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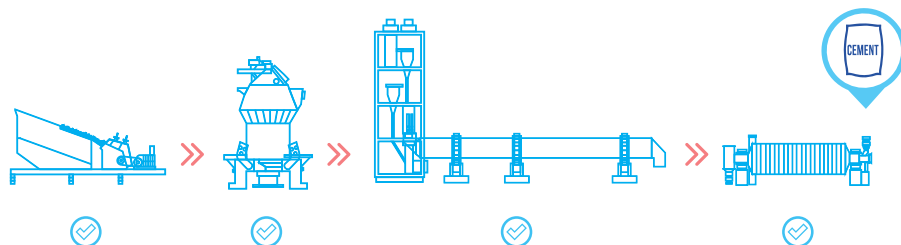
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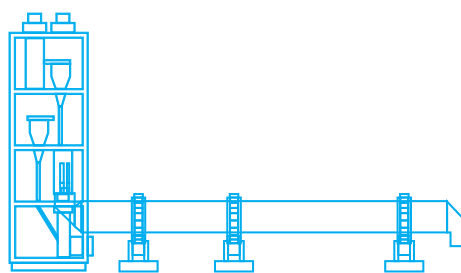
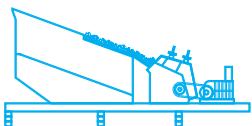


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ISSN: 1753-6812

Published by Pro Global Media Ltd
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Dear readers,

Welcome to the May 2019 issue of *Global Cement Magazine* - the world's most widely-read cement magazine! This issue will be distributed to delegates at the forthcoming *IEEE-IAS/PCA Cement Industry Technical Conference* in St Louis, Missouri, US, on 28 April - 2 May 2019. Accordingly, these pages are brimming with US-related content, including revealing interviews with PCA President Mike Ireland (Page 66) and Chief Economist Ed Sullivan (Page 70). There's also our look at recent events in the US and Canadian cement sectors (Page 80), as well as a report on the exceptional LafargeHolcim Ste Genevieve plant, which will be visited by IEEE delegates after the conference itself (Page 74).

They say the US does everything 'bigger and better' and the Ste Genevieve plant goes all out to prove that point. Built for an eye-watering US\$1bn, it produces nearly 4Mt/yr of cement from one of the largest kilns anywhere in the world. As currently configured, its raison d'être is to continuously produce CEM I as efficiently as possible. Even without alternative fuels, the plant's CO₂ emissions per tonne of cement are around 20% lower than the US average, due to engineering-based economies of scale. The plant's reach within the US and Canada is also unrivalled.

In his thought-provoking article on the cement sector in 2050 (Page 10) Robert McCaffrey suggests that the Ste Genevieve plant could be a sign of things to come for the cement sector: Huge, highly-efficient and strategically-located clinker plants that are capable of covering a wide area. Indeed, a trend towards regional grinding plants has already been observed in several countries. This wide-ranging article looks at the demographic, economic and environmental factors that will come to bear in the cement sector over the next 31 years... and how the sector will respond.

Elsewhere in this issue, we carry interviews with the renowned vertical roller mill supplier Gebr. Pfeiffer (Page 20) and the automation and monitoring expert SICK AG (Page 28). There are also features on: Gears (Page 19), Maintenance (Pages 26 & 38), Refractories (Page 40) and, to tie in with the *Global FutureCem Conference* in May 2019, cement manufacturer Cementir's FUTURECEM project (Page 44).

Global Cement looks forward to meeting contacts old and new at both *FutureCem* and the *IEEE* conference. If you are attending in St Louis, come and say 'Hi' at Booth #128!

P Edwards

Peter Edwards
Editor

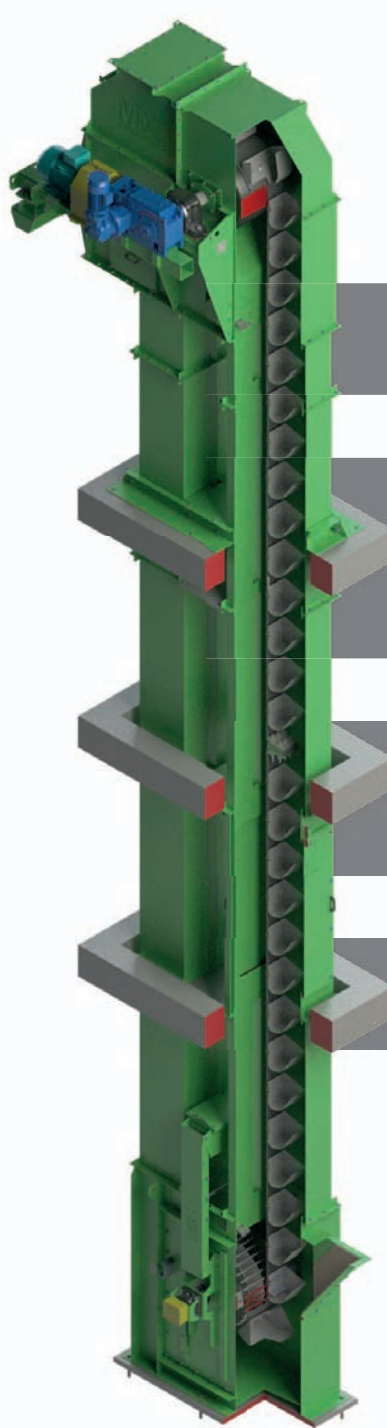


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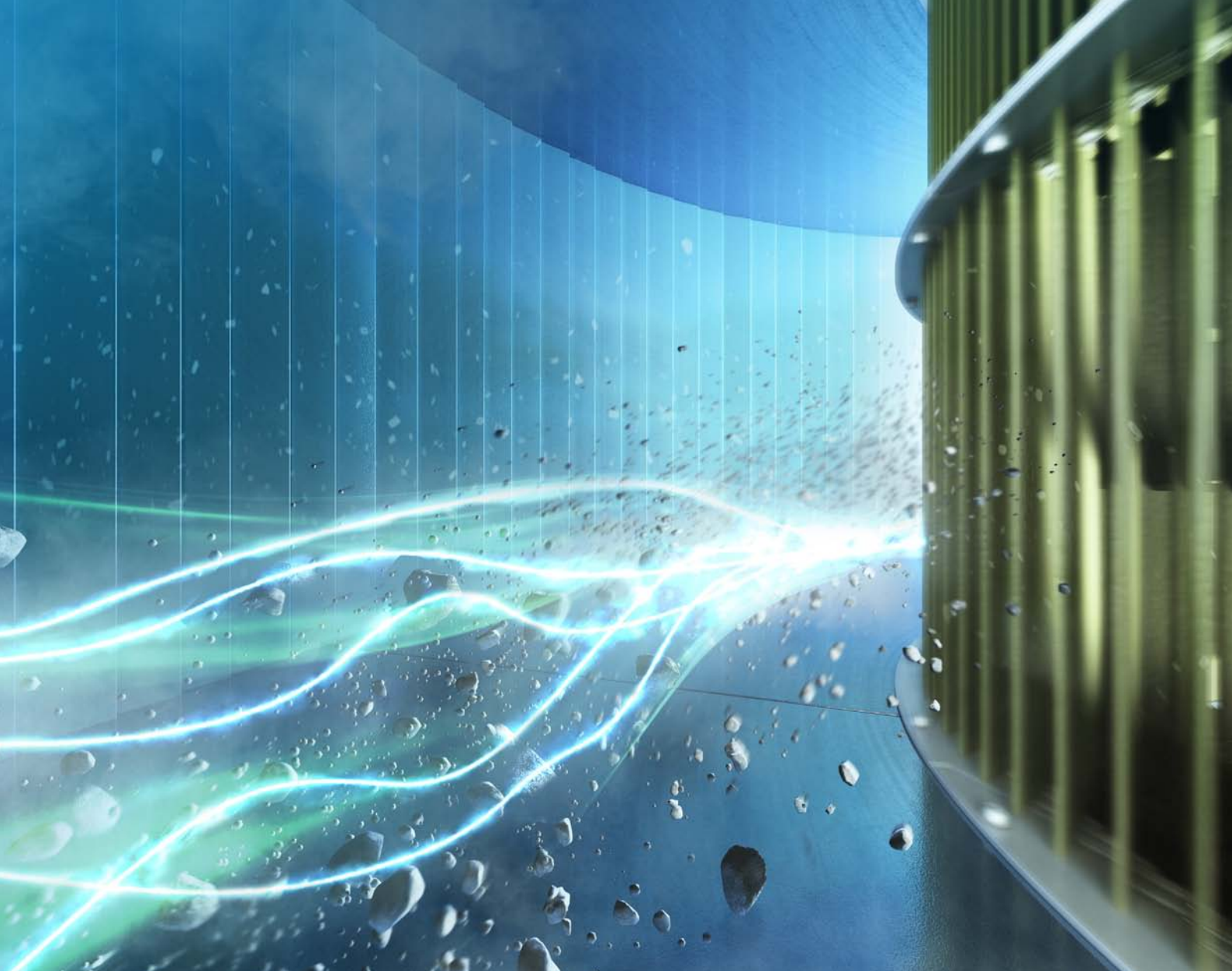
K 2019
16-23 October 2019, Düsseldorf, Germany
www.k-online.com

16th NCB International Seminar on Cement, Concrete & Building Materials
3-6 November 2019, New Delhi, India
www.ncbindia.com

24th Arab-International Cement Conference & Exhibition
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Robert McCaffrey, *Global Cement Magazine*

The global cement industry in 2050

Some things never change, but in the years to 2050, we can expect profound shifts in societies, demographics, technologies, business and the environment. All of these factors will have huge effects on the cement and concrete industries. Using data from a wide variety of sources, here I give some suggestions on how the global cement industry will look in 2050.

The global cement industry will respond over the next three decades to some of the most momentous shifts in humankind's history. Populations will have increased from 6bn in 2000 to 9.7bn in 2050, while global urbanisation rates will increase from 47% in 2000 to around 66% by mid-century. Global GDP was US\$33tn in 2000 but will have grown to nearly US\$140tn by 2050. The world is rapidly ageing: 7% of the world's population was 65 or older in 2000 (420m people), but in 2050 it will be 17% (1.6bn people).

These statistics offer the global cement industry some of the greatest opportunities in its history. At the same time, the industry faces great challenges: it uses expensive energy to create a product with high emissions of CO₂, in an increasingly carbon-constrained world; it makes its product in highly capital-intensive factories in a sector with chronic over-capacity and decreasing barriers to entry.

I suggest in this article that the global cement industry will evolve into a more global, integrated, energy-optimised, lower- or no-carbon, increasingly automated business over the next three decades and beyond.

The unchanging future

Some important things will not change between now and 2050.

Human nature in all its forms will not significantly change: To a greater or lesser extent, we will all show greed, fear, laziness, ambition, ignorance, learning, kindness and many other attributes that go to make up human nature. However, figures suggest that we as a species are becoming less violent and that wars are becoming less prevalent.

Balance sheets and business will not change: It's never 'different this time.' Successful businesses will get three things right: They'll make things that people want to buy; they'll bring in more than they spend; They'll have money to spend when they need it. A loss will always be a loss and a profit a profit. No business can afford to make a continuing loss.

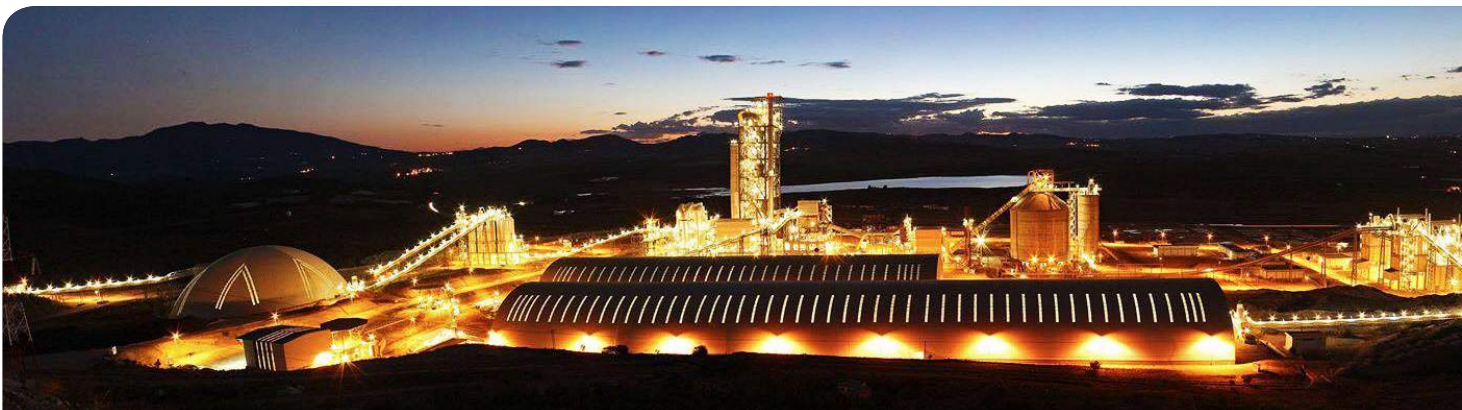
Markets will always be imperfect. Some things will be expensive, some things cheap. Some things will offer good value for money, and some things will not. Think of an iPhone or a tonne of concrete. Which offers the best value for money?

- Basic physics and chemistry will not change.
- Maths will not change.
- Our physiology will not change.

People will still eat and sleep, they will digest (and the rest) and they will procreate. They will be born, grow up and will age. They will move from place to place. Some will get ill and some will get better. However, we will all die, eventually. These things will not change.

Below - Figure 1: A modern cement plant: Carthage Cement, Tunisia.

Source: Amine Abdelkhalek, entrant to the *Global Cement Photography Competition*.



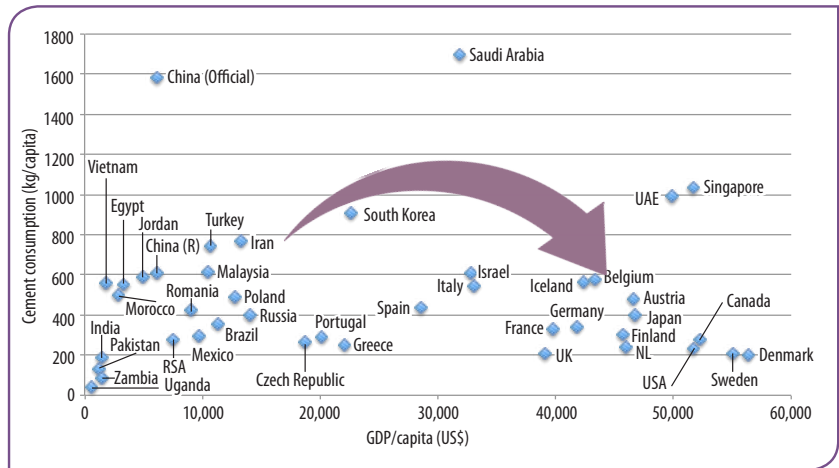


All of these unchanging things have had and will continue to have a profound effect on the cement industry. Human nature will still drive people to live in safe and comfortable surroundings, and to provide security and a healthy environment for their children. Cement and concrete can help. Human nature will drive people to innovate and so technology, including for the production of cement, will continue to become more efficient.

Concrete provides a value-for-money solution to a number of different problems that boil down to a need for immediate and then long-lasting bulk compressive strength. People are prepared to pay for that solution, especially since it offers better value-for-money than currently available substitutes. Cement companies can supply cement, the basic ingredient of concrete, at a profit, and so they do.

People need/want hospitals, schools, roads, houses, railways, energy (production/transmission), bridges, shops, offices and working areas, sewage and waste-water treatment facilities, and other infrastructure, and they always will. Concrete is a suitable material for building large proportions of these facilities. These things wear out eventually, and have to be replaced or renovated. Whether for building or replacement, concrete will be used.

Peak per-capita cement consumption comes as countries transition from rural to urban societies, and as urban infrastructure is progressively built (Figure 2). As countries modernise and urbanise, their cement consumption has historically increased from around 100kg/capita in rural populations, to a peak of around 1500kg/capita/yr, before slipping back to the long term average for developed countries that sporadically build new infrastructure but mostly just renovate, of around 500kg/capita/yr. There is no strong reason to believe that this historical and global trend will change. This evolution from undeveloped/rural nation through developing nation to developed nation status is happening worldwide, and gives a strong pointer for future concrete consumption.



However, clinker \neq cement \neq concrete.

Future changes

It is difficult to make predictions, especially about the future. After all, although there is but one present, there are infinite possible futures (Figure 3). However, we can be sure of the boundary conditions of the future since some changes are already either unavoidable, or already underway:

- Demographic changes;
- Environmental changes;
- Economic and societal changes;
- Technological changes.

Demographic change

On the day I was born, in June 1967, there were 3,362,920,394 people on the planet. Today there are twice as many, 7.7bn, increasing by 82m per year. In the coming decades, Asia (including India and China) and Africa will grow dramatically in population numbers. Together, they had 4.55bn people in 2000 (820m in Africa), they have 5.9bn in 2019 (1.32bn in Africa) and by 2050 they will have a combined population of 7.78bn people, of which 2.5bn will be in Africa. The population of the USA will grow from 282m in 2000, to 330m in 2019 and perhaps to over 400m in 2050.

The 10 most populous countries in 2050 will be India, China, the US, Nigeria, Indonesia, Pakistan, Brazil, Ethiopia, Bangladesh and the Philippines. In other countries, the population will be static or falling, particularly in Eastern Europe, Russia, South Korea and Japan. Starting in around 2030, China's population will start to fall, and it will probably lose around 50m people between 2030 and 2050.

At the same time, many countries in the world will have an ageing population, most notably Japan, Spain, Portugal, Greece and Korea, where nearly 40% of the population will be aged over 65 years by 2050: Over 25% of China's population will be over 65 by the same time.

Above - Figure 2: Development of per capita cement demand (kg/capita) with increasing wealth (GDP in US\$/capita).



It has been said that if the 1900s were the American Century, then the 2000s will be the Chinese Century. However, by 2050, China will be in relative decline. It may turn out that the 2050s and beyond will be the African semi-century.

Environmental change

It is undeniable that the Earth's atmosphere has warmed, and this has led to many recent years being the hottest on record. Due to the amount of CO₂ that we have already put into the atmosphere, the world will continue to heat up, with a variety of environmental impacts. That will be bad enough, but possibly worse is the widespread degradation and destruction of wildlife habitats, reduction in biodiversity and of the pollution and over-exploitation of the seas. Climate change will affect increasing numbers of people around the world.

Due to political action, the price of emitting carbon/carbon dioxide in Europe has increased, from practically zero in 2000 to Euro/US\$25/t in 2019 and probably to beyond Euro/US\$50/t in 2050.

Economic and societal change

Major changes in human society are inevitable. Globalisation will continue, but China will lose some of its economic advantages as its population drops and wage inflation increases. Manufacturing may shift to Africa, to take advantage of lower wages. Global income inequality will continue but extreme poverty will decrease. Gender inequality will decrease worldwide, particularly as women continue to enter the workforce.

At the same time, literacy will increase, hand-in-hand with a global increase in urbanisation (which will grow from 47% in 2000, to 55% in 2019, and to 66% in 2050). Between now and 2050, we will probably see at least one, if not two, major recessions (possibly originating in China).

Technological change

Here are just some of the technological changes that are forecast to affect the world over the next few decades:

- Commercial fusion power;
- Continued growth of renewable energy;
- Efficient, low-cost energy storage technologies;
- General artificial intelligence;
- Self-driving cars;
- Cures for HIV, malaria, Alzheimer's, meningitis and cancer;
- Global internet usage of >90%;
- Immersive virtual reality;
- Humanoid autonomous robots explore Mars...

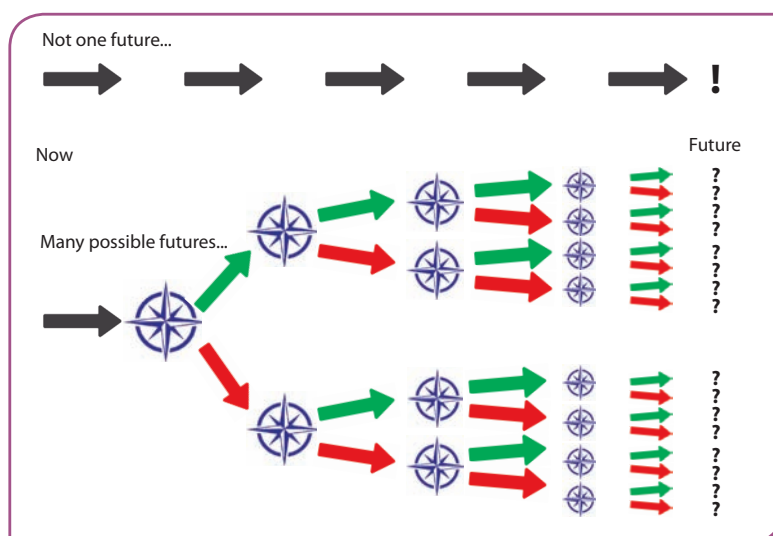
... but there will be other technological developments that we just don't see coming.

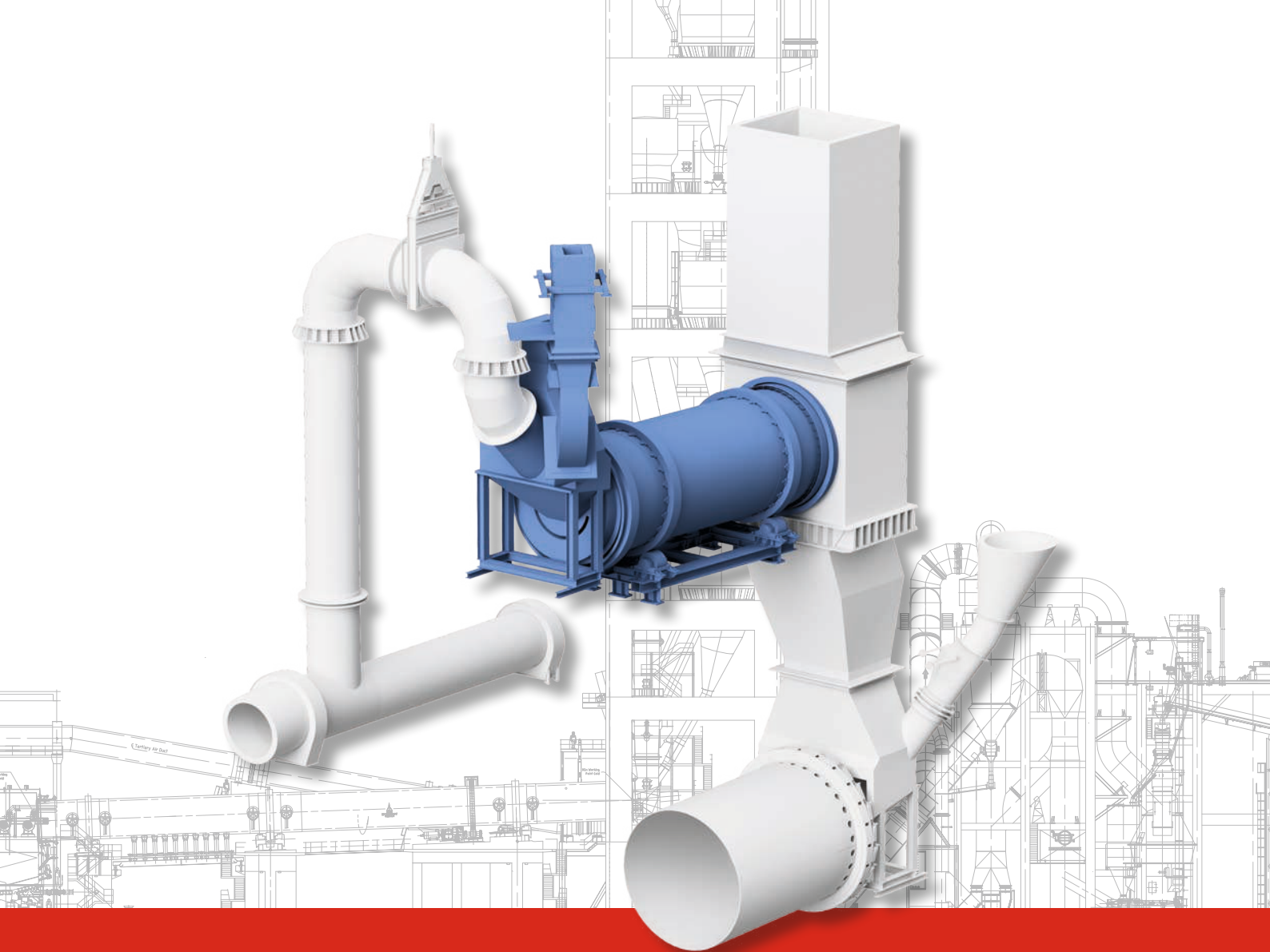
Cement industry technology change

Specifically in the cement industry, we are seeing a maturity in technology that makes it harder to achieve significant gains in energy efficiency with improved machinery.

- Vertical roller mills, horizontal roller mills and roller grinding presses have brought high levels of grinding efficiency (in terms of specific energy consumption) to raw meal milling and clinker grinding;
- Improved designs of separators, cyclones, fans and burners are moving process gases ever-more efficiently;
- Multi-stage, multi-string, preheater, precalciner pyro-systems with efficient coolers and waste heat recovery are reducing energy consumption towards the theoretical minimum heat input for clinkerisation (best available technique (BAT) levels for new plants and major upgrades are 2.9-3.3GJ/t clinker, compared to the theoretical minimum of 1.6–1.85GJ/t clinker). Practical and cost considerations mean that efficiency is nearing a plateau;
- Clinker grindability factors are better understood and are being optimised to reduce grinding energy requirements;
- Increased automation and digitalisation in factory operation (including improved sensor strategies, remote diagnostics, big data analysis (including AI-analysis of unstructured data such as images and video), virtual equipment and plants, computed strength development, widespread in-house use of CFD and intelligent control systems (based first on 'knowledge capture' and then on machine learning) will lead to stabilised and optimised systems and further efficiency gains in clinker production;
- The emphasis on 'digitalised' cement production (with some plants now being operated remotely and by AI) will mean that cement plants will be increasingly sensitive to digital disruption: worms, trojans, viruses and malicious hackers are potentially company-destroying problems. Cyber security will become a critical priority for cement plants in the future;

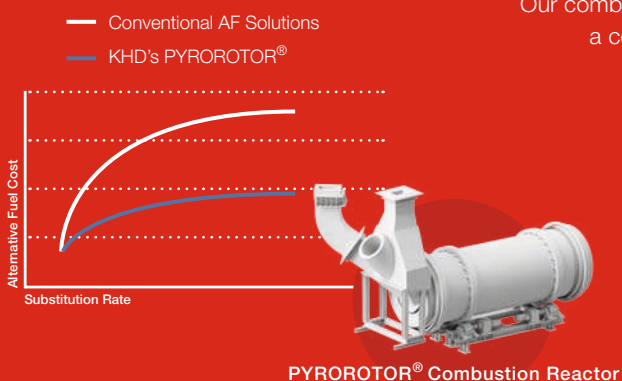
Below - Figure 3:
There are infinite possibilities
for the future - depending
on our decisions and choices
from now onwards (cf Brexit).
Diagram after
Lloyd Walker.





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- Where expensive and fallible workers can be replaced by automation, they will be;
- There will be an increased emphasis on 'high tech' clinker production, with progress perhaps directed by information engineers, working with mechanical, chemical and electrical engineers.
- High-tech cement will use a variety of today's emerging technologies:
 - Solar or electric heating;
 - Indirect firing with carbon capture;
 - 100% use of zero-CO₂ (biomass-based) alternative fuels;
 - Lowest-possible CO₂-emitting raw/recycled materials;
 - Optimised clinker grindability for lowest specific grinding energy;
 - Ultra-high-strength clinker/cements.

The end-point will be an autonomous factory that produces the exact amount and type of cementitious binder, with lowest possible CO₂ emissions, upon a remote command, without human intervention - a kind of 'Autocem plant.'

Cement sector changes to 2050

Technological changes in the cement industry (production efficiency, automation) will continue, as outlined above. However, it is at the intersection of demographic, environmental, economic, societal and technological changes that the cement sector will see the most change in the years to 2050;

- Capital costs for new production capacity have dropped due to the entry of Chinese engineering companies into international markets: Barriers to entry for potential new cement producers are now lower than ever;
- There is currently a global overcapacity crisis - with too much clinker chasing too few buyers and

widespread uneconomic low production capacity utilisation (Figure 4);

- Some of this overcapacity may be taken up through demand growth (for example in Africa), but companies have an ongoing tendency to build too much capacity in order to protect market share.

• Countries that are suggested to transit from developing to developed status by 2050 include: Argentina, Chile, China, Costa Rica, Croatia, Hungary, Iran, Kazakhstan, Latvia, Lithuania, Malaysia, Panama, Poland, Romania, Russia, Saudi Arabia, South Africa, Thailand, Turkey, UAE, Uruguay;

• As more and more countries become mature, they will morph into 'renovation mode' - and their cement demand will drop by 30-60%;

• There are far too many 'legacy' cement plants. Too many are too small, too polluting, too inefficient: In an ongoing trend, they will be closed (or turned into grinding plants and/or distribution terminals);

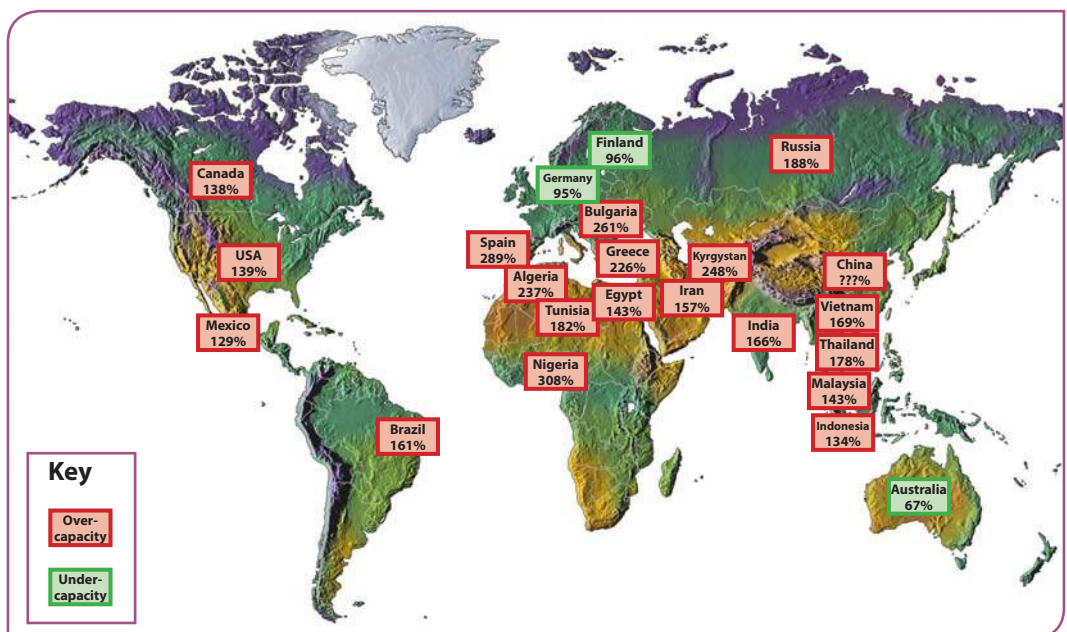
• Cement companies got 'burned' in the financial crisis, finding themselves with too much debt: They are in a decades-long process of 'deleveraging' (paying back debt). For example, LafargeHolcim aims to pay down its debt to achieve two times or less 'Net Debt to Recurring EBITDA ratio' by the end of 2019. During deleveraging, less money is available for capital projects, jobs and maintenance;

• New 'greenfield' cement plants are essentially now 'off the menu';

• Fast-payback projects such as using alternative fuels and the use of waste heat recovery for electric generation will become even more widespread;

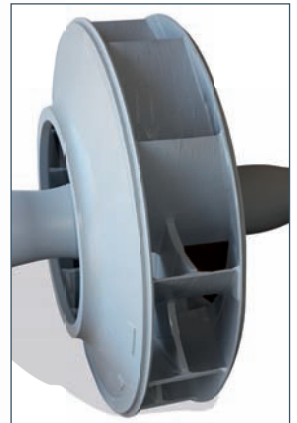
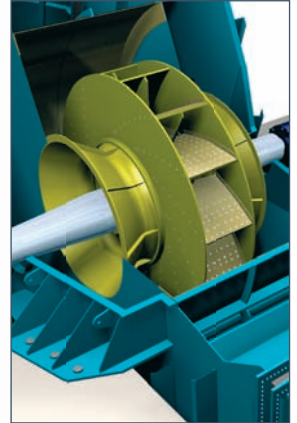
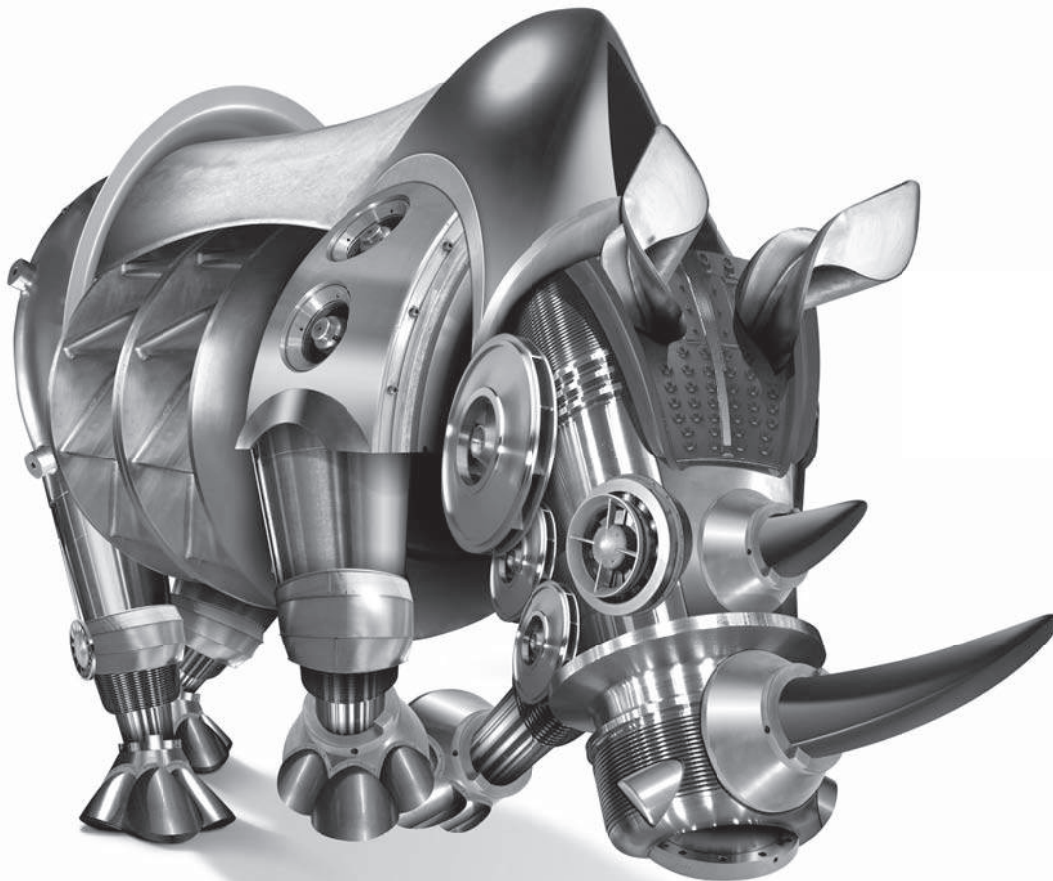
• Legacy clinker production will be concentrated into large, modern, efficient and relatively non-polluting 'mega-factories,' ideally with good transportation connections (a good example being

Right - Figure 4: Global cement market overcapacity: Cement production capacity expressed as a percentage of each country's cement demand in 2018. Figures from *Global Cement Directory 2019*.



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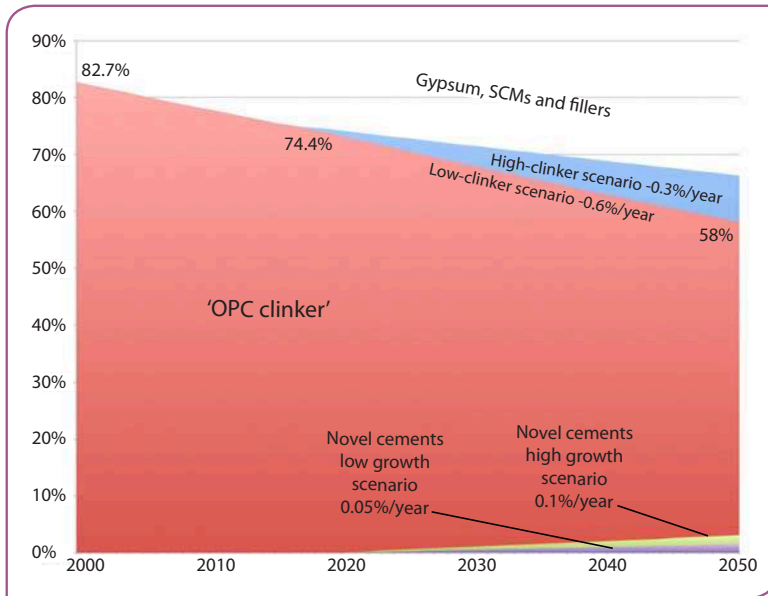
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Above - Figure 5: Global clinker factor trends, 2000-2050. The high-clinker scenario sees the clinker factor decreasing by 0.3% per year, whereas the low-clinker scenario sees its current trend of a reduction of 0.6% per year continuing. Novel cement growth scenarios range from 0.05% market share growth per year to 0.1% market share growth per year.

the 12,000t/day LafargeHolcim Ste Genevieve plant on the Mississippi River) - See Page 74).

- New high-tech cement plants may be built for low- or zero-CO₂ production;
- Cement plants may find themselves under physical or cyber attack by environmental activists in the future;
- Our studies show that ownership in the global concrete industry is extremely fragmented and is ripe for rationalisation. LafargeHolcim under new CEO Jan Jenisch is busy selling non-performing cement assets in over-supplied countries and reinvesting in concrete companies;
- Vertical integration (cement-aggregates-concrete) will continue: There is more synergy (profit) to be gained from optimising the cement-concrete business than from just efficiency gains from the cement industry alone;
- Given the rapidly escalating cost of carbon emissions, expensive and polluting clinker production will become less profitable;
- Cheaper low- or no-CO₂ substitutes for clinker will increasingly be used (including novel cements, fillers, blends etc) (See Figure 5);
- Iron and steel slag and coal-fired power-station flyash have their own associated CO₂ emissions, so that with increased demand (for use in low-clinker-factor cement) and reduced supply (due to the rise of Electric Arc Furnaces and the progressive demise of coal-fired power stations), slag and flyash costs will dramatically increase.
- The increasing cost of clinker will strongly spur the cement-concrete industry towards innovation in mix design and use.
- Cement-concrete companies will become 'mix-agnostic' - not favouring clinker over other functional ingredients - as the clinker production part of their business becomes less profitable.
- Development of additives and ultra-fine cement

grinding may result in reduction of the cement content of concrete;

• There will continue to be innovation in the properties of clinker/cement-based concrete, including:

- Self-diagnosing concrete;
- Self-repairing concrete;
- Carbon-storing concrete (eg: Solidia);
- Thermal insulating concrete;
- Heat-conducting concrete;
- Permeable concrete;
- Lightweight concrete;
- Light-transmitting concrete;
- Translucent concrete;
- Light-emitting concrete;
- Electricity-storing concrete;
- Ultra-high strength concrete (>100MPa);
- Glass-fibre reinforced concrete.

• There will be a clearer focus on lifetime emissions from buildings: Although clinker may be CO₂-intensive, low-clinker cement, and low-cement concrete is less-so. Due to thermal inertia, building durability and 'insulatability,' concrete may still be chosen over alternative materials (such as wood, steel, glass and plasterboard). We await the figures to prove that buildings based on concrete have lower lifetime emissions compared to other building materials.

• Alternatives to traditional cement and concrete will continue to be developed, including alkali-activated cementitious material (AACM) (using a high percentage of GGBS, e.g. Cemfree); geopolymer cements (alkali-activated metakaolin, e.g. banah UK); geopolymer/concrete hybrids (e.g. C-Probe);

• Concrete will continue to compete in an intense struggle for market share with its potential substitutes in a range of applications, including asphalt, plasterboard, bricks, timber, steel, glass, aluminium and others.

• Concrete will continue to be used when it is the cheapest suitable material: Other materials will be used when they are the cheapest suitable material.

Caveats

All of the future-looking statements in this article presuppose that nothing untoward occurs in the years to 2050 that affects regional or national economies, apart from the previously-mentioned likely global or regional recessions and environmental degradation.

However, other more-or-less likely events that could affect widespread economic development might include: global insect population collapse ('insectageddon'); Cascadian and other 'Ring of Fire' earthquakes and tsunamis; long-term trade wars; Chinese regime change; US debt default; economic and/or political collapse of the EU; pandemics; a crisis in antibiotic resistance; the global sand crisis (etc) (See Figure 6).



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Conclusions

Cement-based concrete has been providing building solutions for more than 2000 years. The raw materials to make concrete are widely available. It is cheap, durable, strong and fairly easily installed by semi-skilled labour. Huge installed bases of cement manufacturing facilities, aggregate quarrying and concrete production give the clinker-cement-concrete industrial complex an almost unstoppable momentum. However, even the largest supertanker can be turned with enough time.

If the companies that currently make clinker and cement, and which will increasingly make the concrete, decide that there is profit - or more profit - from making low- or no-CO₂ cements and low-cement concrete, then they will be likely to invest in these higher-margin business lines.

The following final predictions should be treated with caution:

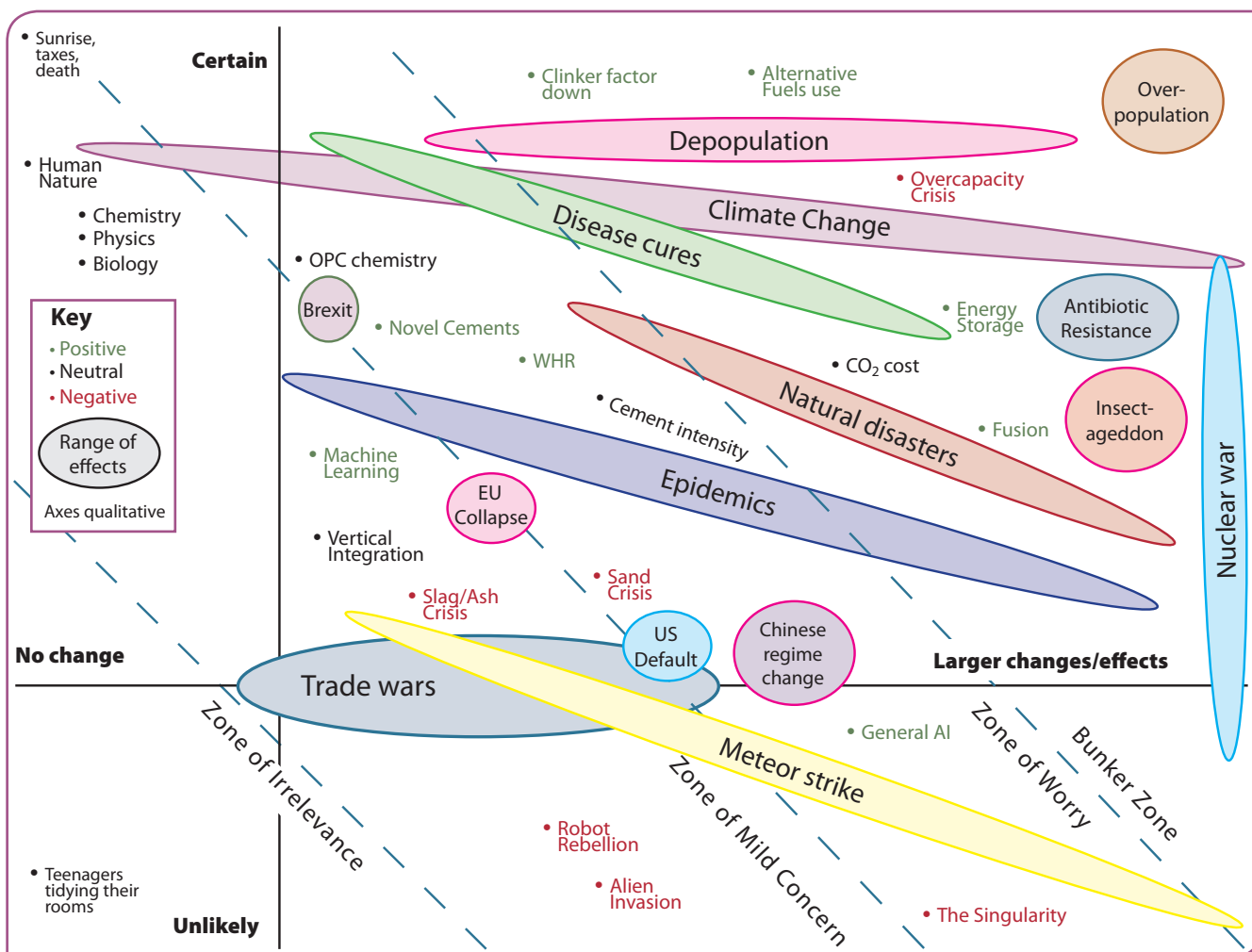
- Global population will be 9.8bn in 2050, compared with 6bn in 2000 and 7.76bn in 2019;
- The world will rapidly be ageing;
- Economic development will have shifted from west to east – but Africa will also be growing, fast;
- We will have had at least another two major recessions/bubbles/financial meltdowns by 2050;

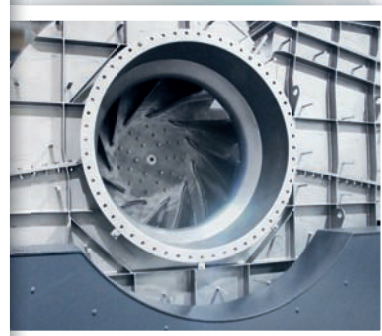
- Carbon emissions will become expensive and will be important for all calculations and decisions;
- Carbon-neutral fuels will be ubiquitous;
- Waste heat recovery units will have moved beyond Japan, India and China and will be widespread throughout the rest of the global cement industry;
- We will still make Portland clinker, but in more sophisticated and efficient ways: Novel cements will take market share from 'traditional cements';
- The number of cement plants in developed countries will halve by 2050 compared to 2000;
- Cement plant operation will be progressively automated: expect widespread levels down to 100workers/Mt of production;
- The *clinker* intensity of construction will decrease, due to the use of lower-CO₂ cements, but the *concrete* intensity of all construction will have increased due to urbanisation;
- Cement companies will be increasingly vertically integrated (cement-aggregates-concrete);
- Global clinker overcapacity will continue;
- Grinding plants will become more common;
- The price of cement will have to increase in real terms, to reflect its increased costs.

For more information please see www.Cement2050.com

Below - Figure 6:

'Disastergram/Opportunitygram,' showing all future scenarios according to their likelihood and magnitude of possible effects. Axes not to scale and opinions are the author's own.





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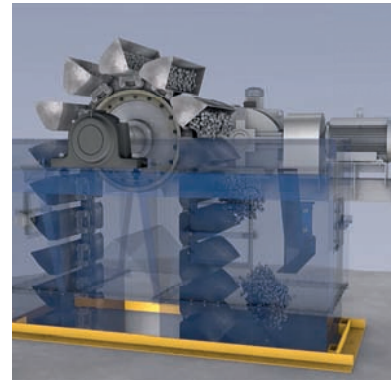
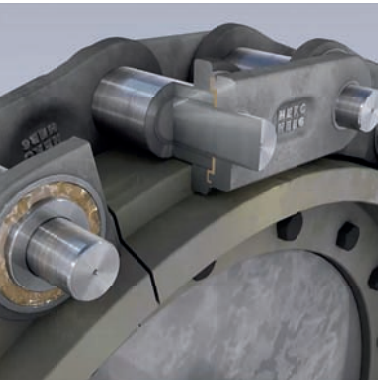
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Lukas Steiner, Wikov Industry

Added-value drives for cement mills and kilns

Wikov Industry's Lukas Steiner looks at lateral gear drives for the cement sector and the separate lubrication system that was originally developed by Wikov Gear in the Czech Republic back in 2008 and first commissioned in 2009.

In cement plants lateral gear drives (LGD) are positioned at 40° under the mill or kiln. They are side drives that save space, thanks to their position under the mill and they require simpler foundations than some other drives. The smaller foundation not only means lower capital expenditure but also it minimises the risk of critical vibrations.

LGD drives are a new chapter in Wikov's gearbox history for cement plants. However, for more than a decade a large number of Wikov Side Drive gearboxes have been in operation, to the benefit of mill operators around the world.

Side drive development

Despite the rims of conventional side drives being thoroughly sealed during installation, field experience shows that seals are far from perfect and wear very quickly. Conventional side drive gearboxes, which are open in the direction of the rim, simply get polluted by cement dust. This results in rapid wear of the gears and bearings, contamination of the lubrication oil and clogging of filters and the lubrication system in general.


Wikov has been developing its side drive technology since around 2006. The motivation behind it was to bring conventional side drives to the next level, reduce the failure rate and realise a product with innovations to the benefit of cement plant maintenance staff. Reliability and low maintenance requirements were the primary drivers. Therefore complete engineering and manufacture takes place in the Czech Republic to ensure utmost quality. Today, it is a proven attractively-priced solution that lowers the total cost of ownership.

The technical benefits of Wikov's Side Drives lie mainly in their separate lubrication system (SLS), which has two independent oil circuits. The SLS divides gearbox internals, such as gears and bearings, from the outlet pinions that are in direct contact with a girth gear and contamination by abrasive material like cement dust and other dirt.

The closed and sealed design of Wikov's Side Drives doubles the life of the gearbox internals. Sealing in the area of pinion shafts at outlets is contactless, maintenance-free and specially developed for the side drive based system.

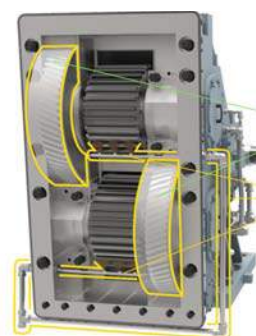
The advantage of the system is the significant increase in the lifespan of gearbox internal components, especially of bearings, which are extremely sensitive to cleanliness and lubricating oil quality. In order to achieve pure lubricating oil that fully conforms to the intended design, one would have to include in the lubrication system a full-flow filter, filtering at about 3µm. This is not realistic for practical applications. Therefore Wikov has to ensure that the lubricating circuit of the bearings and the transmissions is as insulated as possible from the external environment of the casing. The time between repairs or replacement of bearings in the new gearbox can be doubled through using the system.

The gearbox lubricating system uses two independent lubricating devices. The oil from the girth gear space is drained to the girth gear's lubricating system's tank and the oil from the separated inner space of the gearbox is drained to the second lubricating device. Each circuit uses, or can use, a different oil grade: VG320 for the gearbox and VG460 for the girth gear. High quality synthetic oil makes sense with Wikov Side Drive, as it does not become degraded by external pollution. By maintaining its original properties, the oil increases gearbox efficiency and reduces energy costs.

The side drive is designed to enable drop-in replacement for any existing drive at the cement plant, since the connecting dimensions are identical. 

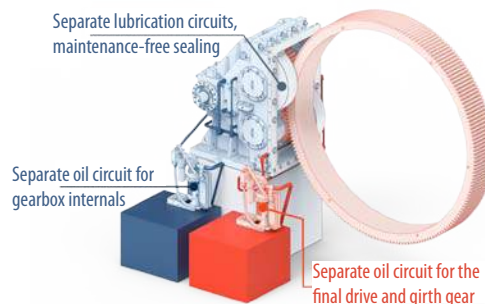


Above: A Lateral Gear Drive designed and manufactured by Wikov drives a horizontal ball mill at a cement plant in North Africa.



Separate lubrication
for extended lifetime of
gearbox internals

Smart lubrication
piping for increased
resilience and easy-to-
dismantle service



Two oil circuits: One supplies the fast rotating gearing and bearings. A second supplies oil for the output pinions and the girth gear.



Interview by Peter Edwards, Global Cement Magazine

In discussion: Mathias Dülfer, Gebr. Pfeiffer SE

Global Cement recently spoke to the Chairman of the Executive Board of the German vertical roller mill supplier Gebr. Pfeiffer about the company's corporate culture, current cement grinding trends and future trajectories...



Above: Mathias Dülfer, Chairman of the Gebr. Pfeiffer Executive Board since April 2018.

Global Cement (GC): Please could you introduce your career at Gebr. Pfeiffer and elsewhere prior to your appointment as Chairman?

Mathias Dülfer (MD): Certainly. I joined Gebr. Pfeiffer as Chairman of the Executive Board with direct responsibility for Engineering and Sales in April 2018, while my board colleague Christoph Geupel manages the commercial side. I recently completed one year at the company. Before the move to Gebr. Pfeiffer, I gained 28 years of experience leading plant machine and process engineering companies. Over the past year I have learned a lot about the cement industry, thanks to the fantastic support from the whole Pfeiffer team. I've travelled a lot and I've met a lot of great personalities.

GC: What attracted you to Gebr. Pfeiffer and what do you bring to the company?

MD: Gebr. Pfeiffer was attractive to me as a well-known dynamic and innovative producer of equipment for the cement sector. It has similarities in terms of its technical scope and approach to the companies I have previously worked for. From the other side, I think that there are some challenges for cement suppliers right now, particularly with respect to energy efficiency, CO₂ reduction and

digitalisation. I have been involved with the development of these approaches elsewhere. This experience fitted the company's needs and meant a good fit for both parties.

GC: What is the most important aspect of your role within Gebr. Pfeiffer?

MD: It is no secret that the cement market is a challenging place at the moment, which is also true for suppliers like Gebr. Pfeiffer. Therefore, my first target is to lead the company through these challenging times. In parallel, the second goal is to lay the foundations for the company to maintain our leading role in the market, also for the future. This will be achieved through further development of our technology relating to the pressing questions of the day. We'll also be enhancing our international presence, sharpening our internal processes and increasing our service portfolio.

GC: How important is the cement sector to Gebr. Pfeiffer in 2019?

MD: The cement sector represents around 80% of our annual sales, so it is very important indeed. We are dedicated to the sector and focus on offering the best solutions to our many clients. We also serve the

gypsum, limestone, clay and other sectors. The biggest gypsum mill in the world was supplied by Gebr. Pfeiffer and in 2018 we commissioned a limestone mill that can grind limestone to a fineness of 0.1% residue on 0.02mm.

GC: Which is the most difficult sector to design and build mills for?



Right: Gebr. Pfeiffer stands side-by-side with its customers. Here Pfeiffer start-up engineers support the commissioning of the MVR 6700 C-6 with MultiDrive® at the Barroso plant in Brazil.

Profile: Gebr. Pfeiffer SE

Gebr. Pfeiffer was founded by Jacob Pfeiffer in 1864 as a small machine factory in Kaiserslautern, Germany. Its first products were steam engines, mills for food production and malting equipment. However its focus soon turned to machines for the building materials industry. Already at the beginning of the 20th century, Gebr. Pfeiffer employed 500 people in Kaiserslautern and exported 75% of its machines.

Gebr. Pfeiffer sold its very first vertical roller mill in 1956, which later became a success under the MPS brand. The mill is a significant factor in its success and there are now several thousand examples worldwide. The MVR mill has nowadays replaced the MPS mills for several applications. Combined with MultiDrive® available up to 18,000kW, the MVR series has proven itself worldwide to be a highly efficient, actively redundant single-mill solution that

also reduces overall investment costs. The first was installed in 2008 and nearly 100 MVR mills for raw material and cement grinding are now in operation all over the world.

More recently the company has developed its ready2grind modular grinding system, consisting of an entire turn-key grinding plant for small to medium capacities. It is made from pre-assembled modules in containers. This enables producers to enter the cement market at a lower investment cost over a shorter time-frame. The first system was installed in Kenya in 2017.

Below: In 1925 the biggest cement mill in the world until that point leaves the company's premises. A challenge for the workers and an exciting event for onlookers!



MD: Every product has its challenges and it is not possible to say that any one material is more 'difficult' than any other. However, we do learn from handling different products and we are often able to apply the lessons learned in one sector to the others.

GC: How does the company come into contact with new clients?

MD: We are expanding internationally right now based on the mantra 'Think global, act local.' Despite our global reach, having a local presence is hugely important to us. Besides this, we organise several customer events around the world. We have an event in Beijing, China going on as we speak and next week I will be in Manila, Philippines, at another of our events. Such events provide a good opportunity not only to inform the market of our solutions but to listen to the requirements and questions of the producers that operate in different markets. We can also rely on word-of-mouth recommendation from our existing customers that are satisfied with our equipment.

It is fair to say that we are constantly in discussion with existing and potential clients. We are not interested in leaving clients 'in the dark' once they have purchased a piece of equipment from us. Our approach is about liaising with customers throughout the ownership of the equipment.

"There are more requests for clinker and slag grinding solutions, due to a reduction in the number of greenfield projects."

Around the world

Gebr. Pfeiffer's headquarters are located in Kaiserslautern, Germany, where it retains an extensive engineering workshop and sales base. Its largest overseas presence is in India, where it has sales, service, engineering, procurement and quality-control functions. A subsidiary in Miami, US, serves the North and South American markets. The company also operates subsidiaries in China, Russia, Malaysia, Egypt and Brazil, and has dedicated agents all over the world. It has a global network of fabrication partners.

The company is currently enlarging its global presence. "It's important to be in the same time zone, speaking the same language and working with the same approach as your customers," says Mathias Dülfer.



GC: What trends do you see in the cement sector at the moment?

MD: At present we are getting more requests for clinker and slag grinding solutions than for raw material installations. This is due to the reduction in the number of greenfield projects and has been observable for the past 1-2 years. Furthermore, this is connected to a trend towards smaller and mid-size mills. Within the last few months we have received lots of orders for mills with capacities of 50-70t/hr, which can easily be produced by our new ready2grind modular system, as well as those with a capacity of around 200t/hr. Other trends include requests for higher cement fineness to drive better strength. Finenesses of 5500cm²/g (Blaine) and above are required, which our technology is perfectly designed for.

Another point, which comes up more and more in our discussions, is a desire for higher automation and a shift towards 'smart machines.' To meet this need, we recently launched our advanced maintenance system GPpro. The first example is now in operation. We have implemented intelligent algorithms that allow status-controlled and pin-point maintenance, ensuring optimal equipment availability. GPpro detects early signs of wear in the seal air sealing rings in the grinding roller, in the hydraulic system as well as contamination of the hydraulic oil, to name just a few applications.

GPpro also allows users to analyse data for remote support. We are now working on the next steps of this approach because our customers will benefit greatly from the additional capabilities.

GC: So what is next?

MD: Unfortunately, I cannot talk about new innovations we may be due to launch in the near future.

However, I can say that one thing that drives us is a machine that essentially runs and optimises itself. That includes artificial intelligence that allows the machine to learn by itself to stay on top of its performance. We believe this is necessary because skilled operators will become even harder to find in the future. Last, but not least, remote monitoring will allow the company to learn about the use of our mills across the spectrum and to pass best practice into subsequent designs.

GC: Where are the most requests coming from?

MD: There is a clear trend towards developing markets for the reasons I outlined above. If anything, this is now accelerating. South East Asia has recovered particularly well following the most recent financial crisis. Whereas the Indian subcontinent, with nearly 150 mills sold, remains a strong market for Gebr. Pfeiffer, Africa is also a place where Gebr. Pfeiffer has been chosen by a good number of clients. The ready2grind option is particularly popular in all regions where smaller terminals are the right choice. Europe nevertheless remains an important market for us as well.

GC: How do Gebr. Pfeiffer and the client arrive at a final design after first contact?

MD: During the design and concept discussions, we do not like to think of the company as a machinery supplier, but rather as a consultant and partner. We seek to understand the possibilities of the client's market and the type of material they are going to work with to arrive at the best concept. Some companies, often the major players, will already know exactly what they are looking for. Others are new to the market and need competent assistance. Therefore, we offer our process design experts, test facilities, laboratories and maximum support.

GC: Can you take us through the construction and commissioning of a mill?

MD: At all times we keep the client informed so it can prepare itself for the arrival of the equipment, for example what is required in terms of foundations or steel structures. Normally this goes along with visits to the site to check that everything is in place before delivery. From the signing of the contract to delivery takes around six to nine months for a small to mid-size mill. For larger mills it is more like 10-12



Right: A Gebr. Pfeiffer MVR mill, the largest cement mill in Australia, has been operating since 2014.

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months. All equipment is delivered as pre-assembled as possible.

During commissioning, at the very least there will be supervision from Gebr. Pfeiffer's engineers. If a client requests a full engineering, procurement and construction (EPC) service, we can also provide this. After installation and commissioning, we will stay on site to optimise the equipment. Afterwards, we stay in close contact with the client for the lifetime of the mill.

Right: A training session at Gebr. Pfeiffer's latest ready2grind installation in Costa Rica.

GC: Is the current consolidation seen in the cement sector an opportunity or a threat?

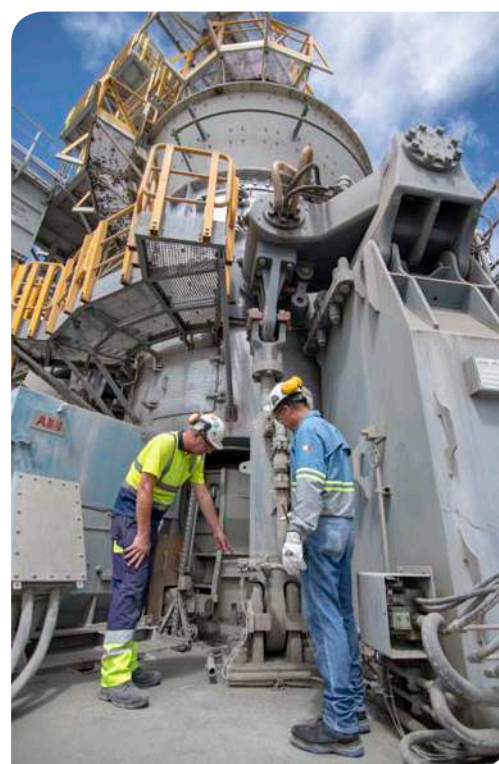
MD: There is no doubt that, presently, the consolidation of some major cement players has delayed a number of projects. On the other hand, those players will return strengthened in the medium-term. I would say that the projects have been postponed, rather than cancelled.

There are also other opportunities for suppliers like Gebr. Pfeiffer that arise from the consolidation at the top. New and smaller players identify opportunities and are jumping into some new markets. They can make decisions very rapidly.

GC: What are the largest threats to and opportunities for Gebr. Pfeiffer in the 1-5 year timeframe?

Below: The major assembly work takes place at the company's own workshop at the headquarter in Germany. Permanent quality controls accompany every stage of the manufacturing process.

MD: The largest threat to Gebr. Pfeiffer, and I would say the cement sector as a whole, is if we do not adequately address the pressing issues around climate change and CO₂ emissions that the industry and the world face. This is why we continue to strive



for efficiency in our designs, as well as lower CO₂ emissions.

The other part of your question is linked to this. The team at Gebr. Pfeiffer is hungry to find solutions to these issues to transform our approach to suit the new environment. That represents a tremendous opportunity for the company to make use of its strength as an innovative and dynamic systems supplier. With the MVR we have a very strong range of mills that can capitalise on the trend towards lower power consumption.

With regard to the use of supplementary cementing material as well as a growing variety product portfolio, the MVR offers the greatest possible application and a maximum of flexibility for our customers. The extremely low vibration and the low water requirement are further advantages. I am convinced that Gebr. Pfeiffer is well placed to tackle the challenges of the cement market well into the future.

GC: Thank you very much for giving us a great insight into your company.

MD: You are very welcome indeed! 🌐



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Ali Al-Duhaimi, Ready Engineering Company

A mill maintenance project at the LafargeHolcim Karbala plant in Iraq

In March 2019 Iraq-based Ready Engineering Company received a maintenance order to rehabilitate one of the cement mills at the LafargeHolcim Karbala cement plant in Iraq. Here the company presents a summary of the work carried out...



Above: Ali Al-Duhaimi, Director of Ready Engineering Group.

The maintenance contract awarded by the Karbala plant to Ready Engineering Company included:

- Replacing and aligning the trunnion, including replacing the bearing supporting it;
- Replacing and aligning the mill's girth gear;
- Replacing the diaphragms and liners;
- Replacing most of the air slides.

Drivers behind the project

Trunnion: A few months prior to the rehabilitation, the client experienced spikes in temperatures on the outlet trunnion journal bearing. After closer inspection it turned out that there were a few cracks on the neck bearing. One of the initial suggested solutions was to re-weld the cracks and order a new trunnion.

Girth gear: Amazingly, the 32 year-old mill has only ever had one girth gear! The plant decided to change

Changing a mill trunnion and 32 year old girth gear for the first time in Iraq!

the girth gear as per the plant team inspection, as all of the teeth were worn and out of tolerance. There was no option but to replace the gear entirely to ensure safe and uninterrupted operation.

Challenges

Source: The client decided to order the trunnion from Turkey and the girth gear from China. This decision was not without risk, as using different suppliers could give rise to differences in terms of tolerances and fabrication cultures. This caused some issues during the installation. For example, there were differences in fixation bolt and nut tolerances and it was difficult to align the girth gear with the trunnion flange. This took a lot of effort and time.

Space limitation: The mill was located between two operational mills, which meant there was very limited space for Ready Engineering's crew to operate in. The limited space also impacted the team's ability to move the trunnion, given that it could not impact upon the operations of the other two mills. As a result, Ready Engineering carefully planned its operations and chose suitable equipment and tools, including a specific mobile crane that had the right dimensions to fit in the available space.



Right: The final steps of removing the old trunnion.



Profile: Ready Engineering Company

Ready Engineering Company is an Iraqi company established in 2003 that provides a diverse range of products and services to support the country's industrial and business sectors. Initially a spare parts supplier, Ready Engineering is now proudly specialised in the supply of parts and engineering solutions to the cement, oil and gas, power and food sectors, among others. It supports its clients' missions through robust supply chain management.




Left: Tightening the fixation bolt of the new trunnion with a torque wrench spanner.

Diaphragm, liners and air slides: As with the girth gear, many of the liners were also original. They were in very bad shape and some looked like they were even welded to the mill shell. They took a tremendous amount of time and resources to replace.

Summary

Finally, after doing the required calculations, professional lifting plan and method statement, Ready

Engineering initiated the work to replace the parts successfully and safely. The total period of performance was 30 sequential working days for all tasks. The job was particularly hazardous, as well as the first of its kind by Ready Engineering in Iraq. However, Ready Engineering's team completed the necessary work safely and successfully. 

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Interview by Peter Edwards, Global Cement Magazine

In discussion: Siegfried Andräb, SICK AG

Global Cement speaks with Siegfried Andräb, Strategic Industry Manager for Building Materials at the German automation and monitoring system expert SICK AG.



Above: Siegfried Andräb has been SICK's Strategic Industry Manager for Building Materials since 2014 and has been employed by the company since 1998.

Global Cement (GC): Please could you introduce the company SICK AG?

Siegfried Andräb (SA): SICK was founded by Dr Erwin Sick in Munich in 1946. In 1952 the company presented the first marketable safety light curtain for accident prevention, which can be seen as a starting point for the company to develop other products. SICK's first move into monitoring systems, which it is most famous for in the cement sector, came in 1956 when it launched the first optical-electronic flue gas monitor. Many further technical developments have since been made across a very wide range of applications, including optical sensors for fill levels, emission and process monitoring systems for various pollutants, and safety sensors and systems applicable to cement.

GC: How is SICK structured in 2019?

SA: Internally, SICK is organised into three sections: Process Automation, Factory Automation and Logistics Automation. Building Materials, for which

I am responsible, is part of the Process Automation section.

Internationally, SICK is present in 88 countries, 53 of which have national sales and service units. In financial terms the company turned over more than Euro1.5bn in 2017. The group has a portfolio of more than 40,000 products, mainly in the Factory Automation and Logistics Automation sectors. There were over 8800 employees in 2017.

In recent years the company has been expanding fairly rapidly, with double-digit growth in turnover. Given the general state of the global economy, this is quite an achievement.

GC: Can you sum up your role in a sentence?

SA: As Strategic Industry Manager for Building Materials it is my responsibility to coordinate development of my sectors' solutions, keep on top of the ever-changing regulations in different jurisdictions, follow major market trends and to develop international key accounts.



Right: SICK AG's headquarters are located in Waldkirch, Baden-Württemberg, Germany.

GC: How important is the cement sector within SICK and its Building Materials sector?

SA: Cement is the largest sector that comes under the 'Building Materials' banner, which also includes glass, lime and asphalt. Cement is a strategic industry for SICK because, in parallel to historical dust, CEMS and process measurement, it offers opportunities for other products.

GC: What are SICK's cement sector capabilities?

SA: SICK offers what I believe to be the largest range of analysers and sensor solutions to the cement industry of any supplier in the world. We have strong competencies in emissions, dust and gas flow monitoring and have more recently developed our process monitoring capabilities, for example monitoring systems for rotary kilns, pre-heaters, pre-calciners, coal mills, bunkers and so on. In the past three years we have also introduced a number of proven sensors across from the factory and logistics automation competence fields (safety, conveyors, warehousing) into the cement sector, as well as the other sectors covered by our Process Automation section. For example, we have adapted laser scanners for conveyor belt applications in the cement sector.

GC: What is the most common emissions-related request you receive from the cement sector?

SA: Dust monitoring remains the number one request we hear from cement producers, especially in the less environmentally-conscious markets. This is because people can actually see dust, unlike NO_x and other gaseous components, and are relatively likely to be concerned about it. Emissions regulation schemes usually start with dust.

Aside from dust, we increasingly get requests for continuous gas emissions monitoring (CEM) systems that look at a spectrum of pollutants. Aside from plants that are entirely new to emissions monitoring, of which there are still many worldwide, many other plants are looking to revamp patchy or partial systems to meet changing regulations and have greater control. SICK is the only manufacturer of the range of equipment needed to have such a fully comprehensive CEM system.

GC: How are cement sector requests different to the others that you deal with?

SA: The physical differences between the cement sector and the others are mainly down to the harsh environment. The cement sector is a lot hotter and dustier than other sectors and we incorporate those conditions into the design of the equipment we supply to the sector. We often find that the lessons we learn in this tricky sector can be applied elsewhere.



Left: Dust measurement at a cement plant.

The regulations are also more challenging, particularly when it comes to alternative fuels. For example, in the US a plant can come under different sets of regulations depending on whether or not it uses alternative fuels. When alternative fuels come into the mix, things usually get more complicated.

GC: What trends do you see around the world?

SA: In Europe we have strong enquiries from cement plants seeking both emissions monitoring systems and process solutions. In the Middle East and Africa, both busy areas for SICK at the moment, we are seeing a lot more focus on emissions monitoring as these areas are developing their regulations. We expect our process requests to develop in those regions in the coming years, and the same is true for South East Asia. The quietest region is South America, due to the difficult economic situation, for example in Brazil and Argentina.

Aside from full systems and parts, we have been developing our customer service offering. We are already strong in Europe and North America and are ramping up our service capabilities worldwide.

GC: Does SICK offer different products to different regions that are tailored to specific requirements?

SA: The specification of the equipment we provide will depend on which SICK subsidiary is contracted to supply the system. This is often influenced by the main contractor building the plant, the type of cement producer making the request and where the plant is to be supplied. SICK works with all the well



Above: Producing sensors.

known suppliers and cement producers and can cover all bases.

Talking technology

GC: Let's look at the systems in more detail. How do your systems, for example a dust monitor, actually work?

SA: SICK's dust monitors rely on optical principles. The easiest to understand is optical transmission. This works by observing the difference between the emitted light and received light as it travels across a gas stream that contains dust. The level of light received is proportional to the dust load. However, as dust limits fall, this methodology becomes increasingly ineffective. There's basically too little dust in the gas streams so the difference in the signals is negligible and the system cannot 'see' changes in the dust load.

To work at lower dust levels we have sensors that use light scattering principles. Back scattering involves looking at the amount of light scattered back from the dust particles that goes directly back to the source. It looks at the amount of light that is diffracted and refracted by dust particles across the gas stream.

GC: At what dust load do you have to switch from transmission to scattering?

SA: For newer limits, in the range of 10-50mg/Nm³, we have to employ scattering-based technologies. Transmission principles start to become limited at below around 100mg/Nm³, but they're still applicable in many regions.

GC: How do cement plants use the information supplied by the dust monitor?

SA: In many countries the cement plant reports the dust concentration online to the environmental

authorities. Dust monitors are also used in bag filters to help the operator identify leaks so that they can take remedial action.

GC: Do you know of plants that would use that information to automatically shut down an individual bag or row of bags without operator input?

SA: This is not something that I am aware of with our systems, as most operators want to verify the information from the sensor with visual checks and other investigations to correctly identify the bag that has failed.

GC: What is the hardest cement sector pollutant to monitor in SICK's experience?

SA: The answer to this is definitely mercury, due to the low level at which it is present. It has one of the lowest limits of anything out there. For example, the US has a limit of 4.5µg/Nm³ for new plants. Only two manufacturers are able to produce equipment that can measure mercury emissions continuously down to that level and SICK is one of them. The other problem with mercury is that it is very reactive in the gas stream, which makes it tricky to 'see.' SICK's solutions rely on atomic absorption spectroscopy (AAS) at elevated temperatures.

Looking forward

GC: What new projects or products can you tell us about?

SA: We've developed a new hot wet gas analyser for emissions monitoring that will also be adapted for process monitoring applications. We're also working on a hot-spot monitor for coal conveyors before the coal reaches the silo. We continue to develop our App offering for phones and tablets to give our customers greater access to their data and better control of their applications.

GC: With more and more sensors across the cement plant, what's the next step?

SA: There is a lot of discussion at the moment about so-called 'smart sensors,' Industry 4.0 and the Internet of Things (IoT). I would say that SICK has been involved in these areas from the beginning, certainly in Europe and North America, due to its strength in Factory Automation. Automation and intelligent feedback are commonplace in these regions and there is a lot of potential for SICK in other regions as they develop not only their emissions regulations but also the operational efficiency of their plants.

GC: Which governments are dragging their feet on emissions regulations?



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SA: More and more countries are putting emissions regulations in place. The self-commitment of the 32 members of the Global Cement & Concrete Association (GCCA), representing at least 50% of global cement production capacity, also ensures that many countries that don't have emissions regulations also have a minimum monitoring standard.

GC: What can be done to 'force' smaller producers in unregulated markets to look at this area?

SA: Without regulations such producers will not invest in emissions monitoring. Regulations almost always come from the public. People are getting more animated about the environment all over the world. For example in China, there was little focus on environmental regulation before 2006. Now, under public pressure, the government is on a pollution reduction drive, which is having an effect already. China knows that it

will cost less to invest now than it will in another 10 years. There's a lesson in there for all of us!

GC: A thought-provoking final point. Thank you for your time today.

SA: You are very welcome!



Left: Beijing has become globally infamous for air pollution in recent decades. However, public pressure has forced the government to curb emissions from a range of sources. "People are getting more animated about the environment all over the world."



Haley Gershon, BETA Analytic

^{14}C testing for the cement sector

Many alternative fuels contain biogenic (CO_2 -neutral) materials. As these are rich in carbon (^{14}C), radiocarbon dating offers an accurate and cost-effective way to analyse fuel-derived CO_2 and reveal the proportion of biogenic fuel used...

Common alternative fuels include refuse-derived fuel (RDF), municipal solid waste (MSW), sewage sludge and used tyres. These all contain a proportion of 'biogenic' carbon compounds that ultimately derive from recently-living plants or animals. Any biogenic carbon can be considered CO_2 -neutral when it is burned. This is in contrast to petrochemical fuels, the combustion of which adds to atmospheric CO_2 levels.

All living organisms contain a known proportion of the isotope ^{14}C , which is generated by the interaction of cosmic rays with atmospheric nitrogen (^{14}N). In the form $^{14}\text{CO}_2$, it is used by plants in photosynthesis and enters the food chain. ^{14}C atoms decay via beta decay back to ^{14}N . As the half-life of ^{14}C is around 5730 years, the isotope has long been used to calculate the age of pre-historic organic samples.

For over a decade, another application has been developed: Assessing the biogenic content of a cement plant's fuel mix. This is commonly performed using Accelerator Mass Spectrometry (AMS), which separates ^{14}C from the more common ^{12}C (and other C isotopes).

CO_2 that has been produced from mixtures of biomass and fossil fuels will result in a percentage of ^{14}C that is in direct proportion to the biomass / fossil fuel ratio at the point of combustion. Therefore, the World Business Council for Sustainable Development recommends the EN 15440 method, which uses ^{14}C analysis. ASTM D6866 also uses radiocarbon analysis to determine the biogenic carbon content of solid, liquid or gaseous samples. CO_2 samples are sent from the plant to ^{14}C testing laboratories. These report results as a percentage that ranges between 0% and 100% biogenic, depending on the amount of ^{14}C .

If, for example, MSW is used, the analysis can even determine the portion of MSW that is biomass-derived. If a ^{14}C analysis indicates that a stack CO_2 sample is 65% biogenic, 65% of the stack gas CO_2 is biomass-derived and 35% is fossil-based.

This information is not just for academic interest, as cement companies often need proof of the biogenic portion of alternative fuels they use. This is because biogenic CO_2 can be deducted from annual greenhouse gas inventories.

In the US, the Environmental Protection Agency (EPA) requires annual reporting of a company's greenhouse gas emissions for facilities that emit 25,000t/yr or more of CO_2 . The EPA's Final Mandatory GHG Reporting Rule uses ^{14}C analysis to measure the biogenic CO_2 of emissions from the combustion of mixed fuels and municipal solid waste.¹

In the EU, ^{14}C analysis is financially attractive for cement plants that use alternative fuels, as the EU Emissions Trading Scheme (EU ETS) recommends EN 15440 for measuring the biomass fraction of solid recovered fuels by an ISO/IEC 17025-accredited laboratory.² Under the EU ETS, companies may purchase CO_2 credits as long as they do not exceed their annual CO_2 emission limits. Credits are valuable. Buying fewer, or even selling some, helps the cement plant's bottom line.

Similarly, the Western Climate Initiative (WCI) sets requirements for mandatory reporting and includes a cap-and-trade program for several members in the US States and Canadian Provinces.³ Under the WCI, companies are required to submit the same number of emission allowances to the government as the number of emissions they had during the compliance period. The WCI uses ASTM D6866 to determine the biogenic percentage of CO_2 emissions of waste-derived and mixed fuels.

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2. Beta Analytic. European Union Greenhouse Gas Emissions Trading Scheme (EU ETS). August 2018, <https://www.betalabservices.com/renewable-carbon/carbon-credits-euets.html>.
3. Western Climate Initiative. Final Essential Requirements of Mandatory Reporting, July 2009, pp. 51-52.



Below: An Accelerator Mass Spectrometer (AMS). ASTM D7459 outlines the proper technique in collecting gas samples from stacks for ^{14}C analysis. The gas sample is captured in a gas bag that is later shipped to an off-site radiocarbon dating laboratory, such as Beta Analytic, for analysis.



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Florian Gies, KettenWulf Betriebs GmbH

Innovative chain technology for reclaimer systems

KettenWulf presents the new KettenWulf Sealed Chain System Permanently Oiled (KW SCS PO), a novel technology for reclaimer systems...

Automated stockyard units are indispensable for handling and feeding various materials in industrial processes, including cement production. Reclaimer systems with conveyor chains are commonly used, starting from automated bulk material handling in the quarry, to processing at the plant and, subsequently, bulk despatch. The range of different materials to be conveyed is wide and covers coal, limestone, clinker, gypsum and others. Each of these conveyed materials presents different challenges for the reclaimer systems and thus the conveyor chain used. Above all, the abrasiveness and corrosiveness of the conveyed materials is very important and is a major influencing factor in the design and construction of the respective chain system.

Currently, conveyor chains with external, sealed rollers as illustrated in Figure 1 are used. The chain joint of such a conveyor chain must be lubricated by an oil drip system, either externally or through a grease nipple in the pin and corresponding lubrication channels. Lubrication by an oil dripping system in particular leads to the ingress of dust into

“A failure of the new conveyor chain is not permitted, as the downstream process depends on the supply of conveyed material and must not be impaired under any circumstances.”

the chain joint and inevitably leads to excessive lubrication of the conveyor chain. This causes heavy contamination of the entire chain system by material that adheres to the lubricant.

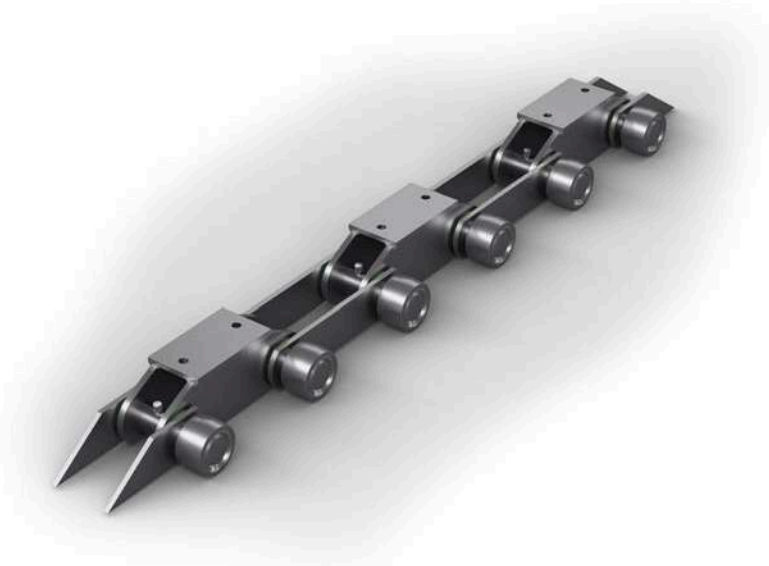
For this reason, in the case of extremely abrasive and/or corrosive materials, a sealing system is often provided to protect the chain joint and enabling a controlled use of the lubricant by using a grease nipple lubrication system at the pin. In this case each single chain joint needs to be lubricated through the grease nipple, with the effect that fresh grease is transported to the chain joint and used and polluted grease is pressed out. Both oil drip systems and grease nipple lubrication systems have high maintenance and resources costs, contaminate their surroundings and lead to significant downtime.

These issues inspired KettenWulf to engineer a solution in conjunction with an operator of a large reclaimer system. After several site meetings, the formulation of a fully maintenance-free conveyor chain system was developed for a reclaimer system.

Establishing practical tests under the toughest conditions and developing such a conveyor chain was the primary goal. Our measurement for success; the operator would save a five-digit Euro sum on maintenance every year and significantly increase machine availability. The revolutionary nature of the project quickly became clear to those involved, as the following customer requirement had to be considered as the top guideline:

“A failure of the new conveyor chain is not permitted, as the downstream process depends on the supply of conveyed material and must not be impaired under any circumstances.”

Below: A traditional reclaimer chain with external rollers.





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In the course of the nine-month development phase, one of the concepts developed proved to be particularly suitable for meeting all the requirements. In addition to the maintenance-free design of the chain joint, emergency operation, in case of damage to the chain system caused by overloads or malfunctions of the reclaimer, could also be ensured. An oil-filled chain joint was designed which is completely protected against external environmental influences by means of a special sealing system.

Similar to a fully closed and sealed gear housing, the permanent oil filling ensures the optimum supply of lubricant to the joint area. In the event of damage, the chain joint can be filled with grease and thus enables emergency operation until the damaged components are replaced.

After a series of internal tests and inspections to ensure the technical performance of this new conveyor chain, two test chains were installed in the reclaimer. The result after more than 12,000 operating hours and regular inspections on site was completely convincing. No measurable wear could be detected at the joint components of the test chain. These outstanding results exceeded the expectations of all parties involved in the project and gave full confidence in the new technology.


In the next step, the plant operator ordered a complete chain system, including the chain and sprockets of the newly developed, maintenance-free conveyor chain from KettenWulf. This conveyor chain has now been installed in the plant and has been operating without any malfunctions under the toughest conditions, ever since.

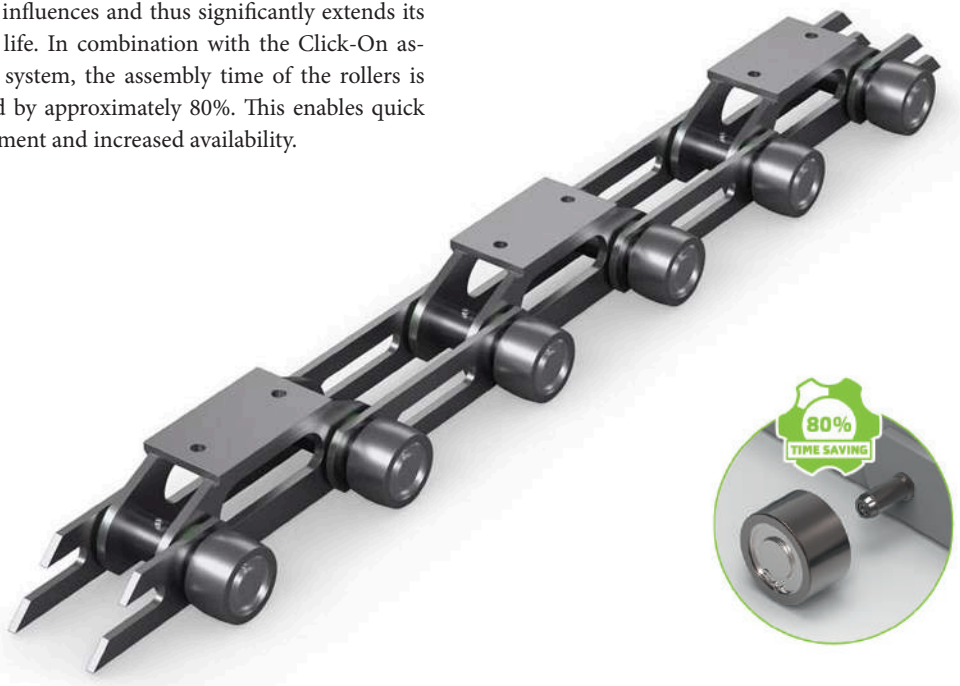
In addition to our new sealing system type SCS PO (Sealed Chain System Permanently Oiled), the sealing technology and the assembly system of the rollers have also been optimised. In particular, the use of the Heavy Environmental (HE) roller increases the performance of the roller to environmental influences and thus significantly extends its service life. In combination with the Click-On assembly system, the assembly time of the rollers is reduced by approximately 80%. This enables quick replacement and increased availability.

KettenWulf Sealed Chain System Permanently Oiled

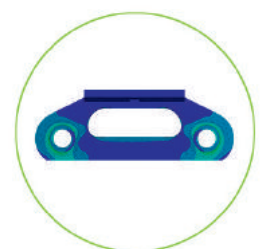
- Maintenance-free chain joint;
- No additional lubricant required;
- Service life continuation in the event of damage via greasing;
- Reduced environmental impact;
- Optimised roller technology;
- Quick roller assembly;
- Increased plant availability;
- Decreased plant operating costs – Power consumption;
- Reduced maintenance costs.

As a study for future chain systems, KettenWulf has determined the exact loads and stresses of the individual chain components by means of FEM analysis, which is shown in Figure 2. Based on this analysis, KettenWulf will be able to reduce the weight of the chain by 15% with further development, in addition to the improvements described above. This weight reduction facilitates the handling of the chain, from production at KettenWulf, through shipment, to assembly at the construction site. In addition, the drive power and thus the operating costs are reduced during the use of this type of chain.

The development and production of this maintenance-free reclaimer chain is an important step to making the chain technology future-proof for the continuously increasing requirements in the field of automated stockyard systems. Besides the massive cost savings in the area of maintenance, the impact on the environment can be reduced and the availability of the plant can be increased. 



Left: The new reclaimer chain, including weight reduction





Joel Maia, FCT Combustion

The FCT Turbu-Flex: A 'two-in-one' burner

FCT Combustion's Joel Maia looks at the development and properties of the company's new flexible Turbu-Flex burner...

When a cement kiln burner designer is looking at a new design, there are several things to consider. One of the most important is the heat transfer required by the process. The area under the lines shown in Figures 1 and 2, shows the heat energy imparted to the clinker along the kiln axial

distances. The more heat that is transferred early on, the more efficient the burner and the lower the back-end temperature. The less heat that is transferred to the raw meal in the early stages, the less efficient the burner and the higher the back-end temperature.

When face plates with different hole patterns are introduced at the end of the burner the heat profile changes. FCT looked at some extremes: A design with 36 small holes

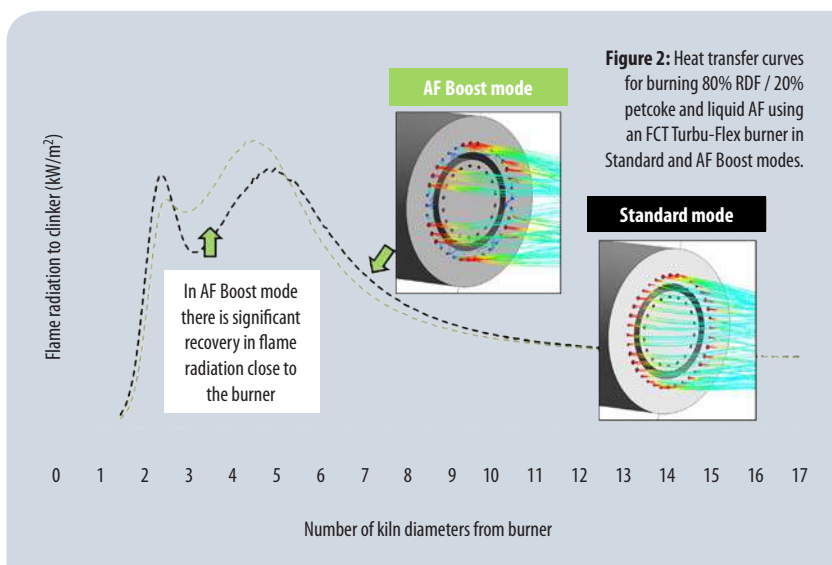
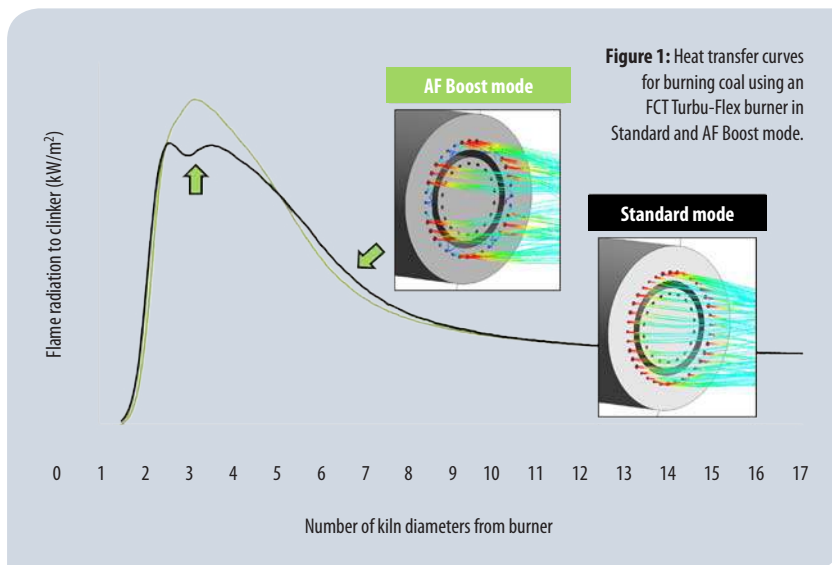


Figure 3a: Burner design with 36 small holes. Most suitable for traditional fuels.

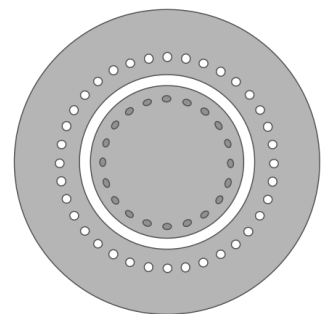


Figure 3b: FCT Turbu-Flex burner combines arrays of larger and smaller holes for easy switching between Standard and AF Boost modes.

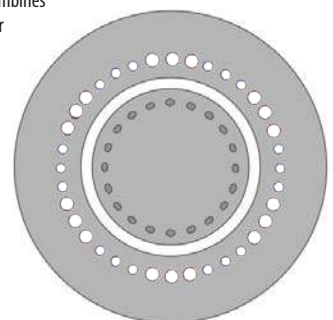
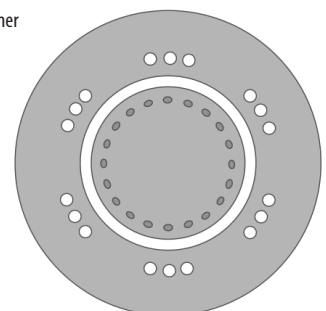


Figure 3c: Burner design with 18 large holes. Most suitable for alternative fuels like RDF.



around the circumference (Figure 3a) provides a less intense, lower temperature flame with relatively low NO_x emissions. This is due to the relatively slow fuel-air mixing in this type of design.

The other design has 18 larger holes that are grouped together with gaps between them where there are no air holes. The cross-sectional area of the holes is identical to the 36-hole case. This gives rise to more intense mixing, higher flame temperatures and higher NO_x emissions. The primary air creates turbulence between the fuel and the secondary air, which promotes mixing at the boundaries. Different face plate patterns work differently.

A flexible approach


There are many cement plants around the world that have to use constantly varying fuels due to legislative, operational and cost challenges. This can result in burners being poorly optimised for the fuel being used. There are great differences between burning two-dimensional solid alternative fuels and liquid fuels, for example. Often plants have to compromise.

To provide flexibility, FCT has taken the two extremes described above and incorporated them into a single design (Figure 3c). The momentum is the same in each configuration. This leads to a design that can switch between different fuels.

This concept led to the development of the Turbu-Flex burner (Figure 3b). It is in fact two different burner designs within the same burner. It has a 'Standard' mode of operation that has 36 smaller equidistant holes that can be used for traditional fuels like coal, which have reliable combustion characteristics. Then there is an 'Alternative Fuel (AF) Boost' mode in which the primary air comes through the 18 larger holes only. This is most appropriate for solid alternative fuels, which naturally suppress flame temperature and thus need more vigorous air-fuel mixing. None of FCT's burners have any moveable parts at the hot end and the Turbu-Flex is no different. The air supply is simply controlled by valves at the back of the burner.

Figure 1 shows the heat transfer differences between the Standard and Boost modes when burning coal. The heat transfer is much better in AF Boost mode, but it generates unacceptably high NO_x emissions. Figure 2 shows the same information for refuse-derived fuel (RDF). This shows that, in Boost mode, significant temperature and heat transfer can be regained compared to burning RDF in the standard mode. The NO_x emissions are around 25% higher in AF Boost mode than in Standard mode, but as NO_x emissions are usually very low with AF, this is not a concern.

Trials and commercial introduction

The first Turbu-Flex burner has been burning 80% solid RDF, 20% petcoke / liquid alternative fuels on a trial basis at a European cement plant since early 2018. Four further Turbu-Flex burners were delivered in the first quarter of 2019 on a commercial basis, again to cement plants in Europe. FCT looks forward to updating readers on the progress of these burners in future issues. 

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Heather Harding, Bricking Solutions

OEM Kiln access ramps: Partner with a pro

Kiln access ramps are an important aspect of safe, efficient kiln maintenance. Producing one in-house may seem cost effective, but poor design and lengthy installations often end up costing more in the long run. Partnering with a specialised manufacturer of kiln access ramps offers a range of benefits, such as a custom-engineered design, easy installation and service options that result in a better return on investment...

One of the biggest benefits of working with an original equipment manufacturer is the quality and experience they bring. Such companies have worked with hundreds of customers to solve specific challenges and, in partnering with them, plant managers can tap into that knowledge to find the solution that best fits their site. Each burn floor presents unique obstacles. Because of this, each access ramp is specially designed to ensure a proper fit.

In addition, original equipment manufacturers have extended access to unique materials not found in-house. For example, a custom manufactured ramp could be fabricated with high-strength 6061 T6 aluminium, making it as strong and durable as steel but at half the weight. Ramps made from this material will support as much as 6.8t live load and offer a 3:1 safety factor.

For added safety, many manufactured ramps come with standard features such as curbs, fall guards and articulated landing feet to ensure that the ramp always sits properly within the kiln. Optional safety cages, personnel tunnels and accessories that

make ramps compatible with third-party demolition equipment are also available.

Ease of installation

Another benefit of working with lighter, sturdier custom-manufactured ramps is an ease of installation that is not possible with most in-house models. By using industrial lightweight aluminium and a modular design, these ramps can be assembled in as little as 1.5hr, depending on ramp length and burn floor configuration. That's around 40% less time than most alternative after-market or self-built ramps. Most manufactured ramp assemblies are easily manoeuvred by basic equipment such as a forklift and don't require special equipment like the hoist systems that are needed for steel ramps.

Sales and service

Another significant benefit of partnering with a specialised manufacturer is the customised care provided by a dedicated sales and service department over the life of the ramp. When a do-it-yourself

Right: A custom-manufactured ramp can be fabricated with high-strength 6061 T6 aluminium, allowing it to support as much as 6.8t live load and offer a 3:1 safety factor.





Profile: Bricking Solutions

Bricking Solutions manufactured the industry's first bricking machine in 1966 to give refractory installers a safer, more efficient alternative to manual installation methods. From that time the company has believed that machines should do the heavy work rather than the people and that customer feedback should drive product development. Bricking Solutions manufactures a wide variety of equipment for the cement, foundry and steel sectors, including bricking machines, conveyors, pallet transfer systems, kiln platforms, ramps and safety cages.



Left: Each burn floor presents unique obstacles. Working with a specialised manufacturer means each access ramp is specially designed to ensure a proper fit.

ramp falters, diagnosing the problem eats away at valuable time. However, working with an original equipment manufacturer means having a partner that can keep downtime to a minimum.

An OEM's experience allows them to respond quickly and offer solutions that keep maintenance projects on schedule. Working with these companies

also provides access to after-market services, such as ramp inspections, spare parts and any safety modifications that might arise from continued safety testing.

Optimised return on investment

The benefits of working with a custom manufacturer can quickly add up to a better return on investment. Original equipment manufacturers offer safe, efficient solutions for routine maintenance and allow plant managers to apply time and resources more effectively on day-to-day operations.



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Oscar Zalacain, Krosaki AMR Refractorios SAU; Raquel Fano Ramos, Refractaria SAU;
Andrey Spitsin, Regional sales representative

Krosaki AMR Refractorios and Refractaria: Full range of refractories for the cement industry

This article gives an overview of refractory materials made by Spanish companies Krosaki AMR Refractorios SAU and Refractaria SAU, including a full range of kiln bricks, developed for application in cement rotary kilns and providing specific engineered solutions to reduce energy consumption and increase productivity.

The development of the Spanish refractory industry is closely connected with the general industrial development of the country, particularly the steel, mining and civil construction industries, including cement. The north of Spain, for example in the Basque country and Asturias, has large industrial clusters. These companies consume high-class raw and technological materials, including a wide range of refractories. It is not surprising, therefore, that this region has become one of the most important centres for the production of refractories.

In November 2018 Krosaki AMR Refractorios SAU and Refractaria SAU, merged, forming the largest, most modern and fastest-developing refractory company in Spain. This was achieved via the integration of Refractaria into Japan's Krosaki Harima Corporation through its affiliated company in Spain, Krosaki AMR Refractorios SAU. This provided the possibility to supply the full range of refractory materials used in cement production, including:

- Magnesite spinel bricks for rotary kilns;
- Alumina silicate bricks with additives of silicon carbide and zirconia for rotary kilns, calciner, cyclones and clinker coolers;

- Unshaped alumina silicate refractories with additives of silicon carbide and zirconia for rotary kilns, calciners, cyclones and clinker coolers, represented by all types of castables and gunning masses;
- Pre-shaped parts, produced from refractory castables, for bull noses, tertiary air ducts, nose rings and other parts of the cement plant;
- Special refractories developed for specific applications, particularly to solve ring/build up formation problems, to reduce energy losses through the kiln shell and to increase life time in hard conditions (alternative fuel, high thermal load process, etc.)

About Krosaki AMR SAU

Aristegui Material Refractorio SA was a private company founded in 1906 that had a leading position in the Spanish refractory sector. It was partly acquired by Krosaki Harima Corporation and Mitsui Co Ltd in 1989, becoming Krosaki AMR Refractorios SAU. Since 2004 Krosaki Harima Corporation has become the sole owner of the company, providing 100% ownership of a plant with the most up-to-date production technology and the latest expertise in the design of refractory materials.

Below left: A 2000t Laeis hydraulic press at Krosaki AMR Refractorios' plant.

Below right: Refractaria SA's headquarters in Gijón, Asturias.



In particular, the company totally renewed its facility in 2010 with the installation of a new 36,000t/yr plant for shaped magnesia spinel bricks. The fully-automated plant is equipped with the most modern units, including highly-efficient mixers, hydraulic presses and tunnel kilns.

The ongoing extension of production capacity will provide the plant with a fourth technological line by the end of 2019, meaning an increase in output up to 48,000t/yr of shaped refractories. We believe that, as of today, Krosaki AMR Refractorios SAU is the most modern plant for production of magnesia spinel bricks in the world.

Due to its specialisation in magnesia spinel bricks, Krosaki AMR Refractorios is globally responsible for Krosaki Harima Corporation's cement business interests.

About Refractoria SAU

Refractoria SA was founded in 1948 and developed into a unique refractory company. Production takes place across 63,000m² at a 50,000t/yr facility in Siero, Asturias. The company produces bricks, refractory castables and gunning masses of alumina silicate with additives of silicon carbide, zirconia and other minerals.

Over the past 10 years Refractoria SAU has placed particular emphasis on the development of new refractory materials for cement applications. This has allowed it to achieve a leading position in the field of special refractories for niche applications, such as the production of Acris bricks to solve ring formation problems and decrease energy losses in the kiln. The company also actively promotes highly-efficient engineering solutions, helping cement plants to solve some typical problems, for instance, to avoid

Quality	MgO (%)	SiO ₂ (%)	CaO (%)	Fe ₂ O ₃ (%)	Al ₂ O ₃ (%)	Density (g/cm ³)	Porosity (%)	CCS (MPa)
MXA	86.50	0.75	1.00	0.75	11.00	3.00	14	65
MXB	88.50	0.75	1.00	0.75	9.00	2.99	15	65
MX90	90.00	0.75	1.00	0.75	7.00	2.99	15	80
MLA	87.00	0.30	0.85	0.55	11.00	3.01	14	60
MLB	89.00	0.40	1.15	0.65	8.00	3.00	14	60
MLC	90.00	0.75	1.50	0.75	7.00	3.00	15	60
MLS	85.50	0.20	0.80	0.55	13.00	3.03	13	70
MKE	82.00	0.20	0.80	0.55	17.00	3.05	13	60
MKS	85.40	0.25	0.85	0.55	13.00	3.10	12	70
AM100 mortar	98.50	0.30	1.00	0.80	0.40			

Left - Table 1: Krosaki AMR Refractorios' range of magnesia spinel bricks.

water jetting in the inlet chamber and calciner by installing its WaterJet Free concept refractory linings.

Magnesia spinel bricks for cement kilns

Krosaki AMR Refractorios' range of magnesia spinel bricks includes three series of products: MX, ML and MK - See Table 1. The manufacture of the ML and MK ranges is performed with the purest synthetic magnesite available, which provides exceptional advantages in comparison with natural magnesite. This includes: Higher purity; Denser structures; The lowest possible oxide content; Lower porosity and permeability; Higher resistance against alkali salts; Higher resistance against clinker abrasion, and; Higher elasticity. MX products are produced from a mixture of the purest synthetic magnesite with a limited amount of natural magnesite. All series contain high-quality spinel, providing exceptional flexibility to the structure of bricks.

We recommend the use of MX bricks while working with natural fuels (coal, gas, heavy fuel oil) and up to 30% alternative fuels. Figure 1 shows the MX range bricks. The ML and MK ranges were developed specifically for harsher conditions, including the use of >30% alternative fuels and high thermal loads.

The MLS range deserves special attention. Due to



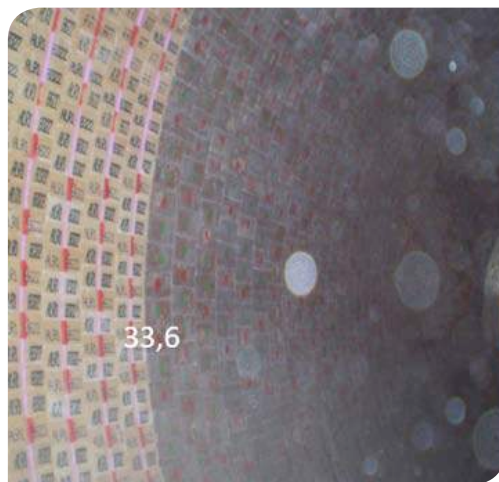
Far left - Figure 1: MX range bricks.

Left - Figure 2: ML range brick, B-622 shape.



Right - Figure 3: Acris 1012, installed in the upper transition zone.

Far right - Figure 4: Acris 1012, installed in the upper transition zone after 18 months of operation.



its unique combination of properties, this brick is at the top of Krosaki AMR Refractories' product range. This brick can be successfully used in any MgO part of the kiln, especially in transition zones, which are its main destination zones.

The latest analysis of Krosaki AMR Refractories' sales per product shows that MLS quality is the product most consumed by the company's cement sector clients. This is due to this range offering the longest service life and thus the lowest specific costs on refractories.

Recent case-studies

Installation reports from recent years reveal that MLS bricks can withstand service conditions with unchanged thickness for extended periods that would completely wear out other materials. For example, at Company A, MLS showed 220mm remaining thickness in upper transition zones after six months of operation. MLS bricks can provide rates of specific wear ranging from 0.00002-0.00005mm/t of produced clinker. This corresponds to 0.06-0.2kg/t of clinker. MLS bricks can increase service life remarkably, extending the campaign to the longest possible extent. For example, in the lower transition zone of a 4.6m-diameter kiln at Company B's plant, the use of MLS bricks provided an eight-month increase in life-span compared to bricks from a previous supplier.

Bricks to eliminate ring formation and decrease heat losses

The phenomenon of ring formation in cement rotary kilns is well-known and often observed. It is noticed that when such rings are in the area of MgO bricks the process of infiltration, with the associated spalling of bricks is very likely. This type of destruction leads to faster loss of lining thickness and an increase in kiln shell temperature. The formation of rings has a negative effect on the productivity of the kiln due to the reduced brick thickness and higher thermal losses through the kiln shell. To tackle these challenges, Refractaria SAU has developed the Acris bricks range, including Acris 8510S, Acris 1012 and Acris 5008.

These materials are designed to be used in the safety zone (Acris 5008), the upper transition zone (Acris 1012) and the upper part of central burning zone (Acris 8510S) to provide more effective clinker production. This is thanks to decreased surface ring formation due to low porosity and lack of infiltration. In the event that rings do form, the ring does not react with the brick surface and falls without spalling.

Due to their lower thermal conductivity Acris bricks offer additional advantages compared to MgO-based materials. This can help reduce fuel consumption and protect kiln shells from high-temperature corrosion, caused by local overheating.

Right - Table 2: Refractaria SAU's Acris range of bricks.

Quality	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	SiC (%)	ZrO ₂ (%)	Density (g/cm ³)	Porosity (%)	CCS (MPa)	Comments
Acris 8510S	75-85	<1.0	N/A	N/A	3.00-3.06	14.5-16.5	120-140	Increased resistance to liquid phases
Acris 1012	38-40	0.5-0.8	9-11	11-13	2.80-2.84	12-14	80-120	Optimum solution for upper transition zone
Acris 0208	50-52	0.5-0.8	4-6	7-9	2.70-2.74	12-15	90-140	Economical version of Acris 1012
Acris 5008	50-52	0.9-1.1		7-9	2.68-2.71	14-16	60-90	Low price and good properties for safety zone. Low thermal conductivity.
Acris 3006	38-40	0.8-1.0		5-7	2.25-2.28	16-18	60-90	Low price and good properties for calcining zone. Low thermal conductivity



Finally, the combination of working characteristics of Acris bricks permits the longest service life of refractory linings in these zones of rotary kilns, which makes this range of bricks one of the most cost-efficient solutions.

Despite recent introduction of Acris bricks to the market, this product range is already widely represented in cement kilns all over the world. Here, the authors would like to share the results of Acris 1012 in the upper transition zone of a 4.15m-diameter kiln. In particular, the problem of high shell temperature and spalling of bricks was detected. To solve these issues, Acris 1012 bricks were installed in the area of 33.6-36.0m.

A kiln inspection showed that installation of these bricks decreased shell temperature, eliminated the spalling of refractory lining and allowed the plant to run the kiln without any unexpected stoppages due to this area.

In the event that ring formation issues are not accompanied with high temperature on the kiln shell, the installation of the Carbal 10 brick can provide brilliant results. This SiC-containing brick can be considered as one of the best of these types of refractories and one of the most efficient solutions in the battle against kiln ring formation and build-ups in the calciner. We can share information about successful reports, received from many customers, in which serious problems with ring formation were detected in the area of 34-37m. After installation of Carbal 10 at Company C in June 2012, the problem was resolved. The bricks are still in the kiln due to their impressive remaining thickness. The wear after one year in service was ~0mm.



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Left - Figure 5: Carbal 10, installed at 34-37m after 12 months of operation, showing 0mm wear.



Michele Di Marino, Jesper Sand Damtoft, Stefano Zampaletta, Cementir Holding SpA

Experiencing **FUTURECEM™**

Cementir Group is broadening horizons with its sustainable **FUTURECEM™** solutions...

Cementir Group, with its mantra 'Building a sustainable future,' regards sustainable growth as both a responsibility and a requirement for producers to continue operating in the cement industry. Cementir Group's business model strikes the balance between the creation of economic value, the protection and conservation of the environment and a sense of responsibility towards people and communities. Cementir Group has based this journey toward sustainability on four pillars: usage of alternative fuels; wind energy production; energy recycling and green cement innovations.

Introducing **FUTURECEM™**

Regarding green cement innovations, the Cementir Group has a long record in the development of more CO₂ friendly types of cement and concrete. This is centred at its Research and Quality Centre in Aalborg, Denmark. There, its researchers have been studying different alternative cement and concrete compositions in cooperation with stakeholders from the whole value chain of construction, as well as leading universities and research institutions.

FUTURECEM™ technology is the result of this extensive applied research, which also covers raw materials assessment, manufacturing technology and concrete technology. **FUTURECEM™** technology

relies simply on the synergy between calcined clay and limestone filler, which allows replacement of clinker of more than 40%, depending on the type of clay, all while maintaining the same performance as a pure Portland cement.

FUTURECEM™ technology is both green and sustainable, since clay and limestone are raw materials available in large quantities on a global scale. This is an essential driver in an era when the supplementary cementitious materials currently used for cement/concrete production, such as fly ash and blast-furnace slag, are both limited in quantity. On a global scale, fly ash and blast-furnace slag production is far too small to reduce clinker content to the amount that is technically feasible. In Europe and the US a fly ash shortage is beginning to be felt as coal-fired power plants are being shut down, while blast-furnace slag is almost fully used, with no plans to increase steel production in these regions.

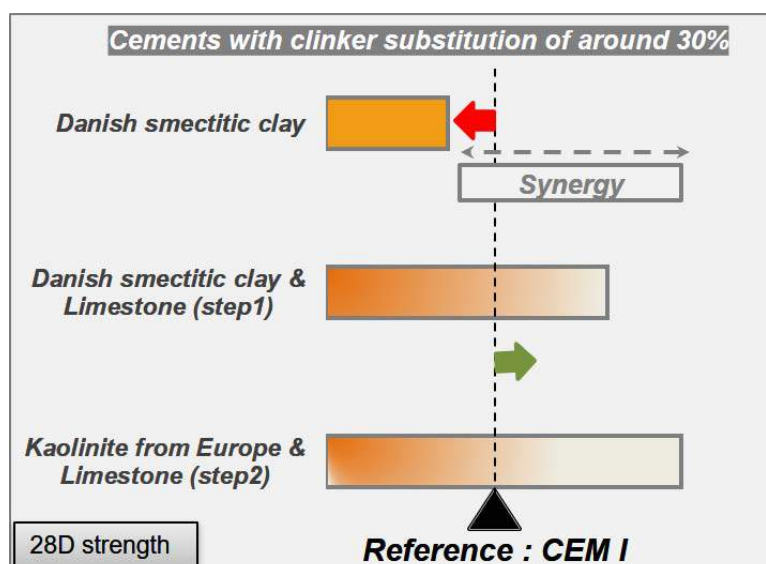
The story so far...

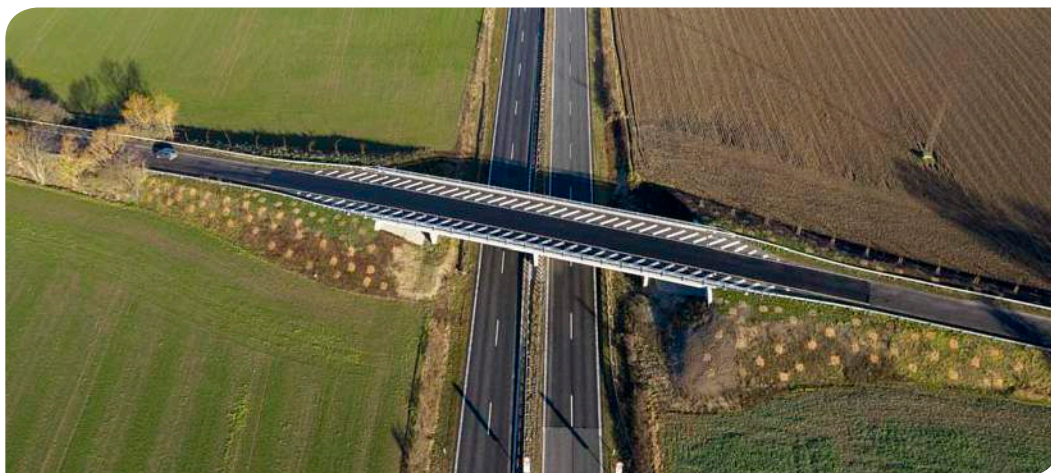
FUTURECEM™ dates back almost 20 years, to when researchers at the Cementir Group Research and Quality Centre discovered the synergy between certain types of calcined clay and limestone. This was not published but was brought back to attention when increased focus on sustainable development

and climate change made the development of new, lower CO₂ cements more interesting.

This led to the original **FUTURECEM™** project from 2008 to 2011, in which the basic technology was developed. In this project, it was surprisingly found that not only kaolinite clay could be used, but also the kinds of smectitic clays known as bentonites, which are found in abundance in Denmark. To protect the development, a patent application was

Right: The synergy between calcined clay and limestone compared to reference CEM I in standard mortar.





Left: A FUTURECEM™ road bridge in Lolland, Denmark.
Source: Torben Eskerod.

submitted.¹ This has since led to FUTURECEM™ to be patented in USA, Canada, Mexico, Europe, India, China and Australia. The patent is currently pending in Brazil.

The next step was the SCM project 2011-2014, which aimed to develop production technology for calcined clay and further developing the technology. The first test batches were produced and used in real concrete production, including a demo wall at the Aalborg Portland cement plant in Denmark.

From 2014-2019, the Cementir Group participated together with research institutions and a range of stakeholders from the construction industry in the Danish project Green Concrete II (Green Transformation of Cement and Concrete Production) with the aim of testing FUTURECEM™ in a wide range of actual ready-mix concrete applications.

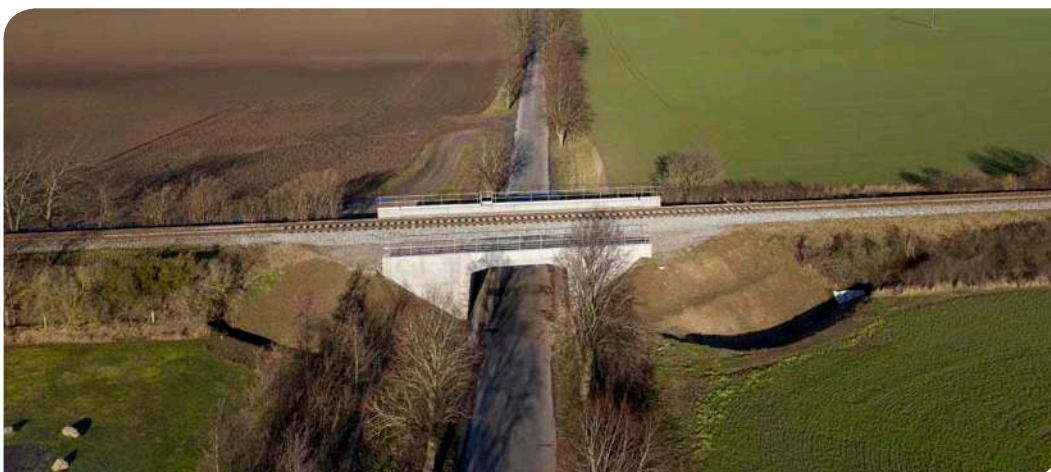
Within this project, FUTURECEM™ has been tested at full-scale in construction parts for infrastructure as well as in an indoor floor and wall in the new concrete laboratory at the Danish Technological Institute (DTU). Such demonstrations show that FUTURECEM™ can be implemented in the concrete industry, while maintaining conventional production and execution technologies. Furthermore,

similar performance to conventional concrete in terms of workability, strengths and other key parameters were achieved.

In order to evaluate durability in aggressive environments, a number of long-term exposure sites have been established. These will document FUTURECEM™-based concrete exposed to sea water or highway traffic. Furthermore, investigations at the Technical University of Denmark, the Danish Technological Institute and the Cementir Group Research and Quality Centre have shown that concrete based on FUTURECEM™ technology is resistant to corrosion by chloride from sea water and salt, shows good carbonation resistance and resistance to alkali-silica reaction as well as no degradation by sulphate attack.

Moving forward

Similar developments are taking place in other areas of the world. It has been estimated that if the existing types of cement are replaced by the green types of cement and concrete, global CO₂ emissions could be reduced by 400Mt/yr.² This is the same as the annual CO₂ emissions of the whole of France. Furthermore, increased use of limestone and calcined clay has



Left: A FUTURECEM™ rail bridge in Lolland, Denmark.
Source: Torben Eskerod.



Right: A view of part of the Aalborg Portland cement plant in Aalborg, Denmark, where the Cemtir Research and Quality Centre is based.



been suggested in a recent road map for global low-CO₂ transition of the cement industry.³

However, when working with concrete today, cement and concrete compositions are based on threshold value requirements as defined by norms and standards. In practice, implementing innovative solutions is difficult, indeed it is sometimes impossible, within the framework of today's legislation. In the short term, limestone-calcined clay cement needs to be accepted in the national adaptations of the European cement standard. Therefore the European cement standard EN 197-1 must be updated to accept up to 50% clinker replacement by limestone-calcined clay. In the longer run, building codes and standards should support the green transition, for instance by boosting performance-based design

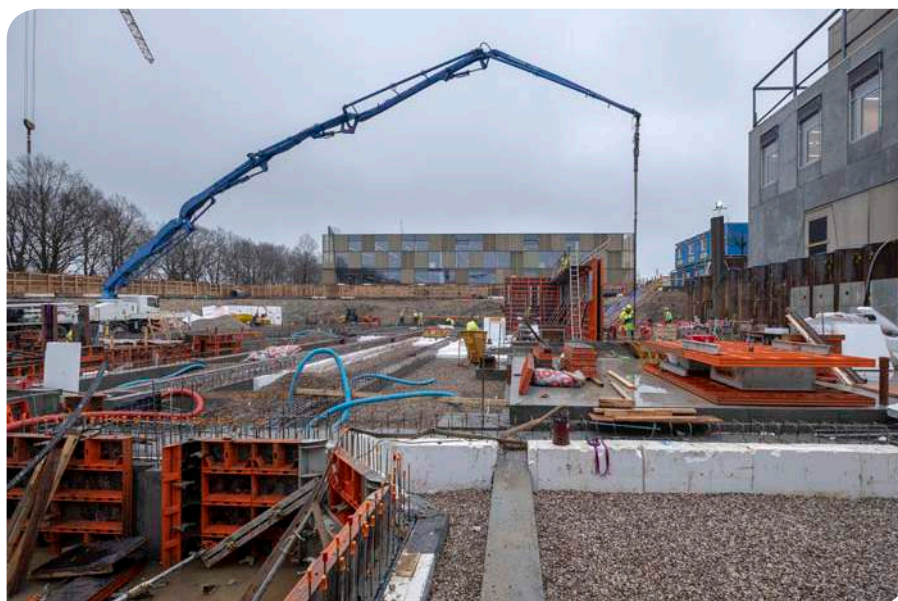
approaches in which composition thresholds are not a limitation.

Beyond cement

FUTURECEM™ is not only for the production of sustainable cement, but is also a sustainable binder as well as additive for concrete addition. As a sustainable binder, it powers new innovative solutions like Aalborg Extreme® Light 120. This is an Ultra High Performance Concrete (UHPC) based on AALBORG WHITE® cement, which is ready to be used (just add water), has reduced shrinkage and is self-compacting for the manufacture of thin/slim concrete products with high mechanical and durability performance and good aesthetics.

As a supplementary cementitious material, it can be used as a substitute for fly ash and blast-furnace slag, (which, as mentioned above, are in short supply), with very similar performance and higher sustainability.

Below: The new DTU Headquarters, built partly with FUTURECEM™.
Source: Torben Eskerod.



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Robert McCaffery, Global Cement Magazine

Review: Global Slag Conference 2019

The 14th *Global Slag Conference* has successfully taken place in Aachen, Germany, with 140 delegates from 36 countries in attendance. The 15th *Global Slag Conference* will take place in Vienna in April 2020.

1: Delegates listen to one of the event's 20 varied presentations.

2: Busy networking in the 'Speed Dating' session.

3: Charles Zeynel of ZAG International provided the opening presentation on the increasing challenges of obtaining slag.

4: Dan Rogers of Smithers Apex outlined future supply and demand scenarios for non-ferrous slags to 2029.

5: Charles Ochola, President of the US National Slag Association spoke about the status of slag and slag products in the United States.

6: Ryan Hyatt from Edward C Levy Co outlined the use of drone-based photogrammetry to analyse slag stockpiles. His presentation was voted the best of the event by delegates.

Charles Zeynel of ZAG International started the conference by saying what he has been saying for the last 15 years, that "slag is a good material, it's in great demand, and there is now not enough to go around." Charlie pointed out that 30% of China's steel production is made in EAF mills, meaning that no new blast furnaces will be built. Demand for slag is outpacing supply and the gap will continue to grow: SCM suppliers are steadily 'moving up the value chain.' Steel companies are now making a profit on slag production, but cement companies are now pushing back, particularly where the landed price of slag is higher than the local cost of clinker. Former users of slag products are looking for alternatives. However, there are tens of millions of tonnes of slag products (particularly in China) in stockpiles and hundreds of millions of tonnes of flyash in ash ponds around the world, that could be utilised by cement companies, and which allow a pushback against slag product price rises. On the other hand, there are multiple challenges to suppliers and to supply lines. "All participants must have a balanced view of sharing the benefits in the value chain." Charlie concluded that knowledge of the markets is paramount for reliable slag supply.

Dan Rogers of Smithers Apex next gave a forecast for the development of ferrous and non-ferrous slags to 2029. Dan gave a thorough breakdown of volumes and uses of slag in various regional markets and

industries. His message essentially backed-up that of Charles Zeynel, in that there are increasing shortages, particularly regionally, due to increasing global demand and due to variations in regional supply.

Charles Ochola, president of the US National Slag Association, gave the next presentation giving an overview of slag trends in North America. He appealed to delegates to work to promote slag as a product, rather than viewing it as a byproduct, or worse, as a waste. Charles suggested that increasing the value of slag in the eyes of users and regulators will bring advantages to all.

Marc Fixaris of ArcelorMittal next spoke about the development of air-cooled blast furnace slag (BFS) and steel slag in competitive local markets. He stated that 82% of the company's basic oxygen furnace (BOF) slag in Europe was 'valorised' in 2018. Marc stated that stringent efforts need to be undertaken to persuade potential users to use 'artificial aggregates' derived from slag, instead of natural stone. Each steel plant should be used as a showroom of solutions, and there needs to be an open and ongoing discussion with shareholders, politicians, stakeholders, journalists and citizens. Crucially, the producer needs to know their products, in terms of composition and behaviour. Once a buyer has been found, the producer's first priority is to provide quality products for long-term contracts. Marc mentioned just such a contract, to sell 5Mt of slag products from a steel





plant in Luxembourg to a local construction company, substituting for natural aggregates.

Andrey Korablin next gave details of business opportunities for slag recycling companies in Russia. Russia produces around 70Mt of steel each year, as well as 20Mt of metallurgical byproducts. Andrey showed a video of Vladimir Putin stating - in Russian, to a Russian audience - that the 300 most polluting industrial plants in Russia, many of them steel and other metallurgical plants, will be required to dramatically improve their environmental performance by 2021 or face forced closure. Andrey pointed out that European and other slag processing companies potentially have a strong future role to play in bringing value to the current and past production of slag-derived materials.

John Yzenas Jr of Edw. C. Levy Co. started the technical sessions of the conference with a presentation on the characteristics of slags. John compared the benefits of XRD and XRF for characterisation. XRD is now widely used as a quantitative approach and the results can be difficult to compare to the Bogue oxide calculations that are derived from XRF results. Many analytical approaches struggle with the variety of compositions and mineralogies that are present in slag products. "All slags are not the same," stated John.

Henning Schliephake of Georgsmarienhütte GmbH next introduced the NoWASTE approach to electric steel making, which produces, you guessed it, 'no waste.' The approach has arisen due to the likelihood of the non-availability of any kind of landfill option in the future in Germany. "First of all, you must know what residual materials you are making in your steel plant, and then, make sure to keep it separate! If it is accidentally or carelessly mixed, you have lost value." In the future we will not be able to use unimproved electric arc furnace (EAF) slag as a road-building component, due to high molybdenum and vanadium contents. Henning suggested that EAF slag should be considered as a liquid iron ore. It can be improved by reduction of iron through addition of reducing materials, to a composition closer to clinker.

Gerhard Auer of Ferro Duo GmbH next spoke about an ingenious approach to removing some heavy metals, particularly lead and zinc, from materials such as blast furnace sludge and EAF dust. The materials can be reacted with chlorine-rich 'solvents' such as a FeCl_2 solution from steel pickling or waste chlorides from the TiO_2 industry or widely-available HCl solutions. The heavy metals react to become ZnCl_2 and PbCl_2 , which have relatively low boiling points. During indirect heating in a rotary kiln the compounds are selectively volatilised and can be

7: Discussions take place in the exhibition area during one of the coffee breaks.

Below: All delegates were given the opportunity to introduce themselves during the 'meet the delegates' session.

8. Nguyen Thi Thu Cuc, Hoa Phat Trading, Singapore.

9. Paul Thorn, Golden Bay Cement, New Zealand.

10. Frank Henning, VDZ, Germany.





11: Discussions on the Swiss Trade stand.



12: York Reichardt of KHD Humboldt Wedag GmbH explains an aspect of his company's slag processing equipment to a trio of delegates from TATA Steel.



13: Volkert Feldrappe of the FEhS - Institut für Baustoff-Forschung (right) in discussion with delegates from Malaysia's CMS Cement.



14: The PEWAG & ROCWORKS stand was the scene of some interesting discussions.



15: Lively interactions during one of the coffee breaks.

16-17: The *Global Slag Awards Dinner* was held at the Tonnengewölbe, Ratskeller in central Aachen.



removed in the process gas for condensation and recovery. A 'mineral compound' is left behind with near to zero heavy metal content, composed of FeO , CaO , carbon and SiO_2 . This material can be recycled back into either steelmaking or cement manufacture, as a raw material or as a fuel, since it has a carbon content of 40%.

"Is it possible to correlate granulated slag analytical results with reactivity?" was the question posed by **Andreas Ehrenberg** of the FEhS, with his answer being "No... or at least, not easily." This is because there are many factors in slag product reactivity, including blast furnace processes, slag viscosity, slag composition, glass formation, storage conditions, the granulation technology used and the specific granulation conditions in each case. GBS may even vary from heat-to-heat. However, laboratory-scale granulation test and mortar tests

are a good start towards predicting slag reactivity.

Yusuke Kato of JFE Steel of Japan next spoke about research that involved oxygen injection into molten slag to promote the exothermic oxidation and increased dissolution of MgO in Fe_2O_3 -rich BOF slag. This process eliminates MgO from the cooled slag, so that hydration and volume expansion can be avoided.

Ryan Hyatt of Edw. C. Levy Co. next spoke about the use of drone-based photogrammetry to measure slag product stockpiles, showing delegates some impressive photo-realistic 3D images of slag product stockyards, which can allow an accurate calculation of stockpile volumes.

Global Slag Awards Dinner

The *Global Slag Awards Dinner* took place at the Tonnengewölbe in the Ratskeller Aachen (barrel-vaulted cellars of Aachen's town hall), featuring the presentation of the Global Slag Awards 2019. Global Slag Company of the Year was Tata Steel Ltd, while slag user of the year was LafargeHolcim. Slag Plant of the year was awarded to the Steelphalt plants of Harsco in the UK, while the slag product of the year was awarded to Koranel synthetic minerals, produced by Metallo Belgium NV. The technology supplier of the year went to Loesche, and the Global Slag Technical Innovation Award went to Tapojärvi Oy of Finland, for its slag-based geopolymers. The Global Slag Personality of the Year went to Michael Connolly of TMS International LLC.



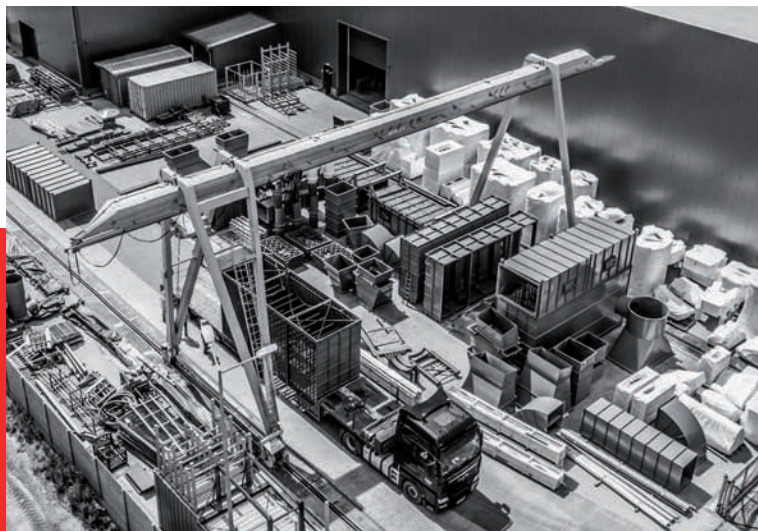
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18: Dirk Schmidt from KIMA Process Control presented on the topic of slag grinding optimisation.



19: Discussions on the SAFERtech stand.



20: Slag processor and supplier Ferro Duo was represented by (left to right): Marina Spanka, Andre Hügen, Dominik Kehrmann and Gerhard Auer.



21: Harsco's Nick Jones (left) in discussion with Edward C Levy Company's John Yzenas and Kelly Cook, both of whom presented at the conference.



22: Smartsrap's Andrey 'Slag' Korablin gave a passionate presentation about the potential for slag processing companies in Russia.



23: GPS-Global Solutions' David Roth makes a point during his presentation on upgrading ladle slag.



24: Loesche's Winfried Ruhkamp presented on the topic of dry granulated BF sand, for which he won the prize for second-best presentation.



25: KHD Humboldt Wedag's York Reichardt provided a range of slag grinding case-studies.



Second day

The first speaker on the second day of the conference, **Dr Winfried Ruhkamp**, with co-authors Holger Wulfert and Horst Ludwig, spoke on a Loesche separation plant for the production of ultra-fine granulated blast furnace slag. Due to low reactivity, only the smallest slag particles ($<2\mu\text{m}$) contribute to early strength in slag cement, whereas large particles ($>60\mu\text{m}$) make virtually no contribution to final strength development. Winfried gave some details of an approach to deliver ultra-fine slag grinding, using an additional cyclone separator group. Approximately 13% of the normal ground granulated BFS that is produced from a Loesche mill can be separated as an ultra-fine product. Using such ultra-fine slag may allow a clinker factor down to 30%, as well as applications in shotcrete, providing low heat of hydration and high early strength. Ultra-fine GGBFS can also be used to produce ultra-high-performance concrete with strength of beyond 150MPa compressive strength, at a lower cost than when using silica fume, partly due to the complete filling of all voids in the concrete.

York Reichardt of KHD next spoke about the energy consumption and total cost of grinding of three different designs of grinding plants: a vertical roller mill, a roller press with finish grinding, and a ball mill, each grinding slag of the same grindability and at the same throughput rate and Blaine fineness. York showed calculations suggesting that the roller press with finish grinding had the lowest total costs.

Dirk Schmidt of KIMA Process Control next spoke about Smartmill 'electronic ears' and

Millmaster (software) approaches to grinding optimisation. Dirk pointed out that having a measurement of the fill level of first and second chambers of a ball mill gives an indication of the grindability of the clinker being fed, and allows control over grinding. It also allows the discovery of problems such as blockages or even a hole in the diaphragm between the chambers. Temperature measurements in the chambers also give useful information and the possibility to take control action, for example with additional moisture input. Millmaster software ensures stable operating conditions in the mill, in combination with data from the Smartmill 'ears.'

Next up was **Jürgen Haunstetter** of the German Aerospace Centre, who introduced the REslag project to find higher value uses for steel slags, including as refractory materials, and, the theme of his presentation, as a solar-thermal energy storage medium. Jürgen said that sintered slag is first pelletised to optimise packing. Expansion of the slag during the heating phase of the solar-thermal system can lead to stresses on the pellets and on the thermal energy

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storage vessel and its internal insulation. Endurance tests were undertaken in a pilot plant to discover if the slag pellets could survive repeated heating and cooling and the stresses involved. Damage was limited to below 10% by weight and the slag pellets were deemed as being suitable for thermal energy storage. A 12m height vessel would use 30,000t of sintered slag and the pellets would have a lifetime of approximately 20 years.



26

Dave Roth of GPS-Global Solutions next spoke on means to upgrade different sizes of solidified ladle slag through the use of Didion rotary impact crushers. The primary objective was to increase metal recovery, while controlling the production of fines, particularly metals fines (which leads to metal loss). Larger lumps can be broken using an internal lump-breaker, while smaller particles can be broken open in an autogenous grinding process, using internal lifting plates in the rotary grinding machine.

Victoria Masaguer Torres of ArcelorMittal next gave an update on the neutralisation of acid drainage waters with passive treatments using slag-based byproducts. Acid mine drainage, containing high concentrations of sulphide minerals, is a worldwide problem. BOF slags can be used as an ion...



26: Gerhard Auer of Ferro Duo GmbH spoke about an ingenious approach to removing heavy metals from blast furnace sludge and EAF dust.



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Scan the QR code below or enter the bit.ly code into your web-browser to read more about Day 2 of the *Global Slag Conference & Exhibition*, see the video of the event and access the full event photo gallery....

See more
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27: Victoria Masaguer Torres of ArcelorMittal updated delegates on the neutralisation of acid drainage waters using slag-based byproducts.



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US: Automated bagged package Distribution with KEITH® Freight Runner®

KEITH® Manufacturing Co is promoting its Freight Runner® dock-to-trailer conveying system, which can reduce the time taken to load or unload bagged cement onto trucks from 45-60 minutes to under five minutes.

The dock-to-trailer conveying system integrates packaging automation with shipping, addressing major issues associated with the loading and unloading of cargo at the dock. By seamlessly connecting the dock conveyor to the trailer conveyor, loading/unloading is both safer and faster. Personnel or equipment no longer need to cross the threshold of the trailer, eliminating confined space entry and reducing forklift damage to cargo or trailers.

The chain rail conveyor is designed to create seamless cargo transfer between dock and trailer. Installed in both the trailer and at the dock, it replaces the standard, manual process of cargo handling that includes a forklift operator and/or an employee using a pallet jack.

Below: The KEITH® Freight Runner® dock-to-trailer conveying system.



Philippines: Holcim contract for CMR Philippines

Holcim Philippines has ordered power monitoring equipment from CMR Philippines for its 2.3Mt/yr Lugait cement plant in Misamis Oriental. It includes the development, delivery, installation, testing and networking of the electrical installation at the unit. Current and voltage transformers are to be supplied as part of a package of engineering support that also sees CMR completing the integration and connection of plant wide power monitoring to Siemens PCS 7 process control technology.

"Winning the Holcim contract reflects the expertise we can bring to successfully deliver complex and technologically-advanced industrial projects," said Rojel Rivera, general manager at CMR Philippines.

CMR Philippines is part of the CMR Group, which designs, manufactures and commissions automation, control system and turnkey project solutions for global industrial and renewable energy sectors, alongside specialist instrumentation for high power diesel engines.

Vietnam: Xuan Thanh order for FLSmidth

Xuan Thanh Cement has ordered a new production line for a plant in Ha Nam Province from Denmark's FLSmidth for around Euro74m. FLSmidth will design and engineer the new clinker production line and deliver equipment for the entire production from crushing to clinker silo. The order is due to be fully delivered by the end of 2020, and, once operational the production line will have a capacity of 12,500t/day. In 2015, Xuan Thanh Cement placed a similar order for a production line that has been operating since 2017.



India: Rail deal for Penna

Penna Cement has signed a five year freight tariff deal with South Central Railway (SCR). As part of the agreement the rate will remain fixed for one year, according to the New Indian Express newspaper. The contract also offers incentives, including discounts if the freight volume exceeds the previous year's amount. Penna Cement is the eighth company to sign such an agreement with the SCR.

Pakistan: Flying order for FLSmidth

Flying Cement has ordered a 71-6 OK model cement mill from Denmark's FLSmidth for its new 7700t/day production line at its Mangwal plant. The mill will be designed to grind Ordinary Portland Cement (OPC) at a capacity of 415t/hr. Commissioning is expected in 2020, and the mill will be supplied together with an FLSmidth ILC Preheater System, 2-Base Kiln, Cross-Bar Cooler, ROKSH 119 Separator, MAAG WPV-5000 Gear, Heat Exchanger and three filters. No price for the order has been disclosed.

World: FCT announces details of global burner projects

FCT Combustion has released details on new burner projects it is involved with. Selected projects include a new contract in the US to convert both kilns to natural gas firing at Ash Grove Cement's Louisville plant in Nebraska. The order includes Gyro-Therm MKII Burners, Natural Valve Trains and NFPA 86 BMS for both of the plant's kilns.

Nova Cimangola in Angola has contracted FCT to convert its 5000t/day kiln to fuel oil firing. The order includes a multi-fuel main burner, calciner burners, oil heating units, oil pumping and filtering units and control panels.

FCT also provided details about a low NO_x kiln conversion

for an undisclosed client. Other selected cement sector projects include the commissioning of Turbu-Flex burner systems (shown) for clinker kilns at Finnsementti's Parainen and Lappeenranta plants in Finland, which had been scheduled for completion in March and April 2019 respectively.

FCT also announced plans to deliver a Turbu-Flex burner system to an undisclosed Chinese client. It is based on a computational fluid dynamics (CFD) study undertaken by FCT to allow for the firing of natural gas and to modernise the plant.

Read more about the FCT Turbu-Flex burner on Page 36 in this issue!



Netherlands: Malvern Panalytical launches new Epsilon XRF spectrometer

Malvern Panalytical has launched a next version of Epsilon X-ray fluorescence (XRF) spectrometer. The upgrade has reduced the product's size to 0.15m². Its precision has been improved by integrating a high-power X-ray tube and a new detector.

"With the new generation of our compact Epsilon 1 benchtop XRF spectrometers, you can take a small-yet-powerful lab directly to your sample for fast product screening and process control," said Lieven Kempnaers, Malvern Panalytical Product Manager for benchtop XRF systems.

The Epsilon 1 product is available in a number of versions tailored for different applications. The Epsilon 1 Lube Oil delivers ASTM 6481-compliant elemental analysis of unused lubricating oils; the Epsilon 1 Sulfur in Fuels quantifies sulphur content in fuels according to ASTM D4294-10 and ISO 20847; the Epsilon 1 Academia enables characterisation of unidentified samples, using Omnia software for standardless analysis; and the integrated camera in the Epsilon 1 for Small Spot Analysis simplifies the investigation of very small objects, inclusions or inhomogeneities.

World: Entsorga plants in US, Hungary and Belarus

Italy's Entsorga is working on alternative fuel projects for cement plants in the US, Belarus and Hungary. In the US it has signed a contract to supply a 60,000t/yr Pelican feed line at Argos Cement's Martinsburg plant in West Virginia. It follows a long-term off take agreement in place with the cement producer to supply alternative fuels.

In Belarus the waste engineering company plans to install an alternative fuel feed line at the Krasno cement plant. Local subsidiary EntsorgaFin will define the material acceptance standards and provide the design for the fuel feed station and feed line.

In Hungary Entsorga was awarded a contract for the supply of an alternative fuels automated handling and feeding system in January 2019 with an unnamed global cement producer. It will provide its Spider and Pelican products to the end user.

Thailand: SCG signs solar deal

SCG Cement has signed a Memorandum of Understanding with France's Constant Energy to build 50MW of solar photovoltaic (PV) units at its plants and associated companies. The target is to deploy and commission the solar PV plants over the next three years, through rooftop-based, ground-mounted and floating solar PV plants. Engineering of a first solar PV plants has started and the pre-construction permitting and licensing process will be handled in the second quarter of 2019, followed by construction.





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Germany: Cemex to sell northwest RMC and aggregate assets

Cemex has reached a binding agreement to sell its aggregates and ready-mix concrete (RMC) assets in the north and northwest regions of Germany to GP Günter Papenburg for around Euro87m. It expects to close the divestment during the second quarter of 2019. The assets in Germany being divested consist of four RMC plants and four aggregates quarries in north

Germany, and 14 RMC plants and nine aggregates quarries in northwest Germany.

The proceeds expected to be obtained from this divestment will be used mainly for debt reduction and for general corporate purposes. The transaction is subject to standard regulatory approval.

US: Votorantim buys up United Materials

Brazil's Votorantim Cimentos has acquired United Materials, a producer of aggregates, concrete and building materials, for an undisclosed amount. The purchase was conducted by its subsidiary Votorantim Cimentos North America. United Materials operates four ready-mix concrete plants, one aggregate quarry and two building materials units in the western part of New York state. It has ~140 employees.



Germany: Five CSC certificates for Cemex

Cemex has received certification from the Concrete Sustainability Council (CSC) for five of its ready-mix concrete (RMC) plants in Berlin and Potsdam. The CSC acts as a certification system, grading building materials facilities on environmental, social and governance practices throughout supply chains. The auditing was conducted by Kiwa Deutschland, an independent certification body recognised by the CSC.



Poland: Lafarge Poland delivers 200,000m³ of concrete in 2018

Lafarge Poland delivered over 200,000m³ of ready-mix concrete (RMC) in 2018 for use in various infrastructure initiatives including road expansion projects. In 2019 the company plans to produce 0.32Mm² of concrete surfacing for a motorway extension. The subsidiary of LafargeHolcim set up its LH Engineering business in 2017 to help implement infrastructure projects. It offers engineering services and the delivery of building materials, including RMC, aggregates and other products.

France: Unibéton buys BHS-Sonthofen batch mixer to help with Grand Paris Express work

Unibéton, part of HeidelbergCement, is producing specific ready-mix concrete for the 'Grand Paris Express' infrastructure project. To optimise its production process, the company replaced a planetary mixer with a DKXS 4.50 twin-shaft batch mixer from BHS-Sonthofen. For the first time in France, the mixer was installed with frequency converters to enhance operations. The company says that the new mixer is a 'major asset to secure the homogeneity of the special concretes.'

"With this mixing line we are producing close to 750m³/day of concrete or around 15,000m³/month," said Stéphane Haffreingue, responsible for Unibéton's operations in the Paris region. "Since the twin-shaft batch mixer has been installed, we have boosted our quality considerably."



Above: The Grand Paris Express project is the largest infrastructure project in Europe. It involves the construction of four entirely new Metro lines, as well as upgrades to a number of other existing lines. By 2030 the network will have doubled in size.
Source: BHS Sonthofen.



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Greece: Titan's results driven by US economy

Titan Group's profit growth in 2018 was predominantly due to its US operations. However, negative currency exchange rate effects have dragged on its financial results. Overall, its turnover fell by 1% year-on-year to Euro1.49bn in 2018 from Euro1.51bn. Its



earnings before interest, taxation, depreciation and amortisation (EBITDA) decreased by 5% to Euro260m from Euro273m. However, its net profit rose by 26% to Euro53.8m from Euro42.7m.

By region, the US region reported rising turnover and stable EBITDA in US Dollar terms. An improvement in results was recorded in Florida, counter-balanced by the lower profitability of the mid-Atlantic region, which was affected by protracted inclement weather and an increase in competition in the broader New York area.

The market remained poor in Greece with falling turnover and earnings. Markets in south-eastern Europe recorded increases, although rising energy costs were a concern. Continued problems were reported in Egypt and Turkey due to additional input costs and market conditions, respectively.

Italy: Colacem buys Spoleto plant

Colacem says that it has purchased Cemitaly's Spoleto cement plant in Perugia, according to the Il Sole 24 Ore newspaper. No value for the transaction has been disclosed. Colacem said that it was confident that the cement sector will have a 'significant' role in the future. HeidelbergCement's subsidiary Italcementi acquired Cementir and the Spoleto plant in 2017.

Czechia: Hranice's sales grow on strong demand

Cement Hranice's sales grew in 2018 due to demand for building materials. Its sales rose by 10% year-on-year to Euro65.8m in 2018. Its profit rose by 16% to Euro19.9m. As in previous years it supplied fellow subsidiaries of Buzzi Unicem in Czechia and Slovakia.

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UK: Terminal application for Cem'In'Eu's Thamesport Cement subsidiary

Thamesport Cement, a subsidiary of France's Cem'In'Eu, has applied for planning permission to build a grinding plant at the London Thamesport seaport on the Isle of Grain in Kent. The unit is expected to cost around Euro21m.

It is proposed that all the mineral raw materials will be imported by sea and the finished cement will then be transported by road either in bulk or in bags. Around 0.48Mt/yr of raw materials will be imported to the site, comprising 24,000t/yr of gypsum, 72,000t/yr of limestone and 384,000t/yr of clinker. Ships will be unloaded using cranes at the wharf. The plant will have six silos with a capacity of 500t for finished products. It is expected to create 35 jobs.



Above: Cem'In'Eu's Aliénor Ciments plant in Tonneins, France was the first of the company's seven planned grinding units across France, Poland and the UK.



Germany: HeidelbergCement expects increased sales in 2019

HeidelbergCement expects increased sales volumes for its cement, aggregate and ready-mix concrete products in 2019. It plans to raise its prices to regain margins it lost in 2018. The building materials producer also intends to continue the cost cutting programme it started in November 2018. It said that energy cost inflation, improvements in Indonesia, Europe and North America, and new state infrastructure projects should result in 'solid result improvement.'

"In view of our strong positioning in raw material reserves and production sites in attractive locations, the unique vertical integration, our excellent product portfolio and our industry-leading margin management, we believe we are well equipped for the opportunities and challenges of 2019," said Bernd Scheifele, chairman of the managing board of HeidelbergCement. He added that the group will continue the digitalisation process of its entire value chain in order to further improve operational excellence.



Portugal: Waste cellulose and clay used to make 'eco-cement'

Researchers at the Department of Materials Engineering and Ceramics at the University of Aveiro have developed a so-called 'eco-cement' that uses waste cellulose and clay. The cement type uses waste from the pulp industry such as ash and lime grains. This makes up 70% of its composition with the remaining 30% being metakaolin clay. The cement can be manufactured at room temperature reducing its energy consumption massively compared to Ordinary Portland Cement. The research team includes Manfredi Saeli, Rui Novais, Paula Seabra and João Labrincha.



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Italy: Dust dispute in Monselice for Buzzi Unicem

The Buzzi Unicem cement plant in Monselice, Padua, has come under fire from concerned locals following an emission of dust on 25 March 2019. Local press reported that the plant failed to notify residents following an emission of raw meal for at least three hours and not until plant staff had been telephoned by the media.

The plant uses marl and supplementary raw materials, the alleged unclear origins of which have particularly animated local environmentalists. Environment Councillor and mayoral candidate Gianni

Mamprin said, "They say it's just dust, but I don't trust them. A plant of this type is incompatible with the tourism project that we want to implement in Monselice. Above all, Article 19 of the Environmental Plan of the Colli Park states that (it) is an incompatible plant in a natural park. If I am elected mayor of Monselice, I will actively commit to the closure of this unhealthy plant, because this territory does not need a factory that continually creates anxieties and doubts for citizens."

Spain: Çimsa buys Cemex's Spanish white cement unit

Turkey's Çimsa Çimento has purchased Cemex's white cement business in Spain, including its Buñol plant, for around US\$180m. Cemex expects to close the divestment during the second half of 2019. The proposed divestment does not include Cemex's white cement business in Mexico, nor its interest in Lehigh Cement in the United States.



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Russia: Eurocement updates on two projects

Eurocement is close to completing a Euro2.5m upgrade to a cement grinding mill at its Katavsky cement plant. The project was intended to improve the quality of its cement products and to replace the mill's filter sleeves. The unit uses Christian Pfeiffer separators, Aumund elevators, Siemens automation systems and Vega grinding media. Pre-commissioning is currently being completed and cement from the mill is being tested at a laboratory.

The cement producer's Kavkaztsement plant is building a captive power plant scheduled for commissioning in August 2019. It has completed the construction of the building that will house the gas combustion engine power station as well as other connecting structures. Employees from the plant are being trained by Wärtsilä in preparation for the start up. The project has an investment of around Euro15m.

France: Second phase of Martres-Tolosane upgrade gets underway

LafargeHolcim France has started the second phase of a Euro100m upgrade project its Martres-Tolosane cement plant. It is starting the construction phase of a new production line following the completion of site preparation and civil engineering. French company Bocard is coordinating the work. Commissioning of the upgrade is scheduled for mid-2020.



UK: Flood defense work starts at Cemex South Ferriby

Construction work has started on a new flood embankment west of Cemex's South Ferriby cement plant in North Lincolnshire. New brick-clad walls will also be built around Ferriby Sluice. The project, led by the Environment Agency, has an investment of around Euro14m. The scheme is scheduled for completion by 2021.

"We are delighted to be contributing building materials to construct the new flood defences. In December 2013 floods damaged the plant putting it out of production for over 12 months and causing immense damage to local homes and businesses. It was estimated that over Euro55m worth of damage was caused," said Piotr Klepak, Cemex Plant Director.



Above: From left to right: Mike Dugher (Environment Agency), Graham Frudd (Bentleys (Contractor)) and Piotr Klepak (Cemex UK).

Moldova: Rybnitsky having a gas

The Rybnitsky Cement plant in Moldova has significantly cut its production costs due to a cheap gas deal, according to Radio Chişinău and the Infotag News Agency.

The deal ensures that Rybnitsky is paying just a quarter of the amount that its local competitor, the LafargeHolcim-owned Rezinsky Cement plant, pays for gas. In 2018 the Moldovan government held off renewing a supply contract with Russia's Gazprom to see if cheaper options were available elsewhere.

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US/Mexico: Cemex to roll out AI Autopilot around the world

Cemex has entered into a global agreement with Petuum to implement its Industrial AI Autopilot software products for autonomous cement plant operations at its plants around the world. The products for cement plant operations are being deployed at select Cemex USA and Mexico plants and will continue to be rolled out in 2019.

"We expect our yield improvements and energy savings to be up to 7%, from the connected AI-based autopilots, which is game-changing for our industry," said Rodrigo Quintero, Operations Digital Technologies Manager at Cemex.

Petuum says that its Industrial AI Autopilot suite of products can deliver real-time forecasts for key process variables, prescriptions for critical control variables and supervised autosteer aligned with business objectives for all cement plant operations including clinker cooler, preheater, rotary kiln, pyro-process, ball mill and vertical mill processes to achieve lowered energy consumption, optimised fuel mix and increased

throughput while maintaining stable operation and product quality. The products are integrated with plant control systems and OSIsoft PI data infrastructure for scalable and standardised deployments across multiple lines and plants globally.

The joint Cemex and Petuum teams achieved a cruise-control-like supervised 'autosteer mode,' where the AI Autopilot could run operations with full engage-disengage control available to the operator.



Mexico: Cemex to invest US\$850m on expansions and green energy

Rogelio Zambrano, president of the board of directors of Cemex, says that the group intends to spend US\$850m towards expanding existing cement plants and promoting renewable energy projects in 2019. Around US\$160m will be invested in Mexico, mainly in central and southeastern plants, according to the

Expansión newspaper. Zambrano made the comments at an annual investors meeting. The group has also published its integrated report for 2018. It reported a 27.1% alternative fuels substitution rate for the business and a 26% rate of power consumption for cement production from renewable sources.



Bolivia/US/Mexico: US court confirms GCC fine

The US District Court of Colorado has confirmed compensation of US\$36.1m awarded to Bolivian investment company Compania de Inversiones Mercantiles (CIMSA) from Mexico's Grupo Cementos de Chihuahua (GCC). The arbitration follows a dispute that started in 2011 between CIMSA and GCC about the sales of shares in the Sociedad Boliviana de Cemento (SOBOCE) to Consorcio Cemento del Sur de Perú.

GCC said that it will continue to dispute the ruling and that it would continue to fight the legal case in Bolivia. In 2015 local courts in Bolivia overturned damages imposed by the Inter-American Commercial Arbitration Commission (CIAC) upon GCC.

Paraguay: FLSmidth to supply new plant in Concepción

Denmark's FLSmidth will supply equipment for a new 1Mt/yr cement plant being built in Concepción. The unit is expected to be commissioned in mid-2021 and it has an investment of US\$180m. The project is being financed by the Cartes Group, the Jiménez Gaona Group and José Ortiz.

Argentina: Loma Negra secures loans for L'Amali

Loma Negra has secured two loans to upgrade Lits L'Amali cement plant. The loans are worth US\$40.9m and US\$12.5m, respectively. The cement producer will use the funds to import equipment to the plant as part of a project to build a new US\$350m production line at the unit.



Chile: Bío Bío becomes 'Cbb'

Cementos Bío Bío has changed its name to Cbb as part of a rebranding exercise for the digital age and to target growth outside Chile. Cbb's CEO Enrique Elsaca said that the change is part of the company's Transforma 2021 plan, including investment of US\$150m in Chile, Argentina and Peru. Cbb is about to inaugurate a cement grinding plant at Arica in Chile and plans to build a US\$20m plant at Arequipa in Peru for commissioning in early 2020.



US: New mill for CalPortland

CalPortland has commissioned a new cement grinding mill and distribution system at its Oro Grande cement plant in California. The US\$58.5m project includes the construction of the finish ball mill and two new cement shipping lanes with two new distribution silos. It completes a partial plant modernisation program that was originally completed in 2008, prior to the acquisition of the facility by CalPortland. The Oro Grande cement plant was purchased from Martin Marietta Materials in mid-2015.

The project began in January 2018 and was constructed by general contractor ThyssenKrupp and sub-contractor The Industrial Company (TIC), in collaboration with CalPortland's Engineering Services team.

The mill is a Polysius two compartment mill with production capability of around 180t/hr. It is equipped with motor, mill and separator technology as well as cement cooler design technology. The system also employs mechanical conveyance (bucket elevator) to convey finished product to the new silos, reducing its energy requirements. These additional systems are being added to the Oro Grande plant.

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Guatemala: Cementos Progreso starts up San Gabriel plant

Cementos Progreso said that its new San Gabriel cement plant began its testing and commissioning process in March 2019. Plant manager Heber Barrios Valenzuela said that this stage of its set-up began in 2018 and will continue throughout 2019. The unit had an investment of US\$500m. Initial work on the project started in 2008 and construction work began in 2013.

The new integrated cement plant will have a clinker production capacity of 4500t/day when fully operational. Key features include a 1.5km conveyor from the quarry to the plant with a capacity of 1000t/hr. After raw material grinding, pre-heating, the kiln and the cooler, the production line has a 70,000t clinker silo. This is

followed by two vertical cement grinding mills, each with a capacity of 220t/hr. For packaging and despatch the plant has four cement silos. Two of

these have a capacity of 10,000t for bulk cement. The other two have a capacity of 5000t for bagged cement. The plant also uses a 0.15Mm³ rainwater reservoir to store water used to cool machinery.



Bolivia: Domestic cement prioritised

Weimar Pereira, vice-minister for Medium and Large Scale Industrial Production, says that the government is close to signing new rules for cement industries that will prioritise domestic products over imported asphalt on roads and for public works. He made the statement in talks with local producers Fábrica Nacional de Cemento (FANCESA) and Cooperativa Boliviana de Cemento, Industrias y Servicios (COBOCE) as well as union representatives, according to the Correo del Sur newspaper. The new rules are expected to be implemented by August 2019.

Colombia: Argos Group to invest US\$819m in 2019

Argos Group plans to invest US\$819m in its cement, construction and energy subsidiaries in 2019. The spending at Cementos Argos will aim to double the company's earnings from 2018 to 2023.



Panama: Government to introduce hexavalent chromium tests on imported cement

Panama's Ministry of Commerce and Industries (MICI) is planning to introduce regulations testing cement imports for hexavalent chromium (chromium VI). Edgar Arias, Director of Standards and Industrial Technology at the MICI, said at a trade forum that the new rules had been agreed.

At present cement is tested at the discretion of the importer. Under the new



regulations cement will be tested before it leaves its country of origin, when it arrives in Panama and for a third time at the point of sale, at the discretion of the authorities.

Panama imports 10,000-20,000t/month of cement from countries that include China, Turkey and Vietnam. Around 20 importers handle the market. Import tax on cement ranges from 10-20% depending on the point of origin.

Barbados: CARICOM sides with Rock Hard in Arawak dispute

The council of trade ministers in the Caribbean Community (CARICOM) has agreed to the classification of Rock Hard Cement's products in Barbados. Rock Hard Cement has faced legal action from its competitor Arawak Cement about the designation of its products and the tariffs they incur. The matter will now be referred to the Caribbean Court of Justice (CCJ) in June 2019 for final arbitration.

Trinidad Cement, the owner of Arawak Cement, took legal action against Rock Hard Cement in the CCJ alleging that Rock Hard was misclassifying its products as 'other hydraulic cement' instead of 'Portland cement-building cement grey' which has a lower import duty. The World Customs Organisation and CARICOM's Council for Trade and Economic Development (COTED) have now both ruled in favour of Rock Hard Cement.

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GLOBAL CEMENT NEWS: THE AMERICAS



US: Clinchfield achieves first cement plant ISO 14001:2015 accreditation in US

Cemex USA's Clinchfield Cement Plant in Georgia has been awarded the ISO 14001:2015 certification for its environmental management system (EMS). It is the first Cemex cement operation in the US to earn this certification. The EMS at the plant follows a continuous cycle of environmental policy: planning, support and operation, performance evaluation and improvement.

The International Organization of Standardisation (ISO) developed ISO 14001:2015 as a standard of processes for organisations to use when setting up, improving or maintaining their environmental management systems to follow established environmental policies and requirements. The guidelines are designed to help organisations improve efficiency, reduce waste, improve overall environmental impact and manage environmental obligations.

The Clinchfield Cement Plant is also one of several Cemex sites to achieve certification from the Wildlife Habitat Council. The plant is also active in the Georgia Black Bear Project. Cemex is currently in the process of achieving ISO 14001:2015 Certification at its eight other active cement plants in the US.

US: Fire at Dragon Products

A fire has damaged Dragon Products' Thomaston cement grinding plant in Maine. The incident took place on the evening of 26 March 2019 following a spill of fuel oil, according to the Portland Press Herald newspaper. The blaze was stopped by firefighters as it started to enter a laboratory and control rooms. No employees were injured.

Plant manager Martin Turecky said that no customers would be affected by the fire and that it was continuing to distribute cement. He added that the cement plant itself had not been affected. An investigation into how the fire started is underway.



Interview by Peter Edwards, Global Cement Magazine

In discussion: Mike Ireland, PCA President

The past 12 months have been a period of transition for the Portland Cement Association (PCA), as its President and CEO Mike Ireland explains...



Above: Mike Ireland has been PCA President and CEO since the autumn of 2017.

Global Cement (GC): Thank you for speaking to *Global Cement* once again. What's been happening at the PCA over the past 12 months?

Mike Ireland (MI): I would say that the past 12 months have been a period of transition at PCA and our industry, particularly in terms of how we interact with other associations and sectors. We have clarified our roles and are seeking to become more efficient with the resources we have, for the benefit of our members. There is a shift towards protecting the industry at high level and preparing it for future changes in terms of regulations, the economy and so on.

A large part of our recent work has involved seeking closer links with other associations. A year ago, five building material associations were looking to form a broader alliance, perhaps similar to the Mineral Products Association (MPA) in the UK. In particular we have developed a relationship with the National Ready Mix Concrete Association (NRMCA). As part of this, it sold its former premises and will move into the same building as the National Stone, Sand and Gravel Association (NSSGA). We have started to share back office operations with these two associations, things like accounting, human re-

sources, benefits and IT. This helps the associations share these costs, freeing up cash for front-line work.

As part of our wider repositioning, we have moved our Washington DC office to be closer to Capitol Hill and will provide spaces for NRMCA, NSSGA and 12 other concrete-related associations in that facility so that they are all closer to the decision makers. Elsewhere we have made some conscious decisions to discontinue some of our activities, with a shift towards a more effective member-focused set-up.

GC: What have been the biggest 'wins' for PCA from an advocacy standpoint?

MI: There are a few, each in a different area. On the environmental side, we have developed a very good relationship with the Environmental Protection Agency (EPA) and were able to work with it to maintain emissions requirements and controls under the EPA's Residual Risk & Technology Review, which ensures stability in regulations until 2021.

We have also worked with the Mine Safety & Health Association (MSHA) to reduce the paperwork burden in terms of the Workplace Exam Rule. We have continued to develop our relationship with that association.

We have done a lot of work on transportation and infrastructure too, which is a really hot topic in the US, as you will know. For example we have secured funding for research in airfield pavement technology and have also successfully helped the Disaster Recovery and Reform Act, which places a greater emphasis on pre-disaster mitigation, to pass. 2018 was a year of extreme weather for the US, with fires, major hurricanes, winter storms and floods. Concrete structures offer the best protection against many of these phenomena and it is great to emphasise the benefits of concrete with this legislation.

GC: Aside from changes on the environmental side, how else has the Trump Administration affected your members?





MI: We welcome a reduction in the regulatory burden with respect to some elements of health and safety paperwork, as I mentioned earlier. We are also happy to see the push for the big Infrastructure Bill. There's nobody in Washington DC that thinks the country's infrastructure is okay, so hopefully the President will take a lead on that. The issue is how to fund it.

A number of commentators, including our own Chief Economist Ed Sullivan, suggest an increase to the Gas Tax, although that's politically charged. However, there is more support than you might think. We hear from user groups, like the Chamber of Commerce and the major trucking associations, that they would welcome an increase in the Gas Tax to fund much-needed improvements to the nation's infrastructure. We're actually working on life-cycle analyses to show the benefits of concrete over the longer term. This will help politicians and legislators to demonstrate that their decisions regarding the use of concrete are fiscally sound in the longer term.

GC: What do you make of the recent negative coverage of concrete in the UK's Guardian newspaper?

MI: That coverage certainly registered very strongly within the cement and concrete industry in the US and to some extent with the general public. The PCA echoes the stance of the Global Cement & Concrete Association (GCCA), CEMBUREAU and others in stating that the coverage clearly didn't give the whole picture. We sent out a response in association with the Massachusetts Institute of Technology (MIT) to carry this message.

GC: What are the PCA's relationships with the new major associations like the GCCA?

MI: PCA is an Affiliate Member of the GCCA. In March 2019 we hosted the other Affiliate Members at our Washington DC office to discuss a number of issues about the work we can do together as part of the GCCA. The GCCA is also involved in MIT's Concrete Sustainability Hub (CST) steering committee, which is currently looking at its research plans for the next five years. There could be significant benefits for other GCCA Affiliate Members from the work that PCA and MIT has already carried out.

The GCCA has certainly hit the ground running and is growing fast. It's had some obstacles thrown its way, for example the Guardian coverage. However, it acquitted itself really well. They have a lot of good people, the right members and significant resources. We look forward to developing a very strong and productive relationship.

GC: What are the PCA's aims for the next year?



MI: The most important thing, which I alluded to earlier, is that we prepare the industry for future changes in terms of US politics, the economy and environmental legislation. Politically-speaking, the recent US Administrations have been progressively further from the centre and there is nothing to say that the next one won't take a different approach. There is talk of a new Green Deal and the Democrats are even looking to tie that in with a future Infrastructure Bill.

We know, for example, that CO₂ pricing is coming down the pipeline. We have it in some states already, in Canada and the EU. We're looking closely at what has happened in those regions to best prepare the sector for what lies ahead. Recently, PCA may have taken a more reactive role on legislation, regulation or negative press as it occurs. Our plan is to be more proactive in communication and education, particularly on items like CO₂ pricing.

GC: Would the PCA welcome a US-wide CO₂ trading scheme?

MI: I think that some form of US-wide CO₂ tax or trading scheme is very likely in the period 2021-2025 and I would be surprised if something was not implemented over that timeframe. The PCA's preference would be for a cap-and-trade system, as we feel that other methodologies do not lead to a genuine drive to reduce CO₂ emissions. We need to take the lead and educate policy makers on the importance of concrete within the sustainability discussion to ensure that the sector can be fully involved in the decisions that affect it.

GC: Is there resistance from some members regarding the need to prepare for such eventualities?

MI: I think our members see what is happening around the world and even in various US States and

Above: The PCA is enhancing its advocacy efforts as part of ongoing restructuring. This includes literally moving its Washington DC office to be closer to the US Capitol.



recognise that cement manufacturing does play a role in the carbon discussion. We just need to ensure we are a part of that discussion, which should consider analysis of the entire life cycle, re-carbonation, use of alternative fuels, the circular economy, etc.

GC: In 2018 Ash Grove Cement, the last major US-owned cement producer, was bought by Ireland's CRH. Do you see continued consolidation in the cement and concrete sectors as inevitable?

MI: I think in the short term there will definitely be a trend towards larger cement and concrete producers in the US market and mergers between those sectors, based on the benefits of vertical integration. As you mention, this is not a US-only phenomenon. Indeed it is the European companies doing the buying and the US companies being bought. How this situation develops as Chinese producers become more geographically adventurous is anyone's guess!

GC: What is the biggest threat to your members over the next 1-5 years?

MI: There is one single clear answer: Competition from other materials. Wood is making particular inroads in that it is increasingly being specified instead of concrete. This is the result of a very defined strategy by the wood sector to penetrate the low and medium-rise construction sector over the past couple of decades.

In response, PCA and NRMCA has been battling this all the way from the building codes down to individual projects. We're winning individual battles but the war continues.

GC: Given the negative Guardian coverage and the advancement of the wood sector, was it an error to move away from public-facing campaigns such as 'Think Harder - Concrete!' in recent years?

MI: It's really disappointing to think that people can believe that a wood-built building can offer the same sustainability, durability and safety benefits as one built with concrete. With our allies, PCA is ramping up efforts to educate the public and other key stakeholders on concrete's many benefits.

We have to remember the Three Little Pigs. The US keeps on building houses with sticks in places that it really shouldn't. They don't stand up to fire, hurricanes or floods. We need to bring the many benefits of concrete into the conversation.

GC: What's the biggest opportunity for your members over the next 1-5 years?

MI: The new relationships that we are developing with other associations, both domestically and internationally, will allow us to educate all stakeholders. For too long we have been too humble about concrete and we've rested on our laurels to some extent.

Something else I'd like to mention here is that when you look at many other sectors of the economy, like agriculture and manufacturing, there have been massive increases in productivity over the past 50 years. For construction, this is not the case. In 2019 it still takes about the same number of people about the same length of time to construct a building or a highway as it did in 1959! If disruptive technologies, for example 3D printing, were to come to bear commercially, that could be a great boon to our sector.

GC: Thank you very much for your time Mike.

MI: It was nice to speak with you.



Right: Destruction in Mexico Beach, Florida after Hurricane Michael in November 2018. PCA research shows that for every US\$1.00 invested in resilient construction, around US\$6.00 can be saved in post-disaster remediation costs.
Image credit: Terry Kelly / Shutterstock.com.



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Interview by Peter Edwards, Global Cement Magazine

In discussion: Ed Sullivan, PCA Chief Economist

Global Cement speaks with the Portland Cement Association's Chief Economist Ed Sullivan, to get his take on the US cement sector ahead of the IEEE-IAS/PCA Cement Conference in St Louis on 28 April - 2 May 2019...



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

Global Cement (GC): It's nice to speak with you again Ed. How is the US cement sector faring right now?

Ed Sullivan (ES): The US cement market is performing well. Our preliminary estimate is that it grew by 2.2% in 2018. This was more modest than we expected but we must remember that 2018 was a strange year for weather across the US. The states that reported declines in cement consumption were all east of the Mississippi. In that region, nine states recorded their wettest months in 124 years. That kind of weather puts a bit of a crimp on pouring concrete. That considered, we anticipate that the deliveries will catch up in the first half of 2019.

Another important point to make is that 2018 was the ninth year of consecutive growth for the cement sector, with a compound annual growth rate of more than 4% since 2010. That said, we are now in the deceleration period of the recovery and remain around 20% below the previous cement consumption peak.

GC: Can you expand on which regions performed best and worst during 2018?

ES: The regions that performed most strongly were the mountain region and the coasts. The Pacific Coast

grew by 6% year-on-year, the mountains by more than 6%. The South Atlantic also did well. Regions that did not perform well included the Mid Atlantic. The populations of such regions are more static, with economies that are on a weaker footing. They suffered less than others but now have less to gain.

GC: What would you say are the biggest changes to the US cement market over the past 12 months?

ES: There are three issues that are starting to emerge. The first is that interest rates are rising. This will continue over the next two to three years. How will consumers and business owners react when further rises come? House prices are already rising based on a lack of construction workers. When you tack on higher mortgage rates, we start to enter a period where affordability becomes an issue. Single-family home starts are already starting to slow.

The second factor is that state governments are huge contributors to public spending, the largest consumer of cement. As employment numbers grow there are more tax payers and revenue expands. However, the US is getting older, with more uptake for MEDICARE and MEDICAID. This is very costly and is out-stripping the extra tax revenue. States won't defund entitlement schemes and so public infra- structure works have to take a back seat.

The third thing is that, as the population of a country ages, the vibrancy of the economy wanes. It doesn't mean that growth stops but rather that growth is less resilient to shocks. There might not need to be a seismic event that knocks out the economy. It could be something much smaller.

GC: How have the first months of 2019 fared compared to your expectations?

ES: We do not have any official data for 2019 because of the recent government shutdown. We used another method to work out consumption using member data that shows 96.2 Mt in 2018 and a 10.5% year-on-year gain in January.

Below: The US will have around 400 million inhabitants in 2050, 60 million more than it does today. Population increase is a major contributor to the PCA's long-term cement consumption forecast of 150Mt in 2040.





GC: We have previously mentioned the risk to cement demand of a trade war with China. Have you been able to estimate how much cement demand has been lost due to the current tariffs?

ES: We have looked at this effect to factor it into our forecasts. There are three main areas of the US economy that are affected: Agriculture, manufacturing and oil states are likely to see the largest adverse impacts in cement consumption terms. However, aside from Texas, the major cement consuming states will be broadly unaffected. We estimate that the national demand will be reduced by just 250,000t in 2019 due to the tariffs.

GC: Which of the Trump Administration's policies have most affected the cement sector so far?

ES: There are two main policies that have affected demand. Firstly, the Tax Reform Bill, which we spoke about last year, did generate economic growth, leading to a moderate rise in construction spending in 2018 and 2019. However, it will be quite a short-lived blip. The longer term effect is that the tax cut does not get fully translated into spending, which contributes further to our national deficit later on. So, good in the short term, less so in the longer term.

The second Trump policy that has affected cement is the clampdown on immigration, which has likely reduced the workforce available for the laying of concrete. During the economic downturn, we lost a large number of workers to other industries and retirement. There was a study by the University of Minnesota which estimated that there were 500,000 Mexican-born construction workers that went back home during that period. Now, due to the stance by the Trump Administration with respect to immigration, many of those same workers are reluctant to return to the US. It is hard to know how many people have decided not to come, but when so many ready-mix concrete firms are looking for workers, it must be having an effect.

GC: What about the US\$1tn Infrastructure Bill: Is that still being talked about?

ES: Oh, it's being talked about... Whether that talk translates into policy remains to be seen. If it came to fruition, it would certainly be a major boon to the cement industry in the US and everyone agrees that our infrastructure is in pretty bad shape. The Bill remains in our forecast but we've had to push it back to beyond the next Presidential election. That's because of issues over funding. We have a mechanism to raise more funds: It's called the Gas Tax, which hasn't been increased since 1991. However, nobody in Congress wants to do that because they fear that it will count



against them at the next election. The Gas Tax won't be touched until 2021, or even beyond.

GC: In 2018 you mentioned that high employment rates would eventually lead to inflationary pressures and a 'boom-bust' scenario. Do you stand by that in 2019?

ES: The US economy is starting to slow due to the late stage of the recovery. That said, we will still employ two million extra workers in 2019 and unemployment will continue to fall. To attract the number of workers needed, regardless of the industry, employers need to pay more. Now, if the economy is not spinning along as rapidly as I previously forecast, then that pressure relaxes somewhat. On top of this, the price of oil is expected to increase by around US\$10/barrel over the course of 2019. The US Dollar is also getting stronger right now, making everything a little bit cheaper. Each of these factors will take a little bite out of the inflationary spirits that are being presented by the labour shortage and means that the Federal Reserve is less likely to have to raise interest rates. Previously we thought that rates would rise three times in 2019. Now we think it will be two increases and some people think that even that's too high.

GC: How do imports and exports fit into the US cement situation at the moment?

ES: The strong Dollar and reduced production in China is making imports more attractive. We expect that imports will rise further during 2019 and they represent an increasingly viable option for the US cement market.

GC: Are you starting to include a 'weird weather factor' into your forecasts?

ES: We first started looking at this around 10 years ago. It is difficult to incorporate extreme weather events into the data so at present we do not account for them. However, we are looking at a major

Above: A large highway intersection in Katy, Texas. Cement demand and intensity will be affected by the size and timing of the government's proposed US\$1tn Infrastructure Bill.



project to marry up the 5000+ weather stations around the US. How much of an effect did the weather really have? At the moment we can make a reasonable guess, but we want to be able to tell you! If we are able to move forward it's going to be a major project that takes our analysis to the next level.

GC: Could that extend to predicting cement demand changes based on the weather forecast?

ES: That is a different aim and would rely on having a very good understanding of the relationships observed in the initial stages of the project. To the extent this improves our interpretations of historical data, it could improve our forecasts.

GC: In general is the task of forecasting cement demand now more difficult or easier than it was in the past?

ES: It depends on the point you look at in the economic cycle. When there is a clear path to stability, it's more straightforward. Right now, with all the volatility, it is less easy. However, our biggest ever forecast error came in 2009 when I expected an 18% decline. The decline was 26%! The second-most difficult period to transition is when the economy goes from rapid to slower growth. We passed that point a couple of years ago. New models help as time goes by but they can't remove volatility.

GC: In 2018 you suggested that the US would demand 160Mt of cement in 2040. Is that still your expectation?

ES: Our preliminary estimate now suggests 150Mt for 2040. This is based on revised estimates for the population, in part related to immigration policies. There are also issues surrounding the state funds for infrastructure that will continue to weigh on the states' ability to consume cement. Finally, as the online economy grows, there will be less demand for cement to build 'real world' structures like offices and retail outlets. For example, one person working from home makes no difference to the road network. However, a few hundred thousand people working from

home starts to affect the need for roads at a county and state level and there would need to be fewer new offices too.

GC: How will the clinker factor change over that period?

ES: I don't deal with the clinker factor, but the supplementary cementitious material (SCM) factor. This is rising and will continue to rise as policies regarding the environment have a greater effect on the cement sector. For a while now, the PCA has been pushing for higher levels of limestone in cement. We're making steady progress on that front.

At the moment we forecast the SCM factor to increase by 0.3%/yr from 10% in 2019 to 10.3% in 2020, 10.6% in 2021 and so on, over our short-term forecast to 2023. Beyond that we have to approach SCM trends in a different way. What will happen to sources of slag and fly ash in 10 years? These are not easy questions as we get into the structure of these industries. Look at how coal is losing importance as an electrical power source in the US. We know there will probably be less fly ash as a result. How much? That's a harder question and it becomes more involved.

GC: Can you comment on future changes to overall clinker demand, rather than cement demand?

ES: The US will increase by 60 million inhabitants by 2050. You can throw as many SCMs in as you like but that contribution, even over the 2040 - 2050 time-span, will still require new sources of clinker, whether that comes from imports, new plants or a mixture. I would say that nobody is thinking about capacity additions right now, but that could be a different conversation in another 10 years.

GC: Can you comment on how cement intensity in concrete is likely to change in the future?

ES: At present we see that cement intensity will remain at around 90t/US\$m of real construction activity until 2021. After then, we will shift from a predominance of residential and non-residential construction to heavy projects as the result of the Infrastructure Bill. That increases the cement intensity of construction overall.

In terms of the cement intensity within individual structures, I don't see that changing. An office will still require the same amount of concrete in 2030 as it does today. What may well change, and I alluded to it earlier, is that when we look at per capita cement consumption, there is a gradual overall increase.

GC: Ed Sullivan - Thank you very much for your time, once again.

ES: It was a pleasure!



Below: Coal is losing importance as a power generation source. Less fly ash will be available as a result in the future, but working out how much less is not an easy task.





WHEN ENVIRONMENT AND PERFORMANCE GO HAND IN HAND THAT'S BUILDING TRUST

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BUILDING TRUST





Interview by Peter Edwards, Global Cement Magazine

Plant report: Ste Genevieve - LafargeHolcim's technological marvel

The LafargeHolcim cement plant in Ste Genevieve County, Missouri, US, boasts one of the largest single cement production lines in the world, with a capacity of approximately 12,000t/day. Its excellent limestone reserves and location directly on the Mississippi River enable it to produce vast quantities of cement at low cost for distribution over the majority of the eastern United States. *Global Cement* recently spoke to the plant's manager John Goetz about this mega-plant ahead of the visit by delegates of the 61st IEEE-IAS/PCA Cement Industry Technical Conference on 2 May 2019...



Above: John Goetz started his career in the cement sector with Holcim (US) in 1992 at the Dundee plant in Michigan. First employed as a labourer, he made the most of the opportunities available within the group to rise to supervisor and production manager at Dundee, before being appointed as plant manager at two other group plants. He became plant manager at Ste Genevieve in September 2014.

Global Cement (GC): Please could you outline the history of the Ste Genevieve plant?

John Goetz (JG) - Plant Manager: I first became aware that the Ste Genevieve plant was being conceptualised when I was working at the Holcim Dundee plant in 2000. The location in Ste Genevieve County provided the most amazing quality limestone over thousands of hectares with easy access to the Mississippi River. The plant is uniquely located on the Mississippi below the last lock at St Louis, enabling it to provide cement over an unusually large portion of the United States. The concept of the plant from a design perspective is that it can produce a very large volume of cement at a very low cost, which makes it economical to provide cement over a wide region.

Around 5Mm³ of rock and soil had to be excavated before construction could begin in 2006. Most of the plant equipment arrived via the Mississippi River, which was helpful for this fairly congested site. The major structures were completed in 2007 and 2008, with first crushing in December 2008 and first clinker on 4 July 2009.

GC: Could you please describe the production process at the plant?

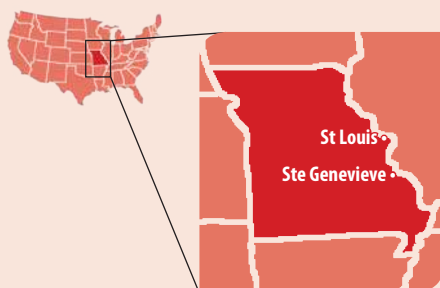
JG: All of the limestone is mined from the plant's extensive captive quarry, which has reserves for more than 100 years of production. The high-quality limestone is blasted by an external contractor and then a fleet of Holcim-owned Komatsu front-end loaders and 100t haul trucks move material to the primary

Right: View over the Ste Genevieve plant at sunset.





Plant Profile: Ste Genevieve



Owner Holcim (US) < LafargeHolcim
First clinker 4 July 2009
Capacity 12000t/day (3.8Mt/yr)



crusher, a 2000t/hr FLSmidth Mineral FFE gyratory crusher. A secondary crusher reduces material to <150mm for storage in the plant's 65,000t Temcor aluminium dome. Within the dome is a stacker-reclaimer, which is from FLSmidth MVT.

After combining the limestone with correctives from our 350m secondary materials storage building, there is a single combined raw-mill feed system for two 515t/hr vertical roller mills from FLSmidth. Then there are two 15,000t FLSmidth CF silos for raw meal, which is introduced to the kiln system via FLSmidth Pfister feeders and via an Aumund belt bucket-elevator system. The preheater is a Holcim patented two-string hybrid tower that consists of four quad cyclone stages and a final dual cyclone in the fifth stage. It's truly a technological marvel, with a total of 18 cyclones and a 10m-diameter calciner, and a retention time of around seven seconds. The efficiencies driven by the design, which I believe is unique in the world, provide unparalleled energy efficiency, very low emissions and economies of scale that are not matched anywhere else in the United States. Indeed, I'm fairly confident that Ste Genevieve is the largest kiln in operation today anywhere in the world and it continues to out-perform our expectations on every front.

The tower is fired by a low-NO_x calciner from FLSmidth and the three-support rotary kiln by a FLSmidth Duoflex burner. Following the kiln, the clinker goes through an IKN cooler. Clinker grinding is carried out using four FLSmidth OK 36.4 vertical roller mills and transferred to the cement storage systems for truck, rail and barge distribution.

GC: Have there been any changes since the plant began production in 2009?

JG: The manufacturing process is essentially unchanged with the one exception of the replacement

of the clinker cooler in 2014 with a new IKN cooler. However, we continue to learn about the process and optimise the plant towards its full potential. Energy efficiency improvements have been achieved every year since startup and the last couple years have set

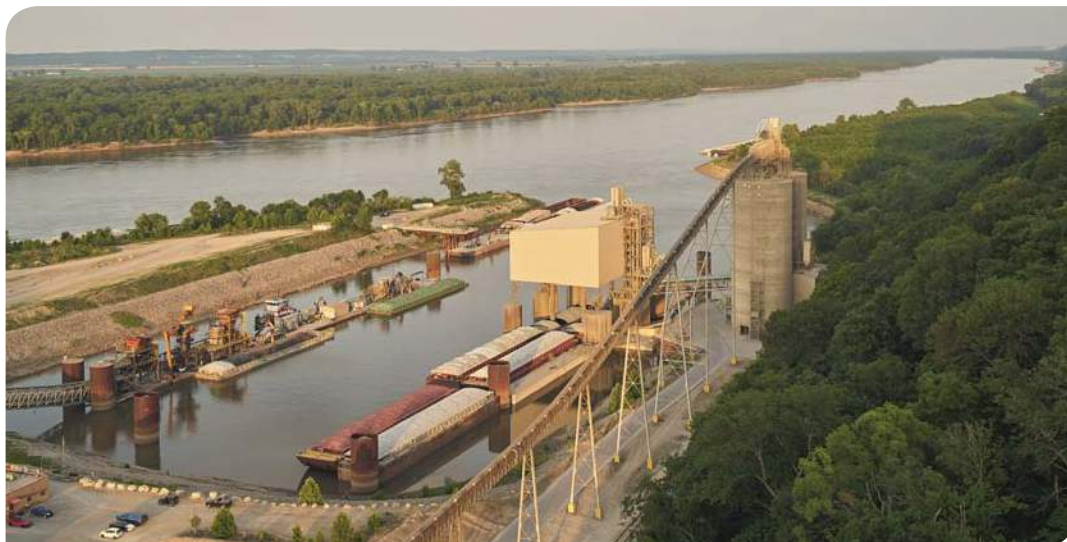
Above: The raw material handling conveyor manages more than 1Mt/yr of raw materials and fuel from the barge unloading system.

Equipment	Manufacturer	Description
Primary crusher	FFE Minerals	Fuller-Traylor 1600NT, 450kW, Crushing to 229mm
Secondary crusher	Sandvik	S6800, 515/830t/hr, Crushing to 150mm
Stacker	MVT	2000/2600t/hr
Raw-material store	Temcor	Circular storage dome, 65,000t capacity, 104m pile diameter
Raw mills	FLSmidth / MVT	2 x FLSmidth Atox 50 by MVT, 515t/hr 3900kW, Table Ø = 5m
Preheater	Patented in-house design	2-string hybrid tower, 1 x 10m diameter calciner, 12,000t/day
Rotary kiln	FLSmidth	Ø = 6.6m, L = 93m
Burner	FLSmidth	Duoflex, 200MW
Clinker cooler	IKN	7.8m wide x 119 row pendulum grate - KIDS fixed inlet
Clinker silo	FLSmidth	2 x 90,000t, plus 5000t transitional silo
Coal/petcoke mills	FLSmidth	2 x Atox 27.5, 37t/hr (petcoke), 70t/hr (coal)
Coal/petcoke store	Temcor	Circular storage dome, 23,000t coal, 23,000t petcoke
Cement silos	FLSmidth	8 x 32,000t = 256,000t
Harbour crane	Seram	500t/hr
Bucket-elevators	Aumund Group	
Pan-conveyors	Aumund Group	
Conveying systems	Dimisa SA de CV	
Haul trucks	Komatsu	
Front-end loaders	Komatsu	
Drilling equipment	Atlas Copco	

Above: List of equipment installed at the Ste Genevieve cement plant in Ste Genevieve County, Missouri, US.



Right: The plant's harbour facilities, which offer direct access to the Mississippi River, unlock the massive capabilities of the St Genevieve plant.



many production and cost records for the history of the plant. That counts from the quarry to the harbour.

We continue to improve upon the process and the plant's ingrained advantages, especially on the fronts of environmental performance and energy efficiency. I don't want to comment quantitatively, but I can say that I know of no other plant that operates at such a low specific thermal and electrical consumption per tonne of cement. Our CO₂ emissions are more than 20% below the US average per tonne of cement.

Another small change is that we have now started the process of rehabilitating the quarry where we no longer require access to it. This has occurred over the past two years or so.

GC: Where do the plant's additives come from?

JG: Today we source gypsum, silica, alumina and iron correctives economically from a variety of sources across the vast river network. At the moment we bring in materials from as far north as Chicago to as far south as the Tennessee River Valley via truck or barge. We work in partnership with a number of industrial and power-generating companies to assist them with management of waste streams, which we safely incorporate into the cement manufacturing process. This is one of the main drivers of our ability to produce cement at very low cost.

GC: What about fuels?

JG: The plant currently uses traditional fuels, namely coal and petcoke. Since its inception, access to coal and petcoke have been extremely economical and remain the central fuels used at the plant.

GC: Could the plant use alternative fuels?

JG: The plant is designed to use a variety of alternative fuels. There are some liquid alternative fuels

currently being used. They are sourced from a variety of places in a similar manner to the additives. We constantly look at opportunities to become more environmentally friendly and to reduce our CO₂ footprint. Fuel flexibility is a key component of our plant strategy. We continually review markets and market opportunities and are prepared to implement new fuels at the plant.

GC: What emissions abatement systems does the plant use?

JG: There is an ammonia-based SNCR system to control NO_x emissions, which has been used since the plant was first built. For dust we operate baghouses, which also remain unchanged since 2009. A new dry lime injection system was installed in 2016 replacing the wet lime injection system to help control SO₂.

I'd like to highlight that, over nearly 10 years of production the plant has never had a notice of violation (NOV), which is testament to the importance that the staff place on environmental protection.

GC: What types of cement are made at the plant?

JG: We make 100% low-alkali CEM I. It performs well in all of the markets that we cover. The coefficient of variation is consistently at or below 3.0. Our customers receive the same cement day-after-day, week-after-week, year-after-year. This is great for them from a quality perspective and great for the plant from a process perspective. This is because the plant is optimised to a very high degree. We don't want to jeopardise that by changing the product.

GC: How do LafargeHolcim's other plants fit into this approach?

JG: At the moment Ste Genevieve is pumping out CEM I and other plants make the other types of



Above: Around 20% of the plant's cement is shipped by rail to locations that cannot be reached by the river system.



Above: There are six vertical roller mills at the Ste. Genevieve plant - two raw material mills and four finish mills. There are approximately 10 vertical roller mills presently used for cement grinding in the US. The image shows an FLSmidth Atox Mill vertical roller mill for raw material grinding.

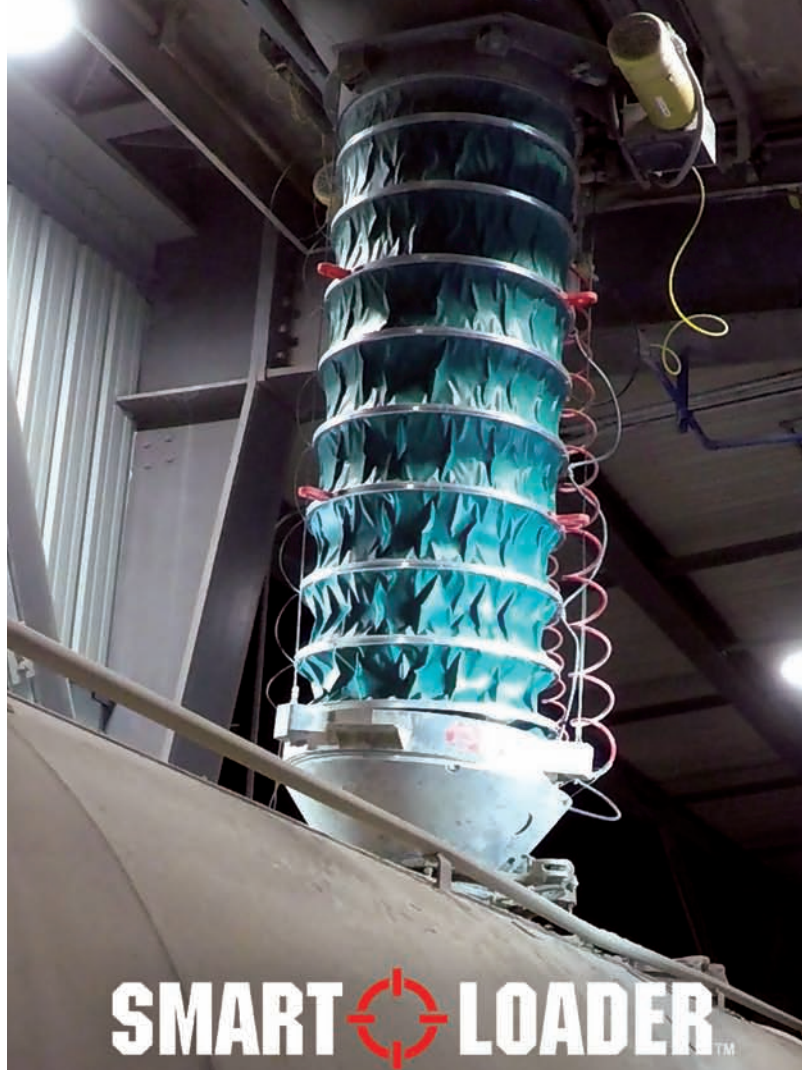
cement. That might not always be the case, but it is the group's current strategy.

GC: To where does Ste Genevieve deliver its cement?

JG: Our product is shipped to 22 different US States,

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Right: The kiln at the Ste Genevieve plant.



from Minnesota down to Texas, as far west as Nebraska and as far east as Pennsylvania. This is mainly thanks to the river system, although we also make use of extensive rail connections and also truck out some product. In 2018 we sent out 70% by barge, around 20% by rail and 10% by road. Those proportions have been fairly static for a number of years.

GC: What would you say is the largest threat to the plant over the next 1-5 years?

JG: This is a tricky question. I honestly don't see any major threats to the plant. It is a unique facility that is well positioned to take on whatever may be thrown at it as the market changes. The plant offers us great opportunities.

GC: Would you not say that the 'retirement time-bomb' is something to worry about?

JG: If by 'retirement time-bomb' you mean that a significant portion of staff are heading towards

retirement, giving rise to a staff shortage, that's not something that is affecting this plant. We have a great local team and a strong development program that aligns with our internship programs for new engineers. All of this has led to a strong and experienced team which we are very proud to maintain.

GC: Has the merger between Lafarge and Holcim given rise to any day-to-day changes as you see it?

JG: What I would say is that, right from when I first started working for Holderbank, as it was back in 1992, until today, the LafargeHolcim Group has great core values based on its people, its customers, its performance and the environment. These values, plus great support from central management, have been retained throughout the merger and I see no reason why it would change now.

GC: John Goetz - Thank you for your time today.

JG: You are very welcome indeed!



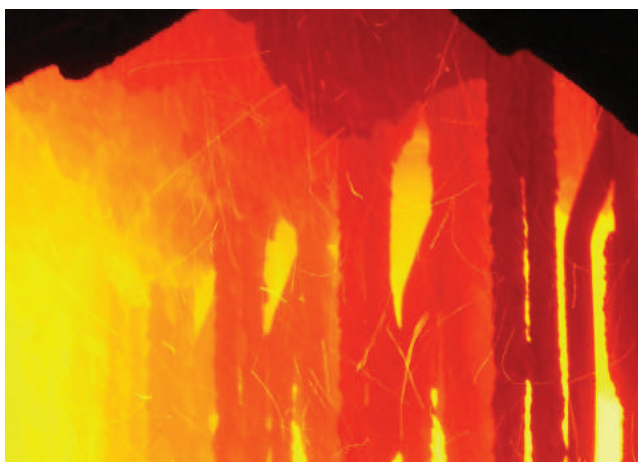
Right: The plant has a 5km access road from the highway.



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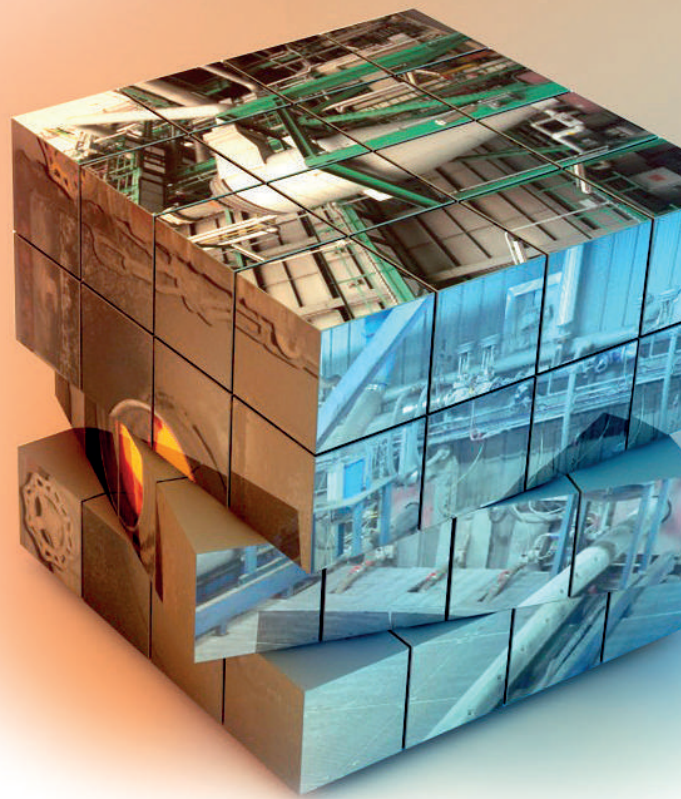
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Peter Edwards, Global Cement Magazine

Cement in the US and Canada

Global Cement looks at the cement industries of the US and Canada, the main players, trends and news highlights from the past 12 months...

The US and Canada both have well-developed cement sectors, with a majority of capacity held within well-established facilities. Capacity addition is infrequent, a common feature of developed economies. However, greenfield projects are more common than some other developed markets, such as the EU. In the US, legacy plants are gradually being mothballed and closed as they fail to keep pace with market demands and, increasingly, environmental regulations. Alternative fuels are a developing area, limited by stringent permitting, public opposition and the relatively low cost of domestic fossil fuels. The recent actions of the Trump Administration in the US have also led to a lower focus on alternative fuels than in the past.

Cement production and consumption have been rising gradually in recent years in both the US and Canada, following the economic crisis of 2008. However, production remains below the historic peak seen in the mid 2000s. There remains significant cement sector overcapacity, particularly in the United States, with limited need to enlarge capacity as it stands.

Cement sector - Producers

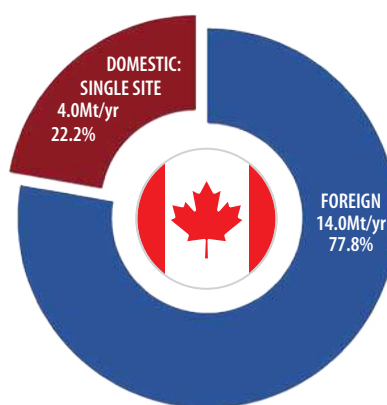
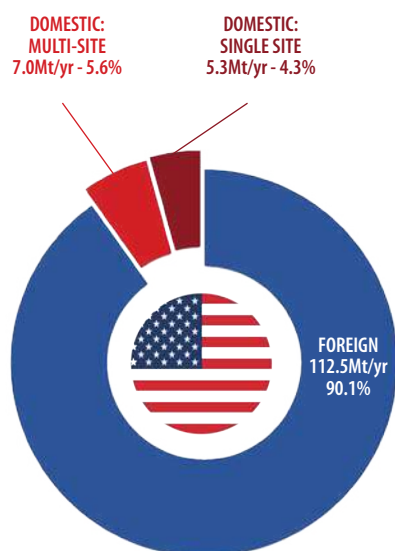
The majority of cement capacity in the US and Canada is owned by major multinational groups, with increasingly small influence from domestic players - See Figure 1. Indeed, a major US-owned producer, Ash Grove Cement, was acquired by Ireland's CRH

Right - Table 1: Summary statistics for Canada and the US.

	Area (million km ²)	GDP (US\$tn)	GDP/capita (US\$)	Cement capacity (Mt/yr)	Population (million)	Capacity / Population (kg/capita)
United States	9.83	19.39	59,531	124.8	327.2	381
Canada	9.99	1.65	45,032	18.0	37.1	485

Right: The Rainbow Bridge above the Niagara River Gorge, taken from the US side, with Canada seen across the water.





Left - Figure 1: US and Canadian cement production is dominated by foreign, predominantly large multinational producers.
Source: Global Cement Directory 2019.

Rank	Producer	Capacity (Mt/yr)		
		Total	Integrated	Grinding
1	LafargeHolcim	29.6	28.3	1.3
2	HeidelbergCement	19.9	17.6	2.3
3	CRH	12.9	12.9	
4	Cemex	12.7	12.7	
5	Buzzi	10.6	10.6	
6	Cementos Argos	7.3	6.1	1.2
7	Votorantim	6.2	4.8	1.4
8	Eagle Materials	5.7	5.7	
9	Taiheiyō	5.3	5.3	
10	Martin Marietta	4.7	4.7	

in June 2018. This most recent transaction has left the US with ~91% foreign-owned capacity. For Canada the figure is ~78%, as shown in Figure 1.

The largest producers across both countries combined are shown in Table 2. In first place is Swiss-based LafargeHolcim, with 29.6Mt/yr. It operates 19 integrated plants and three grinding facilities across the two countries. The second-largest cement producer in the US and Canada is Germany's HeidelbergCement, which operates 19.9Mt/yr across 15 integrated and four grinding plants. The third-largest producer by installed capacity is CRH, which operates 12 integrated plants and one grinding plant, giving it a total of 12.9Mt/yr of capacity.

Left - Table 2: Top cement producers in the US and Canada by installed capacity.
Source: Global Cement Directory 2019.

United States of America



The US is the world's third-largest cement producer by installed capacity after China and India, with nearly 125Mt/yr of cement capacity. The country made 87.8Mt of Portland and masonry cement in 2018 from 98 plants across 34 States, indicating a capacity utilisation rate of around 70%. Texas, California, Missouri, Florida and Alabama were, in descending order of production, the five leading cement-producing States. Together they accounted for nearly 50% of US cement production in 2018.

When cement imports of 14.0Mt are also considered, apparent US cement consumption hit 101.8Mt in 2018, exceeding 100Mt for the first time since 2007, when its apparent consumption was 117.0Mt. This was despite domestic production being affected by long-term mothballing and low capacity utilisation at a number of facilities.

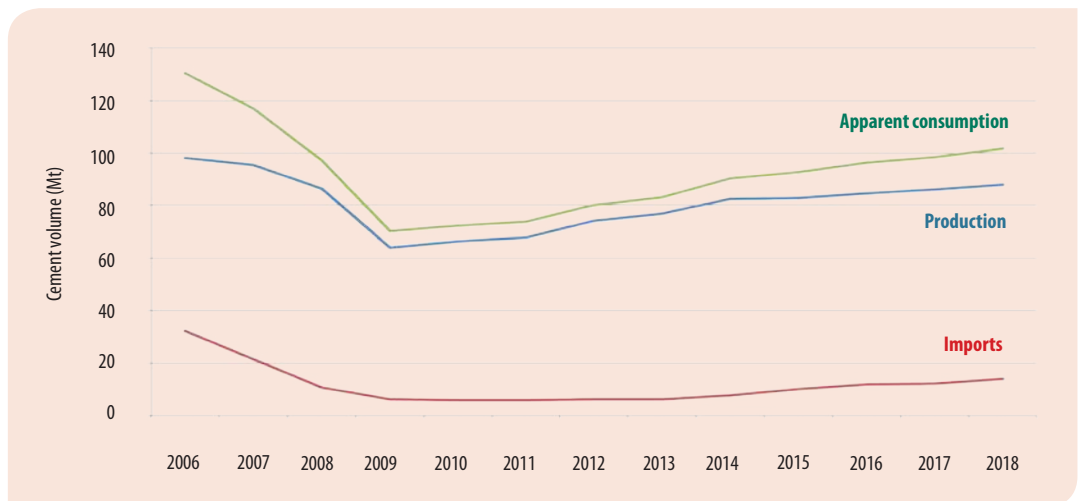
A look at recent cement production and import trends shows a steady recovery in US cement consumption following the economic crisis of 2008 - See Figure 2. The headline is that overall consumption remains 27.8Mt lower than the 2005 peak (129.6Mt).



Left: The St Marys Cement Bowmanville plant, Canada's largest producer of clinker.



Right - Figure 2: US cement production, imports and apparent consumption, 2007 - 2017.
Source: USGS.



Year-on-year, apparent consumption of cement increased by nearly 3.5% overall in 2018, tempered by stagnant sales of masonry cement. Imports were 13.8% higher year-on-year at 14.0Mt. They have now nearly tripled from a slump to 5.8Mt in 2011. The USGS attributed the continued steady improvement to modest increases in construction spending, predominantly due to higher spending in the residential and public construction sectors.

Cement plants

The *Global Cement Directory 2019* lists 94 integrated cement plants in the United States that hold a total production capacity of 124.8Mt/yr. Figure 4 (Page 84) shows the updated integrated cement assets in the country and their capacities. They are operated by a range of multinational and local players.

Top five cement producers



1. **LafargeHolcim** became the largest cement producer in the US in July 2015 upon completion of the merger of the former Lafarge and Holcim. It operates 15 integrated cement plants in the US that share a cement capacity of 22.3Mt/yr, according to the *Global Cement Directory 2019*. It also

operates 1.3Mt/yr of grinding capacity. LafargeHolcim is present throughout the US, with the exception of the south west.

operates 1.3Mt/yr of grinding capacity. LafargeHolcim is present throughout the US, with the exception of the south west.

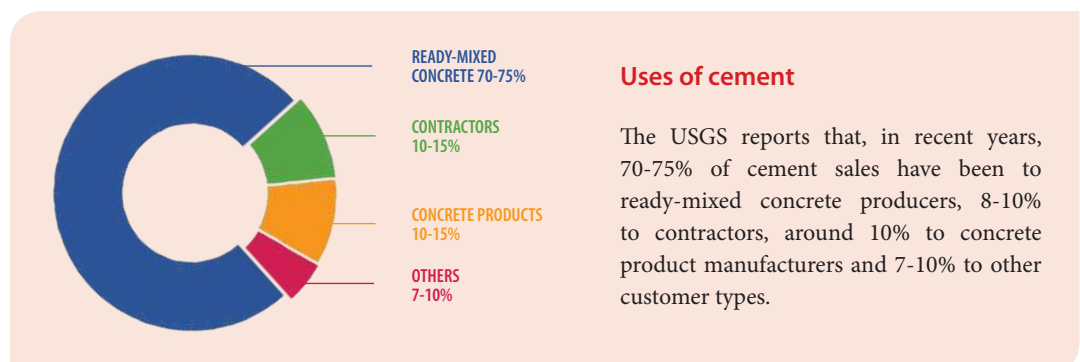
In 2018 LafargeHolcim's operations across the US and Canada generated sales of US\$5.88bn, with recurring earnings before interest, tax, depreciation and amortisation (REBITDA) of US\$1.52bn, 2.7% higher than in 2017. Its cement sales rose by 1.3% to 19.8Mt. The group said that the US and Canadian markets had strong fundamentals in 2018. It said that cost control measures helped mitigate harsh weather at both ends of the year. It continued to add strategic concrete acquisitions as part of a drive towards vertical integration.

HEIDELBERGCEMENT

2. **HeidelbergCement** became the second-largest cement producer in the US when it acquired Italy's Italcementi in July 2016. By adding Italcementi's US subsidiary Essroc to those of its existing Lehigh subsidiary, the headline capacity of HeidelbergCement's US integrated assets grew to 14.1Mt/yr. It also operates 2.3Mt/yr of grinding capacity, with facilities concentrated in the mid-west.

HeidelbergCement reported that the US and Canada were its biggest sales area in 2018, although

Right - Figure 3: Cement predominantly heads to ready-mixed concrete and other concrete uses, with only 7-10% of cement heading to other uses.
Source: USGS.



Uses of cement

The USGS reports that, in recent years, 70-75% of cement sales have been to ready-mixed concrete producers, 8-10% to contractors, around 10% to concrete product manufacturers and 7-10% to other customer types.

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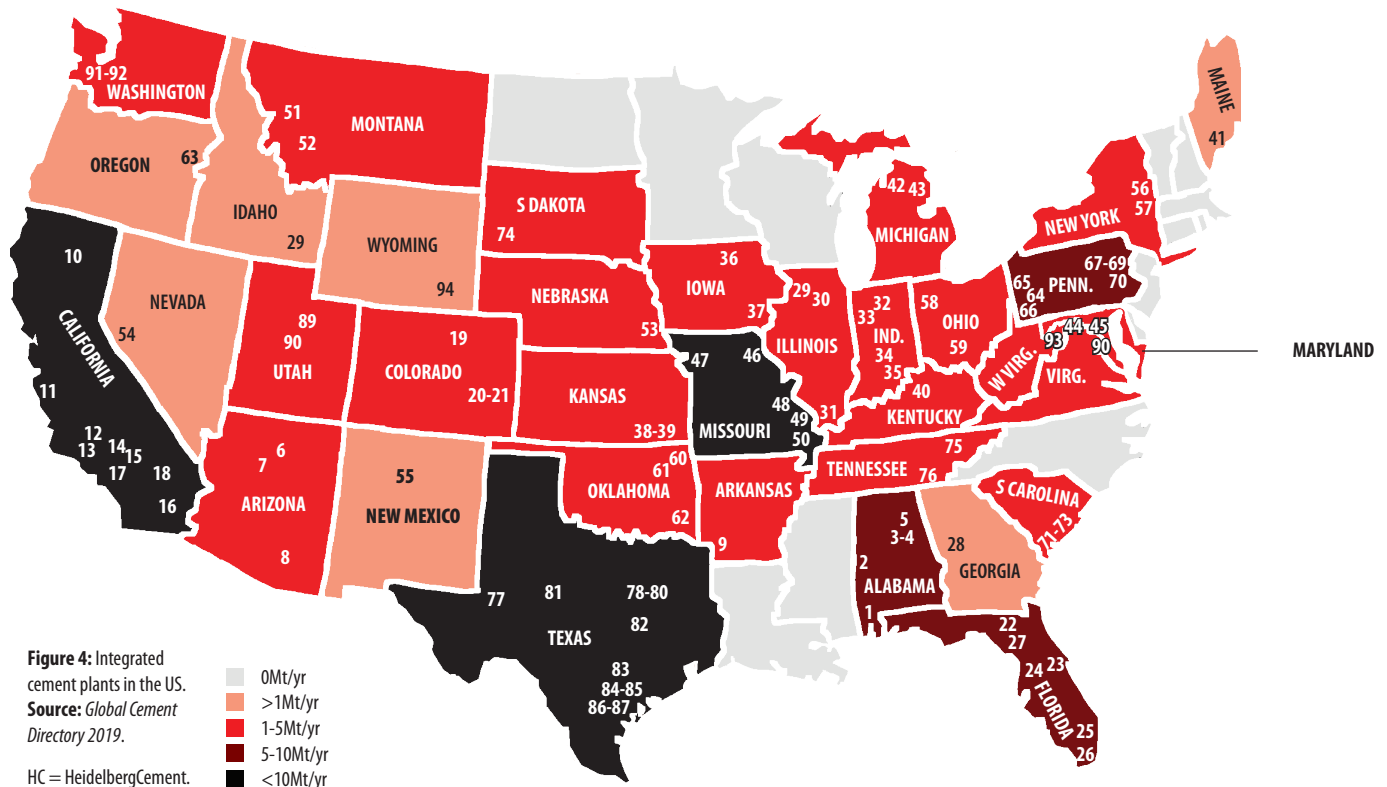
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ALABAMA (7.4Mt/yr)

1. LafargeHolcim, 1.9Mt/yr.
2. Cemex, 1.0Mt/yr.
3. Cementos Argos, 1.7Mt/yr.
4. Lehigh (HC), 0.9Mt/yr.
5. National Cement (Vicat), 1.9Mt/yr.

ARIZONA (3.3Mt/yr)

6. Salt River Materials, 1.1Mt/yr.
7. Drake Cement, 0.7Mt/yr.
8. CalPortland (Taiheiyō), 1.5Mt/yr.

ARKANSAS (2.0Mt/yr)

9. Ash Grove, 2.0Mt/yr.

CALIFORNIA (13.6Mt/yr)

10. Lehigh (HC), 0.8Mt/yr.
11. Lehigh (HC), 1.5Mt/yr.
12. Lehigh (HC), 0.8Mt/yr.
13. National Cement, 1.6Mt/yr.
14. CalPortland, 1.6Mt/yr.
15. Mitsubishi Cement, 1.8Mt/yr.
16. TXI (Martin Marietta), 0.1Mt/yr.
17. TXI (Martin Marietta), 2.2Mt/yr.
18. Cemex, 3.2Mt/yr.

COLORADO (3.5Mt/yr)

19. Cemex, 0.6Mt/yr.
20. LafargeHolcim, 1.9Mt/yr.
21. GCC Rio Grande, 1.0Mt/yr.

FLORIDA (8.7Mt/yr)

22. Suwannee Cement (Votorantim), 0.9Mt/yr.
23. American Cement (50% Elementia, 50% CRH), 1.2Mt/yr.

24. Cemex, 1.5Mt/yr.

25. Titan Florida, 2.4Mt/yr.

26. Cemex, 1.2Mt/yr.

27. Cementos Argos, 1.5Mt/yr.

GEORGIA (0.9Mt/yr)

28. Cemex, 0.9Mt/yr.

ILLINOIS (2.3Mt/yr)

29. St Marys (Votorantim), 0.6Mt/yr.
30. Illinois Cement (Eagle), 1.1Mt/yr.
31. LafargeHolcim, Joppa, 0.6Mt/yr. (Expanding to 3.2Mt/yr).

INDIANA (3.6Mt/yr)

32. Essroc (LH), 0.4Mt/yr.
33. Buzzi Unicem, 1.4Mt/yr.
34. Lehigh (HC), 0.8Mt/yr.
35. Essroc (HC), 1.0Mt/yr.

IOWA (2.0Mt/yr)

36. Lehigh (HC), 1.0Mt/yr.
37. LafargeHolcim, 1.0Mt/yr.

KANSAS (2.9Mt/yr)

38. Ash Grove (CRH), 1.9Mt/yr.
39. Monarch Cement, 1.0Mt/yr.

KENTUCKY (1.7Mt/yr)

40. Cemex/Buzzi Unicem, 1.7Mt/yr.

MAINE (0.8Mt/yr)

41. CDN Dragon Products (55% Elementia), 0.8Mt/yr.

MICHIGAN (3.9Mt/yr)

42. St Marys Cement (Votorantim), 1.3Mt/yr.
43. LafargeHolcim, 2.6Mt/yr.

MARYLAND (4.2Mt/yr)

44. LafargeHolcim, 1.0Mt/yr.
45. Lehigh (HC), 3.2Mt/yr.

MISSOURI (10.2Mt/yr)

46. Continental (Summit), 1.3Mt/yr.
47. Central Plains (Eagle), 1.2Mt/yr.
48. Buzzi Unicem, 2.3Mt/yr.
49. LafargeHolcim, 4.0Mt/yr.
50. Buzzi Unicem, 1.4Mt/yr.

MONTANA (1.3Mt/yr)

51. CRH, 1.0Mt/yr.
52. LafargeHolcim, 0.3Mt/yr.

NEBRASKA (1.0Mt/yr)

53. Ash Grove, Louisville, 1.0Mt/yr.

NEVADA (0.6Mt/yr)

54. Nevada Cement (Eagle), 0.6Mt/yr.

NEW MEXICO (0.6Mt/yr)

55. GCC Rio Grande, Tijeras, 0.6Mt/yr.

NEW YORK (2.5Mt/yr)

56. Lehigh (HC), 0.5Mt/yr.
57. LafargeHolcim, 2.0Mt/yr.

OHIO (1.3Mt/yr)

58. LafargeHolcim, 0.5Mt/yr.
59. Eagle Materials, 0.8Mt/yr.

OKLAHOMA (2.3Mt/yr)

60. Buzzi Unicem, 1.0Mt/yr.
61. Central Plains (Eagle), 0.6Mt/yr.
62. LafargeHolcim, Ada, 0.7Mt/yr.

OREGON (1.0Mt/yr)

63. Ash Grove (CRH), 1.0Mt/yr.

PENNSYLVANIA (5.7Mt/yr)

64. Armstrong Cement, 0.4Mt/yr.
65. LafargeHolcim, 0.8Mt/yr.
66. Lehigh (HC), 0.1Mt/yr (White).
67. Buzzi Unicem, 1.0Mt/yr.
68. Essroc (HC), 2.0Mt/yr.
69. Giant (Elementia), 1.2Mt/yr.
70. Lehigh (HC), 1.2Mt/yr.

SOUTH CAROLINA (4.5Mt/yr)

71. Giant (Elementia), 1.2Mt/yr.
72. LafargeHolcim, 2.2Mt/yr.
73. Cementos Argos, 1.1Mt/yr.

SOUTH DAKOTA (1.3Mt/yr)

74. GCC Dakotah, 1.3Mt/yr.

TENNESSEE (1.8Mt/yr)

75. Cemex, 0.8Mt/yr.
76. Buzzi Unicem, 1.0Mt/yr.

TEXAS (15.6Mt/yr)

77. Cemex, 0.9Mt/yr.
78. Ash Grove (CRH), 1.0Mt/yr.
79. LafargeHolcim, 2.4Mt/yr.

80. TXI (Martin Marietta), 2.4Mt/yr.

81. Buzzi Unicem, 0.6Mt/yr.

82. Lehigh (HC), 0.1Mt/yr (White).

83. Lehigh (HC) / Eagle, 1.4Mt/yr.

84. TXI (Martin Marietta), 2.3Mt/yr.

85. Cemex, 2.5Mt/yr.

86. Alamo Cement (Buzzi), 1.1Mt/yr.

87. Capitol Cement, 0.9Mt/yr.

UTAH (2.0Mt/yr)

88. LafargeHolcim, 1.1Mt/yr.
89. Ash Grove (CRH), 0.9Mt/yr.

VIRGINIA (1.5Mt/yr)

90. Roanoke Cement (Titan), 1.5Mt/yr.

WASHINGTON (1.1Mt/yr)

91. Ash Grove (CRH), 0.7Mt/yr.
92. LafargeHolcim, 0.4Mt/yr.

WEST VIRGINIA (1.8Mt/yr)

93. Essroc (HC), 1.8Mt/yr.

WYOMING (0.7Mt/yr)

94. Mountain (Eagle), 0.7Mt/yr.



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sales revenue fell by 1.9% year-on-year to US\$4.81bn. Its result from current operations before depreciation and amortisation was US\$1.11bn. The group reported that the marginal decline was due to adverse weather conditions and associated pressure on margins in the north of its North American region.



3. Cemex: Formerly the largest cement producer in the US before the creation of LafargeHolcim, Cemex has eight cement plants in the US that share a capacity of 12.7Mt/yr.

Cemex reported that 27% of its sales were in the US during 2018. The country delivered Cemex sales of US\$3.75bn, a year-on-year rise of 9%. Its operating EBITDA was US\$644m, a rise of 7% year-on-year. Cement sales volumes were 5% higher than in 2017.



4. Buzzi Unicem has 10.4Mt/yr of integrated cement capacity across nine plants in the US. Its assets are spread across the southern, mid-western and north-eastern regions of the country.

Across all operations, Buzzi Unicem's net sales rose by 2.4% year-on-year to Euro2.87bn in 2018 from Euro2.81bn in 2017. Its cement and clinker sales volumes increased by 4.3% to 27.9Mt from 26.8Mt. Ready-mix concrete sales fell by 3.6% to 11.8Mm³ from 12.3Mm³. It reported that poor weather hampered business in the US.



5. CRH: Now with 10 integrated plants and 10.4Mt/yr of cement capacity across the US, CRH has grown significantly in the North American market over the past five years. Prior to acquiring the former Holcim Trident plant in Montana it had zero cement production capacity in the country. However, CRH rose dramatically up the ranks to fifth-largest in June 2018 when it purchased Ash Grove Cement.

Globally, CRH's sales revenue rose by 6% year-on-year to Euro26.8bn in 2018 from Euro25.2bn in 2017. Its earnings before interest, taxation, depreciation and amortisation (EBITDA) increased by 7% to Euro3.37bn from Euro3.15bn. The Americas Materials division, which includes cement, concrete and aggregate activities, saw its sales rise by 12% to US\$10.1bn and its EBITDA rise by 18% to US\$1.68bn.

In its Annual Report 2018 CRH's CEO Albert Manifold reported, "2018 was another year of record profit delivery for CRH. We benefited from good demand and continued favourable market fundamentals in the Americas."



US cement news highlights

PCA Spring Forecast: The Portland Cement Association (PCA) forecasts that cement consumption will grow by 2.3% year-on-year in 2019. It is a slight drop from the rate of 2.6% that it previously forecast in November 2018. The PCA also said in its Spring Forecast that rising state deficits had forced many states to adjust budgets, reduce costs, and reprioritise spending. Read more on this topic in our interview with PCA Chief Economist Ed Sullivan on Page 70.

Executive Order: US President Donald Trump signed an executive order in February 2019 that made it the official policy of the Federal government to buy goods locally, including cement, for infrastructure projects. The directive aims to strengthen the 'Buy American and Hire American' executive order issues of 2017 by giving a preference for raw materials manufactured in the US for use in government-backed projects.



Right: Donald Trump signed an Executive Order prioritising local goods for Federal works in February 2019.

Credit: Andrew Cline / Shutterstock.com

Chinese tariffs: The Office of the US Trade Representative started implementing a 10% tariff on mineral and other products from China, including cement, in September 2018. Minerals affected include limestone flux, quicklime, slaked lime, gypsum, anhydrite, clinkers of Portland, aluminous, slag, supersulphate and similar hydraulic cements, white Portland cement, Portland cement, aluminous cement, slag cement, refractories and more.

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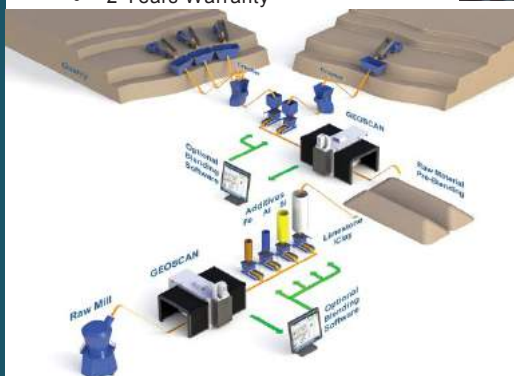
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Right: McInnis Cement officially opened its new Bronx terminal in October 2018.

Source: McInnis website.

Bronx terminal: Canada's McInnis Cement officially opened its terminal in the Bronx, New York, in October 2018. The terminal can store up to 44,000t of cement, mostly to be delivered by ship. City Council Member and Land Use Committee Chair Rafael Salamanca, Bronx Community Board 2 Chair, Bobby Crespo and members of several Bronx organisations and the local business community joined McInnis Cement executives to celebrate the opening of the unit, the first new industrial maritime project built on the South Bronx waterfront in more than 50 years.

Rapid City upgrade: Grupo Cementos de Chihuahua (GCC) announced that the upgrade to its Rapid City cement plant in South Dakota had started operation in December 2018. The expansion has added 0.4Mt/yr of production capacity to the unit taking its total capacity to 1.3Mt/yr. The project, which began in 2016, cost the company US\$105m.

Quarry expansion: Lehigh Cement applied to the Pennsylvania Department of Environmental Protection to expand the quarry at its Nazareth cement plant in November 2018. It wants to increase its mining area by a third to 112 hectares from 84 hectares at present.

API Monogram: LafargeHolcim has received American Petroleum Institute (API) certification to produce oil well cement at its Holcim Theodore plant in Alabama in November 2018. It became one of only four cement plants in the country with an API 10A Monogram and Q1 Quality Management System. Production of Class A oil well cement will start immediately at the site and the company plans to add Class H production in the future.



In a related move, LafargeHolcim has also upgraded its terminal at Weirton in West Virginia following a 10-year furlough. The site will be used to store and distribute oil well cement products for markets in the Appalachian region.

"We have made a significant investment in the Weirton terminal in direct response to the growing needs of our energy industry customers. Demand for access to our oil well cement has increased dramatically, yet existing distribution channels had grown congested," said Jamie M Gentoso, chief executive officer (CEO) of US Cement operations.

Wind turbines: LafargeHolcim plans to build three wind turbines at its Paulding cement plant in Ohio to power the unit. Jamie M Gentoo, CEO of LafargeHolcim's US cement operations, said that using distributed wind energy at the plant would be a first for the company in North America. Turbine construction began in December 2018 in partnership with One Energy. The three Paulding turbines are expected to generate more than 12GWh/yr and should eliminate the equivalent of more than 9000t/yr of CO₂.

New Texan terminal: GCCM Holdings ordered a ship unloader from Siwertell for a terminal in Corpus Christi, Texas, in September 2018. The Siwertell ST 640-M unit will have a continuous rated cement-handling capacity of 1500t/hr and will be able to unload ships of up to 60,000dwt. The unloader is currently being built and will be delivered fully-assembled by heavy-lift ship to the port. The unit is expected to start operation in the third quarter of 2019.

Right: LafargeHolcim's Paulding plant in Ohio will shortly be using wind power.



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Cement production trends

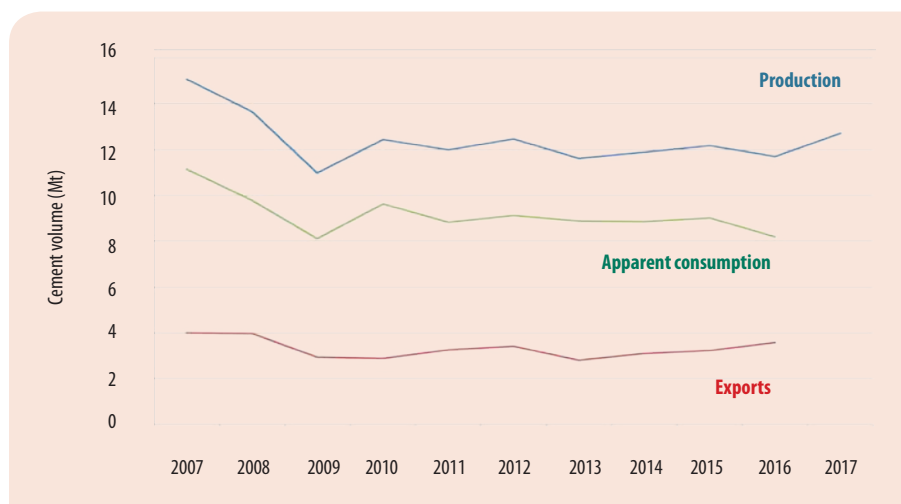
Canadian cement production rose by a fifth from 12.6Mt at the turn of the 21st Century to a peak of 15.1Mt in 2007. However, with the onset of the global financial crisis, production dropped by 9.3% to 13.7Mt in 2008 and by a further 19.7% to 11.0Mt in 2009. From 2009 to 2016 production hovered in the region of 12.0Mt/yr, although a slight up-tick to 12.7Mt was observed in 2017, the most recent year for which Statistics Canada has released information.

Export trends

Canada has historically been a net exporter of cement, predominantly to the US. However, a slump in US demand for cement reduced the amount exported from more than 5.0Mt in 2004 to less than 3.0Mt in 2010. Over the following five years, exports stabilised at just over 3Mt/yr, before rising to 3.6Mt in 2016, the last year for which full data has been made available.

Below - Figure 5: Canadian cement production, exports and apparent consumption, 2007 - 2017.

Source: Statistics Canada.



Below: The LafargeHolcim Exshaw plant recently started an alternative fuels trial, using construction renovation and demolition waste, non-recyclable plastic, carpet and textiles, shingles, treated wood products, wood products, rubber and tyre fluff.



Cement in Canada and its Provinces

As exports take a significant proportion of Canadian cement, around 30.5% in 2016, less than 10Mt/yr of cement is currently consumed within Canada itself. In 2016, the most recent year for which full Provincial data is available, Ontario, Canada's most populous Province, (38% of the population) consumed 3.2Mt of cement, around 38% of the 8.2Mt consumed in Canada that year. The Province that consumed the next most cement was Quebec, which had shipments of 2.0Mt, around 24% of the national total. It also has 24% of the country's population.

Cement producers

Canada's cement industry comprises 16 currently-active integrated cement plants, one ongoing project and one proposed plant (See Figure 6). The active plants share 18.0Mt/yr of capacity, giving a national capacity utilisation figure of around 71% in 2017. In 2019 the largest producers of cement by installed capacity are LafargeHolcim (five plants, 6.0Mt/yr), HeidelbergCement (three plants, 3.5Mt/yr) and CRH (two plants, 2.5Mt/yr).

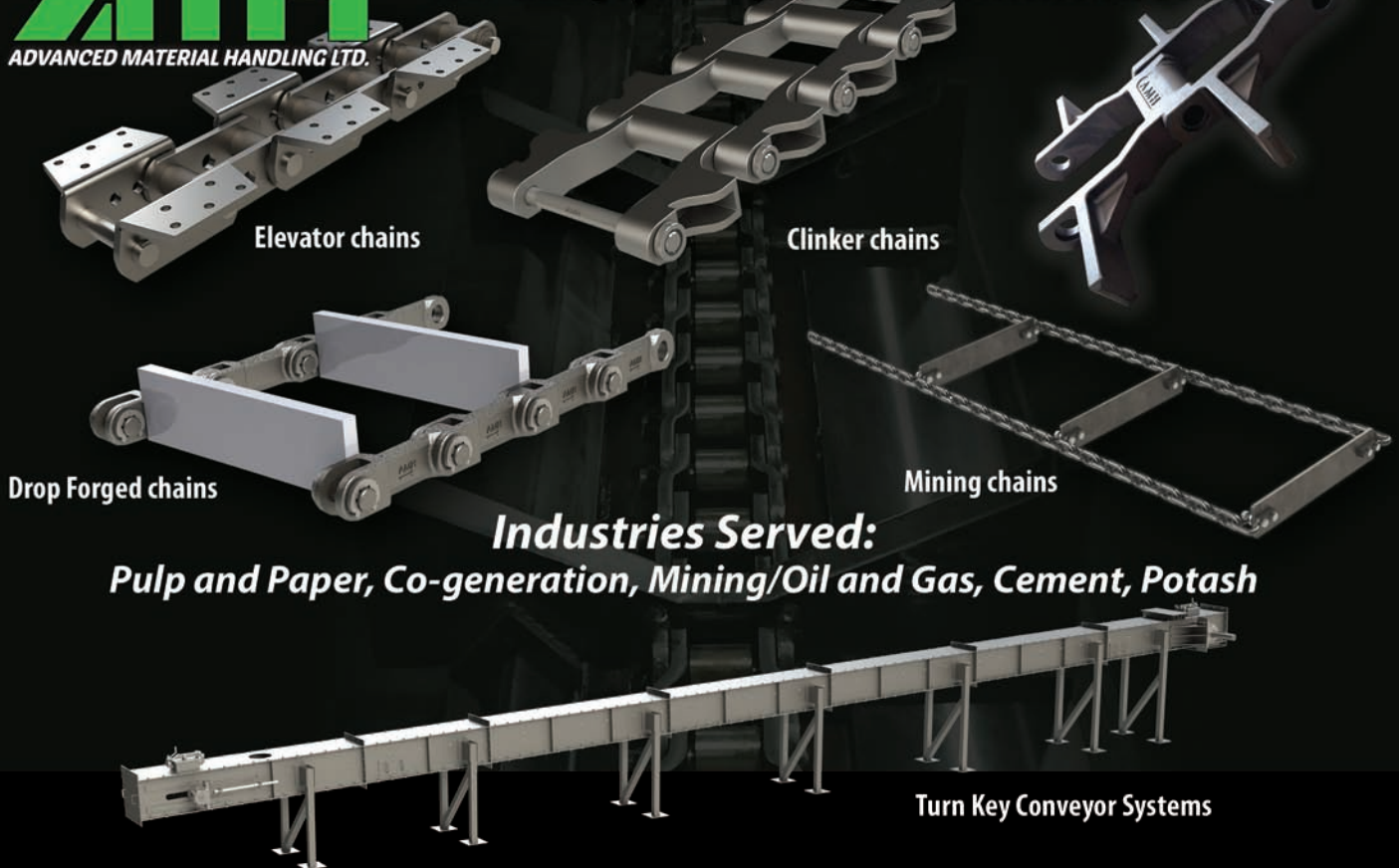
Recent news

McInnis: McInnis started 2018 looking for new financial investment, although three bids were rejected by McInnis' owner Caisse de dépôt et placement du Québec (CDPQ) as they were deemed to be too low. A change of CEO from Hervé Mallet to former CFO Jean Moreau appears to have since steadied the ship. In November 2018 the Quebec government, which had invested heavily in the plant during its construction, requested that CDPQ swap its US\$200m debt in McInnis into equity. This has not been granted.

Production at the plant unexpectedly stopped at the start of January 2019 following an 'unspecified' mechanical issue. There were reports that the kiln shell had been damaged by an over-heated bearing.

Fuels for Exshaw: In February 2019 the Alberta Climate Leadership Plan allocated US\$7.5m for the Lower Carbon Fuels Project at Lafarge Canada's Exshaw cement plant. The project will study the use of co-processing alternative fuels to replace natural gas. Technologies for fuel handling, processing and injection will be installed at the site to replace 50% of its natural gas use. The implementation at Exshaw will be supported by development of a waste and fuel processing facility in Calgary.





Industries Served:

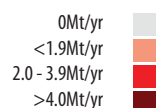
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Left - Figure 6: Map of Canada with integrated cement plants. Provinces and Territories are colour-coded by cement production capacity.

Source: Global Cement Directory 2019.



LH = LafargeHolcim.
HC = HeidelbergCement.

BRITISH COLUMBIA - 2 plants - 2.4Mt/yr

1. Lafarge Canada (LH), 1.1Mt/yr.
2. Lehigh Hanson (HC), 1.3Mt/yr.

ALBERTA - 2 plants - 3.6Mt/yr

3. Lafarge Canada (LH), 2.2Mt/yr.
4. Lehigh Inland (HC), 1.4Mt/yr

ONTARIO - 6 plants - 6.4Mt/yr capacity

5. Essroc Canada (HC), 0.8Mt/yr.
6. Federal White, 0.5Mt/yr.
7. Lafarge Canada (LH), 1.1Mt/yr.
8. St Marys Cement (Votorantim), 1.2Mt/yr.
9. St Marys Cement (Votorantim), 0.8Mt/yr
10. CRH, Mississauga, 2.0Mt/yr.

QUEBEC - 5 plants - 5.6Mt/yr capacity

11. Ciment Québec (HC), 1.0Mt/yr.
12. Lafarge Canada (H), St Constant, 1.0Mt/yr.
13. CRH, 1.1Mt/yr.
14. Colacem Canada, 0.3Mt/yr.
15. McInnis Cement, 2.2Mt/yr.

NOVA SCOTIA - 1 plant - 0.6Mt/yr

16. Lafarge Canada (LH), 0.6Mt/yr



China: Cement producer results for 2018

China: CNBM revenue rises by a fifth

China National Building Material Company's (CNBM) revenue grew by 19% to US\$32.6bn in 2018 from US\$27.4bn in 2017. Its profit rose by 44% to US\$2.09bn from US\$1.46bn. Its adjusted earnings before interest, taxation, depreciation and amortisation (EBITDA) increased by 18% to US\$6.33bn from US\$5.37bn.

By product line its cement sales rose by 25% to US\$18.7bn from US\$14.9bn. Concrete sales rose by 31% to US\$6.17bn from US\$4.70bn. Overall sales rose in most regions, with the exception of the Middle East and Africa. The group's cement companies' cement production volumes fell slightly to 336Mt and cement sales fell by 2.4% to 323Mt. Particular declines in cement sales were noted at North Cement, Sinoma Cement, Tianshan Cement, Ningxia Building Materials and Qilianshan. The group's overall concrete sales volumes rose by 3.4% to 96Mm³. Sales from its engineering services division rose by 9% to US\$5.09bn from US\$4.67bn.

China: Huaxin's sales rise by a third

Huaxin Cement's sales revenue rose by 32% year-on-year to US\$4.09bn in 2018 from US\$3.11bn in 2017. Its net profit grew by nearly 150% to US\$772m from US\$309m. Its cement sales volumes increased by 3% to 70.7Mt and its ready-mix concrete (RMX) sales increased by 11% to 3.56Mm³. By region its operating revenue grew in all domestic regions, except for Jiangxi.

During 2018 the cement producer completed its acquisition of Chongqing Lafarge Shui On Cantian Cement. Its Tibet Shannan Third Phase 3000t/day and Shigatse Second Phase 3000t/day projects were put into operation. In total the group added 4.77Mt/yr of cement production capacity in 2018. In its future risk analysis it said that production capacity utilisation in the cement industry is 'yet to be improved and that the 'fundamental contradiction' of the overcapacity has not been solved.

Switzerland's LafargeHolcim runs Huaxin Cement as a joint venture. The company operates almost 200 subsidiaries in nine provinces in China as well units in Tajikistan and Cambodia. Huaxin has a cement capacity of 100Mt/yr, a ready-mixed concrete capacity of 23.3Mm³/yr and an aggregate capacity of 25Mt/yr.

China: Tianrui reports strong sales

Tianrui Cement sales revenue rose by 19.5% year-on-year to US\$1.5bn in 2018 from US\$1.25bn in 2017. It attributed the growth to a 15% increase in the price of cement. Its earnings before interest, taxation, depreciation and amortisation (EBITDA) grew by 15.3% to US\$573m from US\$497m. Its sales volumes of cement remained stable at 29.4Mt compared to 29.3Mt in 2017.



China: Anhui Conch registers massive up-tick in results

Anhui Conch's revenue grew by 70.5% year-on-year to US\$19.1bn in 2018 from US\$11.2bn in 2017. Its sales volumes of cement rose by 25% to 368Mt. Its net profit increased by 88% to US\$4.44bn from US\$2.36bn. The cement producer attributed this to 'significant' growth in its prices.

During the reporting year the group commissioned four cement grinding units for its Yueqing Conch Cement and Jiande Conch subsidiaries. It also acquired Guangdong Qingyuan Cement, increasing its production capacity of clinker and cement by 2.7Mt/yr and 4.0Mt/yr respectively.

Outside of China, the group completed and commissioned two clinker production lines and four cement grinding units at Battambang Conch Cement in Cambodia and PT Conch North Sulawesi Cement in Indonesia. Its Luangprabang Conch Cement project in Laos has moved to the equipment installation phase and construction of Myanmar Conch Cement (Mandalay) in Myanmar has begun. Preliminary work has also started for the Vientiane Conch Cement project in Laos and the Qarshi Conch Cement project in Uzbekistan.

China: Shanshui profit doubles

China Shanshui Cement's revenue grew by 19% year-on-year to US\$2.63bn in 2018 from US\$2.2bn in 2017. Its profit from operations nearly doubled to US\$563m from US\$295m. It reported growth in most of

its operating regions, with the exception of Xinjiang Region, where revenue fell slightly to US\$71.1m. It attributed its overall sales revenue growth to raised prices.



Pakistan: Exports grow by over 50%

The All Pakistan Cement Manufacturers Association (APCMA) has reported that cement exports during the first eight months of the current Pakistani fiscal year, from 1 July 2018, saw growth of 52.3% year-on-year compared to the same period of the prior fiscal year. Exports were 4.65Mt compared to 3.05Mt.

In February 2019 exports were up by 69.1% year-on-year at 0.51Mt. The southern part of the country, particularly the Sindh region, fared considerably better than the national picture, as cement exports from the region increased by 185% to 0.35Mt in February 2019. Local consumption in the region was also higher, albeit less dramatically, with sales of 0.67Mt as compared to 0.61Mt a year earlier. However, plants in the north continued to suffer, with exports falling by 16% to 1.86Mt over the eight-month period from 2.21Mt a year earlier. In February 2019 exports from the north declined by 8.7% to 0.17Mt.

Among other factors, the export of cement to India has been suspended due to a 200% increase in the import duty, as the Indian government had announced to de-list Pakistan from the status of 'Most-Favoured Nation.' The APCMA also said that rain in almost all parts of Pakistan had also affected construction activities.

Philippines: New plant approved

Holcim Philippines plans to build a new cement plant in Bulacan province have been approved by the Board of Investments. The 2.5Mt/yr Bulacan Line 3 plant is part of the company's US\$300m investment drive to increase its production capacity by 30% by 2020, according to the Manila Times newspaper. The approval also grants the project tax incentives covered by the government's investment code.



Uzbekistan: Plant upgrade begins

Qizilqumsement has started building a US\$110m upgrade to its Qizilqum cement plant. The project is intended to increase the plant's clinker production capacity and decrease energy costs. It is scheduled for completion in 2020.

China/France: CNBM and Fives outline strategic agreement in Paris

Song Zhi Ping, president of China National Building Material Company (CNBM), and Frédéric Sanchez, chairman of Fives, have signed strategic agreement towards climate change and cooperation in third countries. This agreement develops the collaboration plans drawn up in January 2019 between cement producer and plant manufacturer CNBM and the engineering group Fives. It forecasts a volume of business of at least Euro600m over three years, and forms part of CNBM's stated strategy of developing in partnership with western companies. The agreement was signed at the Elysée Palace in Paris during a state visit to France by China's President Xi Jinping.

The agreement focuses on upgrading CNBM's cement plants in China, building new plants outside of China and creating a Joint Engineering Centre to implement these projects and share information. The Joint Engineering Centre was inaugurated on 28 February 2019 in Shanghai. With regards to modernising its cement production lines in China, Fives said that its technologies, particularly in grinding,



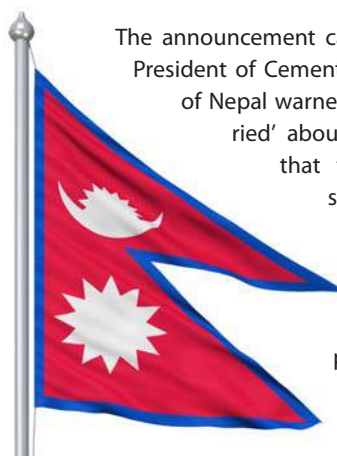
Above: Song Zhi Ping (centre left), President of CNBM and Fives Chairman Frédéric Sanchez (centre right) pose for the international press after signing the agreement, flanked by their national Presidents Xi Jinping (left) and Emmanuel Macron (right). **Source:** Fives website.

would 'significantly' improve performance and return on investment with regards to modernising CNBM's domestic cement production lines. Fives said that the agreement is in full alignment with the Paris Agreement.



Nepal: IME to build new plant

IME Group plans to build a US\$90m cement plant at Chormara, Nawalparasi. The unit is scheduled to be commissioned in early 2024, according to the Kathmandu Post newspaper. This will follow one year of preliminary work, one year for fund raising and two years of construction. The plant will mine limestone from a quarry in the Madanpur and Sisdi Rural Municipalities of Palpa district. The quarry will be 25km from the designated plant site. The mine has 18.7Mt of limestone, according to a report by Investment Board Nepal.



The announcement came as Dhruva Raj Thapa, President of Cement Manufacturer Association of Nepal warned that the sector was 'worried' about new investments, given that the country has become self sufficient in terms of cement production. Clinker imports have now stopped due to increased domestic production capacity, with capacity estimated to be sufficient until at least 2029.

Sri Lanka: President inaugurates construction of Hambantota plant

Prime Minister Ranil Wickremesinghe has inaugurated the construction of a cement factory at the Port of Hambantota. An unnamed Chinese cement producer was linked to the project, with production scheduled to start in mid-2020.

Australia: Wagners halts Boral supplies

Wagners Cement suspended its supply of cement products to Boral for six months in mid March 2019. Wagners has a cement supply agreement with Boral where it supplies cement on an annual basis for a fixed price. However, Boral issued a notice to Wagners saying that it has found cheaper cement from a 'long established' supplier in South East Queensland.

As per the agreement Wagners can either match the lower price or suspend its supply. Wagners has decided to suspend its supply to Boral, pending resolution of the issue. It said that the potential financial impact of the pricing notice is US\$14m.

Uzbekistan: Almalyk starts exports to Afghanistan

Uzbekistan's Almalyk Mining and Metallurgical Complex (AMMC) has started exporting cement to Afghanistan. A trial consignment of Ordinary Portland Cement (OPC) was despatched from the company's new 1.5Mt/yr Sherabad cement plant in Surkhandarya, according to the Trend News Agency. It intends to export 0.5Mt/yr to Afghanistan. As part of a contract signed with the Hamid Company, just under 1000t of cement has been sent by train to Mazar-i-Sharif.



Singapore: International Cement Group announces major 'Belt and Road' projects

International Cement Group, based in Singapore, is planning to build new cement plants in Central Asia, Africa and South-east Asia to complement China's Belt and Road Initiative. The company, formerly known as Compact Metal Industries, has held a ceremony to mark its listing at the Singapore Stock Exchange, according to the Business Times Singapore newspaper.

The company already holds a 65% stake in a

1.4Mt/yr cement plant in Tajikistan. In mid-2018 it said it was building a new plant in Kazakhstan. This project is scheduled for commissioning by the end of 2019. In March 2019 the group agreed to buy a majority stake in Namibia's Ohorongo Cement from Schwenk Namibia for US\$104m. In late 2018 the group said it had failed to buy a majority stake in a partially-built cement plant at Salamanga in Mozambique.

15. TÇMB International Technical Seminar & Exhibition 8-11 October 2019 Kaya Palazzo Golf Resort, Belek, Antalya/ Turkey

15. TÇMB International Technical Seminar & Exhibition

15th TÇMB International Technical Seminar and Exhibition will be held in Kaya Palazzo Golf Resort Belek, Antalya, Turkey between 8th and 11th October, 2019.

The program is open for both national and international attendees from cement industry, service and technology providers. The event is important for the manufacturers to follow up the recent developments and creates an opportunity for the participants to consider the new investments while having a chance to benchmark their business for every two years.

14th TÇMB International Technical Seminar and Exhibition held in 2017 was found very successful by global cement industry with the participation of more than 576 participants, also 131 foreign and national companies from cement and related industries.

For Registration: tekniks@tcma.org.tr

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Towards Circular Green Economy and Digital Transformation

Sub-Themes:

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- Industry 4.0
- Innovative Production Technologies
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Contents

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Morocco: Results from LafargeHolcim and Ciments du Maroc

LafargeHolcim Morocco's turnover fell by 2% year-on-year to Euro725m in 2018 from Euro743m in 2017. Its consolidated net profit dropped by 18% to Euro156m from Euro177m. The subsidiary of LafargeHolcim said that its sales had fallen less than the 5% that the local cement market suffered. It blamed a drop in operating income on lower revenue and rising petcoke costs. The cement producer said it was 'confident' about the fundamentals of the building materials sector. It plans to commission a new cement plant in the Souss region in 2020.

Meanwhile, Ciments du Maroc's turnover fell slightly to Euro371m in 2018. Its net profit grew by 3.4% year-on-year to Euro96m in 2018 from Euro92.8m in 2017. Its

cement sales volumes fell by 2.7% in 2018 compared to a drop in local cement consumption of 3.7%. The board of the cement producer said that it was continuing its development plan at Nador in the south of the country.



Libya: LCC to invest Euro200m at Benghazi

The Libyan Cement Company plans to spend Euro200m on an upgrade to its plant in Benghazi. The project will increase the unit's production capacity to 3Mt/yr from 2Mt/yr at present. Planning is at an advanced stage, with tenders already issued for the engineering, procurement and construction (EPC) of a mixture of new and upgraded facilities. The Central Bank of Libya, other banks and other investors will supply finance for the project.

The cement producer reopened its Benghazi plant in late February 2019. It has over 1000 employees with more openings to follow.

Lebanon: Al Arz license revoked after protests

Industry Minister Wael Abu Faour has revoked the license of the Al Arz Cement plant project. It follows protests by local residents, according to the Daily Star newspaper. A report by environmental non-government organisation (NGO) Green Globe ranked the region as the 11th most polluted area in the country due to quarrying and crusher activity. The cement plant project was launched in 2017 by entrepreneur Pierre Fattoush.

Kenya: Planned EAPCC land sale blocked

An attempt by the East African Portland Cement (EAPCC) to sell some of its land has been threatened by local residents. 5000 local residents say that the disputed land belongs to them, according to the Standard newspaper. They hold a title deed to the land and a court halted construction work on the site in February 2019. The residents also claim that they have been subject to excessive force by the police.

EAPCC is selling land in a government-backed arrangement to try and clear its debts after it made a loss in 2018. The land has been set aside for Kenya Railways to build a rail container terminal. The railway operator has already made a US\$12m down payment on the property. EAPCC maintains that it owns the land. However, the government has agreed to negotiate with the protestors.

Kenya: Cemtech cleared to buy Simba Cement

The Competition Authority of Kenya (CAK) has approved the acquisition of Cemtech by Simba Cement. CAK said that, as Cemtech had been dormant for a decade, its purchase would revive the company, create jobs and improve the economy in West Pokot County.

Simba Cement is a subsidiary of Devki Group and it trades under the National Cement brand. Cemtech is a subsidiary of India's Sanghi Group. It has been attempting to build a cement plant in West Pokot since 2010. The acquisition includes Cemtech's land, business intellectual property, business records, equipment, goodwill, licenses, stock and third party rights.

Data from the Kenya National Bureau of Statistics used by CAK showed the leading companies in the country's cement sector by market share were: Bamburi Cement (33%), Mombasa Cement (16%), East African Portland Cement (15%), Savannah Cement (15%), National Cement (8%) and Athi River Mining Africa (13%).



Tanzania: Twiga revenue rises 30%

Twiga Cement's revenue rose by 30% year-on-year to US\$151m in 2018 from US\$116m in 2017. Its net profit grew by 60% to US\$24.6m from US\$15.4m. Its cement sales volumes increased by 9%. The subsidiary of Germany's HeidelbergCement said that the local cement market saw continued growth in 2018 and that, despite production overcapacity, it maintained its 'market leadership.'



Source:
HeidelbergCement
Africa website.

Niger: President launches plant

The Nigerien President Issoufou Mahamadou has inaugurated Malbaza Cement Company's plant at Malbaza. The US\$83m plant has a production capacity of 0.65Mt/yr, according to Le Sahel newspaper. It produced its first cement in late December 2018. It has 347 employees.

Egypt: Suez plant damaged

Suez Cement's Kattameya plant has been damaged by the collapse of a soil barrier around a nearby wastewater treatment lake. The incident caused a flood of 1.5Mm³ of treated water that reached the edge of the cement plant. The plant's quarry, some power cables and lighting and a road were damaged. No members of staff at the plant were hurt.

The subsidiary of HeidelbergCement estimates that the flood caused around Euro0.5m worth of damage. It says that it previously raised the issue of the wastewater treatment lake with its owner in 2010 following a risk assessment. This led to the construction of the soil barriers.



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Nigeria: BUA contracts Wärtsilä for new Sokoto line

BUA Group has signed a contract with Finland's Wärtsilä Oy for construction of a 48MW power plant for Line 3 at its Sokoto Cement plant in Sokoto State. The announcement of the deal follows BUA's January 2019 announcement that China's CBMI would build the new line at the site.

Abdul Samad Rabi'u, the executive chairman and chief executive officer (CEO) of BUA Group, signed on behalf of the group while Wärtsilä's Head of Africa, Magnus Miemois, signed for the power plant provider.

BUA is Nigeria's second-largest cement producer by volume, with assets that include the 6Mt/yr Obu Cement I & II plants in Okpella, Edo State, CCNN's 1.5Mt/yr Kalamaina plant and the 0.5Mt/yr Sokoto Cement plant.



Zambia: Zambezi Portland upgrade

Zambezi Portland Cement has spent Euro23m on an upgrade to its plant. Chief Executive Officer (CEO) Gomeli Litana said that the upgrade was necessary due to the high demand for cement, according to the Zambia National Broadcasting Corporation. He added that the expansion was likely to reduce the cost of cement.

Kuwait: Kuwait Cement commissions Magotteaux for mill modernisation

Kuwait Cement has hired Belgium's Magotteaux to modernise three of its cement mills. The project consists of closing the open circuit with fourth generation XP4i separators, installing new mill internals components, including diaphragms, and adapting a new ball charge gradation. The aim of the project is to increase the production rate, reduce the specific energy consumption and improve the product quality, by reducing the residue on 45µm by keeping the same Blaine value.

Kuwait: Kuwait Cement starts deliveries to NPS

Kuwait Cement has made its first delivery of oil well cement to National Petroleum Services. It is producing the product at its Shuaiba plant, according to the Arab Times newspaper. It holds API Monogram licencing from American Petroleum Institute (API) to produce this type of cement.



Ivory Coast: Prestige launches Abidjan plant

Prestige Cement has inaugurated a 1.2Mt/yr plant at Abidjan. The Chinese-Ivorian joint venture had an investment of around US\$35m, according to the Agence de Presse Africaine. The unit has two 0.6Mt/yr production lines using vertical roller mills. Souleymane Diarrassouba, Minister of Commerce, Industry and SME Promotion, attended the event on behalf of the government. Chinese ambassador Tang Weibin was also in attendance.

Earlier, it was reported that imports of clinker to Ivory Coast rose by 2.3% year-on-year to 3.10Mt in 2018 from 3.03Mt in 2017. The value of the product increased by 9.7% to US\$162m from US\$148m. Clinker surpassed crude oil as the most imported commodity by volume into the country in 2017.

Qatar: Al Khalij signs Qatar Petroleum deal

Al Khalij Cement has signed a three-year deal to supply oil well cement to Qatar Petroleum. The agreement was signed by Qatar Petroleum's Executive Vice President Projects, Engineering & Procurement Services Mohamed Al Marri and Qatari Investors Group chief executive officer (CEO) Raja Assili, according to the Qatar News Agency and the Peninsula newspaper. It was announced at the launch of Qatar Petroleum's Tawteen program.

"We are delighted to have been selected by Qatar Petroleum for the supply of oil well cement. This represents an endorsement of the high quality standards of our production facility," said Abdulla Bin Nasser Al Misnad, the chairman of Qatari Investors Group. Al Khalij Cement is a subsidiary of Qatari Investors Group.



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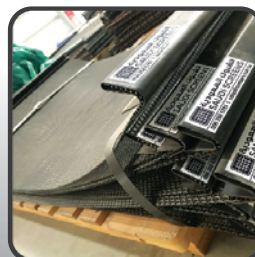
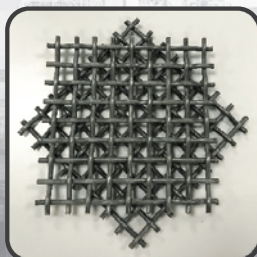
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GLOBAL CEMENT NEWS: MIDDLE EAST & AFRICA



Cameroon: Nomayos plant inaugurated

Cimencam has inaugurated its 0.5Mt/yr Nomayos cement grinding plant. The company also launched a new logo, according to the Ecofin Agency. The new unit will manufacture the company's MultiX CEM II 32.5 R Ordinary Portland Cement (OPC) and its Sublime white cement products.

The subsidiary of LafargeHolcim is planning to regain lost market share in the country since Dangote Cement started operating locally. It is planning to build a new kiln at its Figuil integrated plant in Garoua, which is due for commissioning in 2020.

Senegal: Capacity utilisation rate at just 23%

Bai Lamin Jobe, the Minister of Trade, says that the country has a cement capacity utilisation rate of 23%. Local producers have a capacity of 1.9Mt/yr but national demand is only around 0.4Mt, according to the Foroyaa newspaper. He added that the country imported 0.39Mt in 2018 in answers to members of the National Assembly.

It was also revealed that Jah Multi Industries is building new silos at its import terminal. Jah Cement is also planning to upgrade its terminal into a grinding plant. Construction work started in 2018 and it is expected to be completed by late 2019.



Somalia/Iran: Iran's Qeshm Free Zone to export cement to Somalia

Pejman Bahrami, the deputy head of Qeshm Free Zone Organisation for maritime transport and port affairs, says that 14,500t of cement will be exported to Somalia. It will be transported on a Tanzanian ship, the AMINA-H, that is currently being loaded, according to the Fars News Agency. The Iranian cement industry has a production capacity of 80Mt/yr. It sends its exports to countries including Iraq, Azerbaijan, Turkmenistan, Afghanistan, Russia, Kazakhstan, Kuwait, Pakistan, Qatar, Turkey, the UAE, Georgia, Oman, India, Somalia and China.



Above: Mogadishu, capital of Somalia. Source: MDOGAN/Shutterstock.com



Ghana: New plant for north east

Solomon Namliit Boar, the regional minister-designate for the newly created North East Region, says that negotiations are on-going for a new cement factory to be built at Gbandaa in the Nalerigu Municipality. The project is intended to make use of a 20Mm³ limestone deposit in the area, according to the Daily Guide newspaper. The project has remained in the planning stage for some time with Vice President Alhaji Dr Mahamadu Bawumia assuring local residents in 2017 that the government would find investors.

Kuwait/Saudi Arabia: Qassim exports to Kuwait

Saudi Arabia's Qassim Cement has signed a contract with the Al-Aradah Building Materials Company to export cement to Kuwait. It has agreed to transport 120,000t of cement until the end of 2019. The financial impact of the deal will be disclosed in the cement producer's financial results later in 2019.

UAE: RAK Cement postpones acquisitions

RAK Cement has postponed its acquisition of Newtech cement and the Al banna quarry due to incomplete financing. It previously announced the purchase in late February 2019. It planned to buy the assets for around US\$123m.

Senegal: Consumer Association asks for cement price controls

Omara Ndao, the president of the Consumer Association of Senegal, has asked the government to place controls on the price of cement. His comments followed an increase in the price of cement set by local producers, according to the Senegalese News Agency. He proposed that a technical commission should study the situation and make recommendations to the National Consumer Council.

Namibia: Whale Rock to export to rest of Africa

Whale Rock Cement says it plans to start exporting cement to countries in Africa following the accreditation of its Cheetah Cement products with the Namibia Standards Institute and the South African Bureau of Standards. It hopes to send its exports to Mozambique, Congo and Ivory Coast, according to the Namibian Sun newspaper. The cement producer started producing clinker at its 1.2Mt/yr integrated plant near Otjiwarongo in late 2018.





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Senegal: The maximum price of cement, as mandated by the country's Ministry of Commerce, remained unchanged as of 18 March 2019. The announcement follows a price increase by Sococim to US\$5.95/bag in early March 2019.

India: Cement prices surged by in Delhi and Mumbai by US\$0.36-0.43/bag (50kg) in the week to 9 April 2019. In both cities cement from UltraTech, ACC and Ambuja now sells at US\$4.99-5.06/bag, while Shree Cement and JK Lakshmi sells at US\$4.55-4.48/bag.

Dealers based in Delhi cited the pick up in rural demand as the main reason, as the region enters harvesting season. Besides demand, escalation in input costs has also led to a spike in prices, according to cement producers. A dealer in Mumbai said that the demand was robust across the entire state of Maharashtra, in addition to Mumbai itself.

Egypt: Ordinary Portland Cement prices as of 10 April 2019: Arabian Cement (Al Mosalah) = US\$49.92/t; Arabian Cement (Al Nasr) = US\$49.91/t; Elnahda Cement (Al Sakhras) = US\$47.49/t; Lafarge (Al Makhous) = US\$48.18/t; Medcom Aswan Cement (Aswan) = US\$47.49/t; Arish Cement (Alaskary) = US\$47.78/t; Arish Cement (Askary Beni Suef) = US\$47.78/t; Sinai Cement = US\$47.78/t; Suez Cement = US\$48.47/t; Tourah Portland Cement = US\$49.22/t; Helwan Cement = US\$49.22/t; Misr Beni Suef = US\$48.47/t; El Sewedy Cement = US\$49.91/t; Misr Cement Qena = US\$47.49/t.

White cement prices as of 10 April 2019: Sinai White Cement (Alabid Elada) = US\$124.06/t; Sinai White Cement (Super Sinai) = US\$121.17/t; El Menya Cement (Super Royal) = US\$121.17/t; El Menya Cement (Royal Elada) = US\$124.60/t; Menya Helwan Cement = US\$116.84/t.

Do you have your finger on the cement price pulse where you are?
If so, *Global Cement Magazine* needs you!

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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 104. In this issue subscribers receive information from seven more countries: Niger, Iran, Nigeria, Ghana, Pakistan, Guinea and China.

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

Blended cement prices as of 10 April 2019: Helwan Cement (Al Nakheel) = US\$44.08/t; Helwan Cement (Al Waha) = US\$44.77/t.

Sulphate-resistant cement prices as of 10 April 2019: ASEC Cement (Asic Sea Water) = US\$50.84/t; Lafarge (Kahger Albehar) = US\$52.57/t; Suez Cement (Al Suez Sea Water) = US\$50384/t; El Sewedy Cement = US\$51.59/t.

Vietnam: Cement manufacturers have announced price rises following an 8.36% increase in national electricity prices on 20 March 2019.

VICEM's But Son Cement announced it would increase the price of its cement by US\$1.29/t with immediate effect. Do Tien Trinh, the plant's General Director, said that in addition to the electricity tariff increase, the price of coal sold to cement producers had also increased by 2.3-5.8%.

Cong Thanh Cement Joint Stock Company in the central region did not raise its retail prices but is still charging its distributors US\$1.29/t more than previously.

South Africa:

Our correspondent reports that average coastal cement prices at the start of April 2019 were US\$5.28/bag (50kg) for 32.5 N and US\$5.63/bag for 42.5 N. Inland, the prices were US\$5.59/bag and US\$6.07/bag, respectively. The national averages were US\$5.44/bag and US\$5.85/bag respectively.



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We are but frogs in the valley...

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



I've recently enjoyed a short holiday with my wife, younger daughter and two elderly parents in Sardinia. One evening, after some Sardinian wine, beer and local myrtle liqueur, I wandered out in the chill night to catch some fresh air before bed. I looked out over the night-time hills and valleys and was rapt with the sound of frogs croaking, down the hill in the damp stream. They would go silent for a while, and then one would start up again. Then all the other frogs would join in, and an amphibian cacophony would result. Presumably, at some point in the evening, there would be some kind of frog-based orgy, everyone would get pregnant and the new generation would arise. Biology was never my favourite subject at school.

Anyway, I guess that those frogs have been at it in that valley for a long time. Maybe 10,000 years, maybe 100,000. Maybe a million years. Who knows?

Then I looked up and I saw the faintest sliver of a new crescent moon. The rest of the Moon was clearly revealed by 'Earthshine,' which is light that comes from the Sun, bounces off the earth, shines on side of the Moon that is not illuminated by the Sun and is then seen from Earth. Gazing up in the cold night, it struck me that the Moon has been revolving around the world for the best part of four and a half billion years, uninterrupted, since a Mars-sized body smashed into the Earth early in the history of the Solar System. Every now and again, a meteor of some description, larger or smaller, bashes into the Moon and makes a new crater. It's still happening today. Otherwise, nothing much happens up there, apart from about five year's worth of visits from a dozen Americans in the 1960s and 1970s. I'm reminded of the old joke about the terrible party on the Moon: "There was just no atmosphere."

Looking up again, I saw a spectacular starry sky, with a few easily-identified constellations; Orion, of course, but also Gemini, Leo, the Plough (the Big Dipper to Americans) and Cassiopeia (through which, it's always useful to remember, the Milky Way passes). These stars are strictly the most local of the stars in our galaxy: from a few tens to hundreds or a few thousand light years away. If you ever get to see the Milky Way itself, which is now a rarity in our light-polluted cities but can still be managed out in the country on a good night, you won't see stars, but just the impression of millions of them - or more exactly around 250 billion of them. The stars in the vast majority of our own galaxy are too far away for us to be able to see them individually.

This galaxy of ours has been around 13.5 billion years - since nearly the beginning of the universe (13.7 billion years): it is just one of perhaps 200 billion galaxies in the universe, each with hundreds of billions of stars in them. As the great Peter Cook once said, "As I looked out into the night sky, across all those infinite stars, it made me realize how insignificant they are." He was right, of course. Apart from some terrible gamma-ray burst from a distant supernova that happens to fry all life on Earth, none of those stars can possibly have any effect on us here on Earth. They are all just too far away. For instance, the nearest star to the Sun is Proxima Centauri, which at 4.22 light years away is around 41 trillion kilometres distant. In terms of the universe it is local, but I wouldn't want to walk it.

Even when galaxies collide, as is predicted to happen when the Andromeda Galaxy, our nearest galactic neighbour, smashes into the Milky Way in about four billion year's time, it is extremely unlikely that any of its one trillion stars will collide with any of our 200 billion stars. Perhaps then, given the huge distances between us and any other star, the main effect of other stars on us humans is to make us appreciate our true and humble place in the scheme of things.

I would argue that our place is somewhat like the frogs in that damp Sardinian valley: making a lot of noise, but basically getting on with the job and ensuring that there are frogs in the valley for thousands of years to come.

The unfortunate thing is that we are progressively and inexorably poisoning the world. It has been found that fungicides, antibiotics, herbicides and insecticides are widely present in streams in Europe - and will no doubt be so around the world. Research revealed in 2013 that insecticides were devastating dragonflies, snails and other water-based species in the Netherlands. The pollution was so severe in places that the ditchwater itself could have been used as a pesticide.¹ It's possible that the frogs in the valley won't be around in another 10,000 years. It's also entirely possible that we won't be around either. With our selfish ways, and our scant regard for 'the commons,' we have had quite an effect on the world, and seldom in a good way. Our children are now showing us the way forward, protesting at *our* inaction on climate change. Will we listen? Will we act?

¹ <https://www.theguardian.com/environment/2019/apr/08/pesticides-antibiotics-polluting-streams-europe-wildlife>





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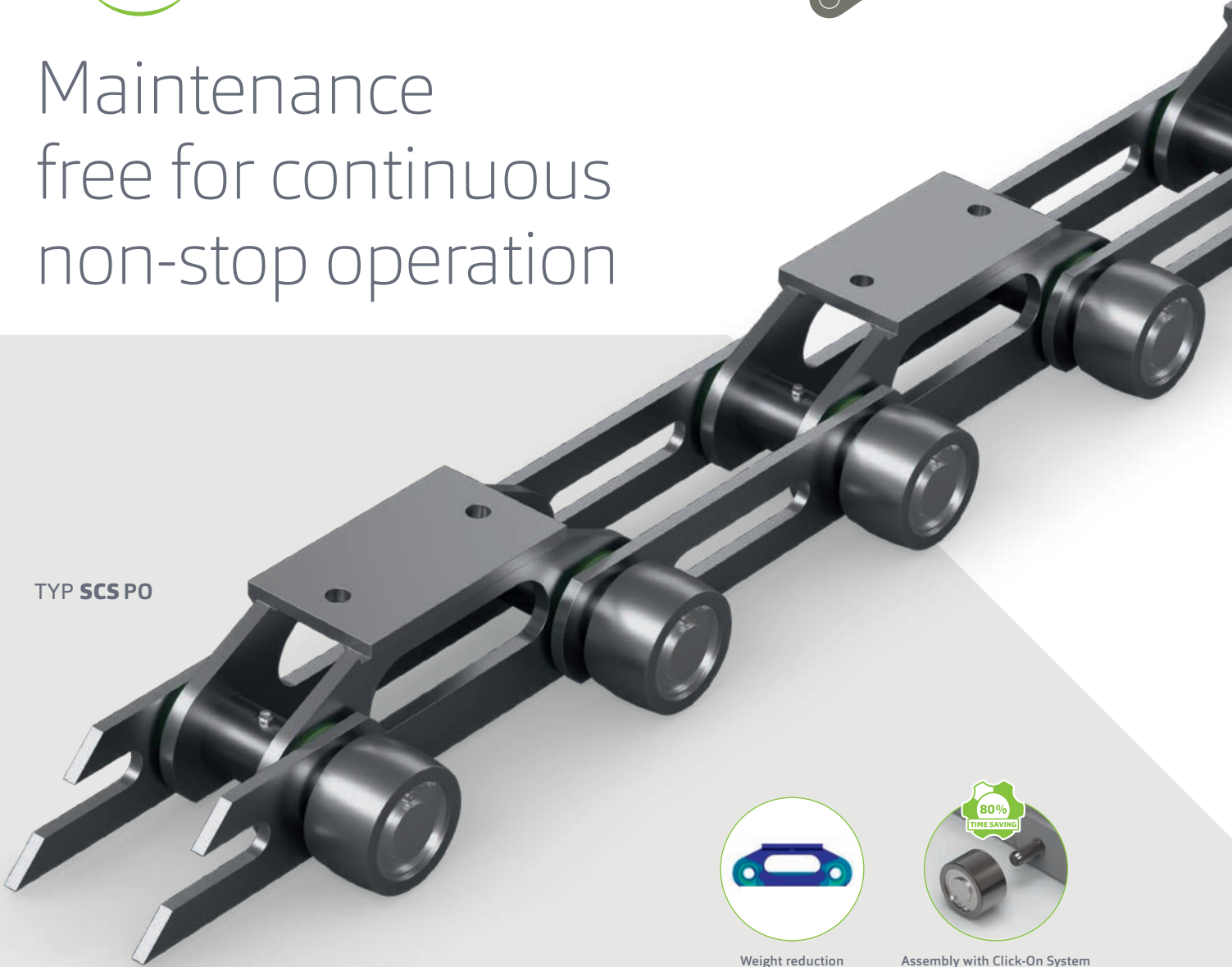
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