additional investments to realise the RTS globally, which would need to increase to US$176-244bn to implement the 2DS roadmap vision.

The global clinker to cement ratio remains stable over time, despite a drop in the amount of low clinker factor cement made in China. The RTS considers that pilot testing and feasibility studies on integrating carbon capture technologies in the cement industry would translate into a modest deployment in the long term, with carbon captured emissions representing 3% of the total generated CO_2 emissions in the cement sector globally by 2050.

The transition of the cement industry can only be attained with a supportive regulatory framework and effective and sustained investments. The Roadmap outlines these policy priorities and regulatory recommendations, assesses financial needs, discusses investment-stimulating mechanisms and describes technical challenges with regards to research, development and demonstration needs and goals.

Realising the RTS alone would incur cumulative additional investments of US$107-127bn by 2050, compared to a situation where the current energy and CO_2 emissions footprint of cement making remain unchanged. This effort is equivalent to 24-28% of the total cumulative investment estimated to sustain global cement production over that period at current performance levels.

However, US$176-244bn of additional global investment is estimated as necessary to implement the 2DS cumulatively by 2050 compared to the RTS. This represents 32-43% of the total cumulative investment estimated to realise the RTS! Governments, in collaboration with industry, can play a determinant role in developing investment risk-mitigating mechanisms that will unlock private finance in areas with a low likelihood of independent investment but are important in the sustainable transition.

The bulk of the estimated global cumulative additional investments in the 2DS, compared to the RTS, would occur in the period post-2030. This highlights the strong market deployment needs of new processes in the second half of the modelling horizon to realise the vision of the Roadmap. It also demonstrates the urgency of the need to focus on related demonstration projects prior to 2030, to ensure technologies can reach commercial readiness early enough. While increasing cement demand poses a greater challenge in reducing CO_2 emissions to achieve the vision, the installation of new cement capacity creates opportunities for integrating state-of-the-art technology in an advantageous situation compared to revamping projects.

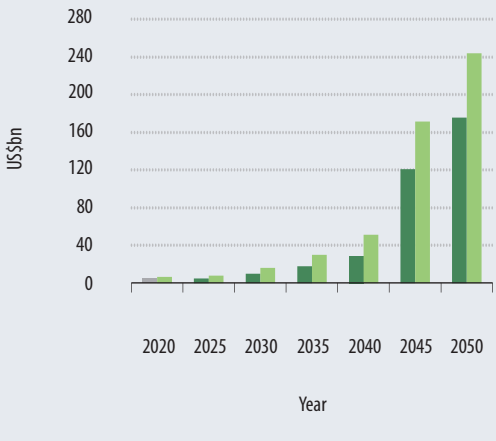
While this Roadmap focuses on cement manufacturing, the IEA and CSI recognise the need to consider CO_2 emissions reductions over the overall life cycle of cement, concrete and the built environment by working collaboratively along the whole construction value chain. For instance, by optimising the use of concrete thermal mass benefits in construction or by maximising the design life of buildings and infrastructure, major additional CO_2 emissions savings can be realised. The significant net positive impact of re-carbonation, whereby up to 25% of CO_2 is re-carbonated in the cradle-to-cradle scenario of a concrete-built structure,[1] is also not covered in the scope of the Roadmap.

Key Message:
The bulk of the 2DS global cumulative additional investments occurs after 2030.

Right - Figure 3: Global cumulative additional investments in the roadmap vision (2DS) compared to the RTS, based on the low-variability case by 2050.
Source: *CSI-IEA Technology Roadmap: Low-Carbon Transition in the Cement Industry*, 2018.

High-cost bound

Low-cost bound



1. *'Substantial global carbon uptake by cement carbonation,' Nature Geoscience,* Vol 9, pp. 880–883, **21 November 2016**.

Here *Global Cement Magazine* presents its monthly review of global cement prices, in US$ for easy comparison. Additional price information is only available to subscribers to *Global Cement Magazine*. Subscribe on Page 96. In this issue subscribers receive information from eight more countries, including Pakistan, China, Kenya and Uganda.

Prices are for metric tonnes (Mt), unless stated otherwise. US$ conversions from local currencies are correct at the time of original publication.

India: Cement became more expensive in Andhra Pradesh and Telangana in early April 2018, with producers citing a rise in input costs. Industry insiders say the price hike will not have any adverse impact on the government projects as companies have already promised to supply cement at subsidised prices to all government works.

M Ravinder Reddy, Director-Marketing, Bharathi Cement, told The Hans India that prices had increased by US$0.30-0.46/bag. "Some said that we increased prices by up to US$1.00/bag, but that's not true. The increase varies from market to market, but it's not more than US$0.46/bag. We have no other option except to increase the price as prices of coal, fuel and other input materials have gone up significantly,"

This assertion was countered by claims from real estate developers in Hyderabad, which claimed that prices had risen from US$4.27/bag to US$5.33/bag, a rise of well over US$1.00/bag. They alleged that cement companies in the two states have formed a cartel and enhanced the prices.

Meanwhile, an internal analysis conducted by Indian brokerage firm Nirmal Bang Institutional Equities showed that landed cost of petcoke will increase by around 6% overall after a recent increase in import duty from 2.5% to 10%. Petcoke is an important fuel for the Indian cement sector.

The Gambia: Cement Companies in The Gambia, have denied having any hand in the price hike of cement in the market. Both Gacem and Salam expressed 'surprise' on the exorbitant price of cement at the market. Gacem's Betty Njie reiterated that it is selling cement for US$5.48/bag (50kg) from its outlets and does not understand why traders are selling cement at US$6.32-6.74/bag.

Egypt: Ordinary Portland Cement prices as of 17 April 2018: Arabian Cement (Al Mosalah) = US$52.96/t; Arabian Cement (Al Nasr) = US$50.86/t; Building Materials Industries (Altaamir) = US$52.44/t; Elnahda Cement (Al Sakhrah) = US$ 51.43/t; Wadi El Nile Cement = US$52.16/t; Medcom Aswan Cement = US$49.17/t; Lafarge (Al Makhsous) = US$52.56/t; Suez Cement = US$52.16/t; Tourah Portland Cement = US$53.57/t; Helwan Cement = US$53.57/t; Misr Beni Suef = US$ 52.74; El Sewedy Cement = US$52.74/t; South Valley Cement = US$51.61/t; Misr Cement Qena = US$51.33/t.

White cement prices as of 17 April 2018: Sinai White Cement (Super Sinai) = US$113.00/t; ; El Menya Cement - Super Royal = US$111.30/t; Menya Helwan Cement = US$114.13/t.

Blended cement prices as of 17 April 2018: Helwan Cement - Alwaha = US$49.04/t. Sulphate-resistant cement prices as of 17 April 2018: Lafarge - Kaher Albehar = US$55.37/t; Suez Cement (Al Suez Sea Water) = US$54.24/t; El Sewedy Cement = US$54.80/t.

Bangladesh: The price of cement increased by US$0.18-0.24/bag (50kg) in the week to 30 March 2018. Crown Cement was being sold at US$5.06/bag, Fresh Cement at US$4.94/bag, Ruby Cement at US$5.00/bag, Akij Cement at US$5.12/bag, Shah Cement (special) at US$4.82/bag, Premier Cement at US$4.58/bag, Holcim Cement at US$5.18/bag, Supercrete Cement at US$4.82/bag and Scan Cement at US$5.18/bag.

Do you have your finger on the cement price pulse where you are?
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The ever-shrinking clinker factor: Threat or opportunity?

Robert McCaffrey Editorial Director, ***Global Cement Magazine (rob@propubs.com)***

The interview by *Global Cement Magazine's* editor Peter Edwards with the president and CEO of the US Portland Cement Association on page 56 throws up some interesting points. Among them is the suggestion that cement and concrete are battling other building materials - notably wood - on a new front: that of sustainability. If you accept that we need to reduce our impact on the planet (who doesn't?), then we really need to improve our sustainability and to 'go green.'

Wood looks 'green.' In its former life, as a tree, it actually was green, at least in colour. During its lifetime, a tree takes CO_2 from the atmosphere and by the near perfect process of photosynthesis (only recently 'improved' by scientists[1]), using sunlight, makes water, sugar and oxygen,[2] sequestering CO_2 in its cells. There are around 3 trillion trees on the planet, or around 420 for each person.[3] If each tree weighs 10t on average, or 5t on a dry weight basis, that's a lot of carbon sequestration in total. However, that's strictly a temporary sequestration, since the carbon sequestered is rapidly given up when the tree dies and rots. Wood used in construction is, again, just a temporary sequestration of carbon. Wood used in construction looks nice, but it's not the whole story.

Cement, on the other hand, is guilty of negative sequestration: The CO_2 that was formerly bound up in the $CaCO_3$ that makes up limestone has to be liberated during the production of Portland cement, to make the CaO that is the ultimate basis of clinker. CO_2 liberation from Portland cement clinker manufacturing is something that cannot be avoided.

However, that is not the whole story. Clinker is only one of the ingredients in cement, and cement is only one of the ingredients of concrete - the ultimate product of our industry. To reduce the amount of CO_2 that is produced during the production of concrete, we can reduce the amount of clinker in the cement and/or reduce the amount of cement in the concrete. For people who are in the business of selling cement to make concrete, this does not sound like a great choice.

The cement industry and the concrete industry are really in the business of sticking things together and making things that last (and that have a wide variety of other desirable attributes as well, including resilience, strength, low labour cost, low material cost, attractiveness, durability, high thermal mass etc). The cement industry would rather use cheaper ingredients in its cement than costly (and polluting) clinker, if the cement has the same properties. So, to come to the theme of this 'Last Word,' is a reducing clinker factor (the amount or percentage of clinker that is used in cement) a threat or an opportunity for the global cement industry?

Of course, there are threats and opportunities of reducing the clinker factor, but I think that the opportunities vastly outweigh the threats. For instance, threats from a decreased clinker factor might include:

- Scarcity of alternative materials with cementitious properties (granulated blastfurnace slag, quality flyash, natural pozzolans);
- Transport costs for supplementary cementitious materials (SCMs) compared to local materials;
- SCM preparation costs (primarily grinding);
- Any loss of performance and possible reputational damage for subsequent material failures;

... but opportunities might include:

- Lower costs of SCMs compared to clinker;
- Better grindability of SCMs compared to clinker;
- Improved cement performance (particularly when using additives) compared to OPC;
- Vast stockpiles of potentially usable SCMs;
- New SCMs on the horizon (Feeco's suggestion of using red mud, for example[4]);
- Greater sustainability in cement production.

As seen on page 53 of this issue, a cement plant in Cuba is to start to produce LC3 ('limestone calcined clay cement') cements. LC3 cements[5] have a clinker factor of only 50%, with the rest being 30% calcined clay (metakaolinite), 15% limestone and 5% gypsum. As the promoters of the technology state, producing LC3 cement 'does not require capital intensive modifications to existing cement plants' and produces binders with the same performance as OPC. There are other options out there for lowering the clinker factor and every possible replacement material for clinker is cheaper than clinker. What's not to like?

The environmental impact of concrete - already one of the 'greenest' building materials by weight - can be further reduced as well. As seen on page 68 of this issue, CO_2 can be recycled back into concrete, increasing its strength and reducing the requirement for cement. Discuss!

1 https://www.technologyreview.com/s/608535/to-feed-the-world-improve-photosynthesis/

2 https://en.wikipedia.org/wiki/Photosynthesis

3 http://www.bbc.co.uk/news/science-environment-34134366

4 http://feeco.com/sustainability-in-industry-employing-red-mud-in-construction-materials/

5 https://www.lc3.ch

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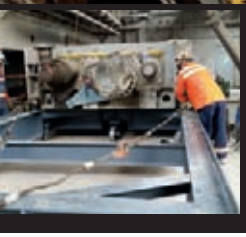
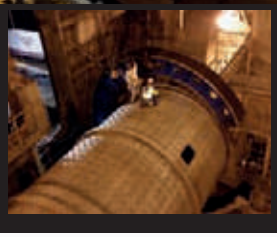

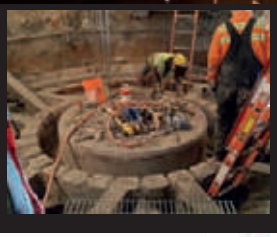
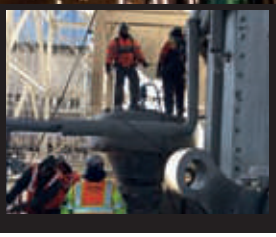
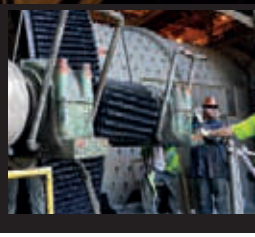

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