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This issue's front cover...

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Dear readers,

Welcome to the September 2016 issue of *Global Cement Magazine* - the world's most widely-read cement magazine. As in other years, this bumper September issue coincides with the *VDZ Annual Cement Conference*, taking place in Düsseldorf, Germany on 27-28 September 2016. As VDZ members sit down at the event, they will be doing so in not just one of the most technologically-advanced, environmentally-conscious and competitive cement industries in the world, but also in a country where cement demand could be set to increase in light of new infrastructure spending. The Bundesverkehrswegeplan (BVWP) 2030 (literally 'Federal Traffic Network Plan') has outlined over Euro264bn of cement-intensive road, rail and waterway projects for the 14 years to 2030. While the plan has already attracted significant criticism from the Green Party and other concerned groups, the BVWP could represent excellent extra demand for the country's cement producers. A review of the prospects of the sector can be found from Page 42 onwards.

Meanwhile, UK players can probably only dream of such investment, but may *need* it given the country's decision on 23 June 2016 to leave the EU. On Page 8 we take the views of Edwin Trout from the Cement Industry Suppliers Forum, who says that, while the UK can expect an economic 'wobble' in the short term, construction is a 'long-term thing' and the fundamentals are unchanged. Edwin suggests that carefully-selected government-led infrastructure projects could help to make up for an expected lull in cement demand from private investments while the longer-term relationship with the EU becomes clearer and confidence returns. Those in the UK cement sector (and the country as a whole) will surely hope that the government can 'juggle' all of these balls to maximise both short and long-term prospects.

This issue also looks at China, the world's largest cement industry. Chinese cement production officially decreased in 2015 for the first time in decades. The fact that the government is prepared to announce a reduced figure is significant in itself, whether or not you believe the values themselves... See more on Page 56. This issue also includes technical articles on additives, chains, pneumatic conveying , alternative fuels, gears and laboratory equipment.

Finally, we give a belated credit to Jennings Alabanza, whose photograph of the Afrisam Dudfield plant in South Africa appeared on the cover of the July-August 2016 issue of *Global Cement Magazine*.

We hope you enjoy this issue of *Global Cement Magazine* - the world's most widely-read cement magazine!

PKEdwards

Peter Edwards
Editor

Cement Industry Suppliers' Forum

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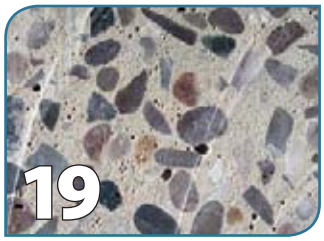

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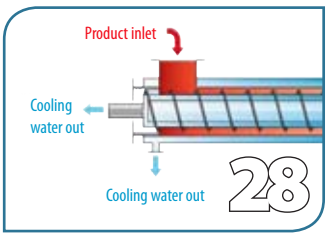

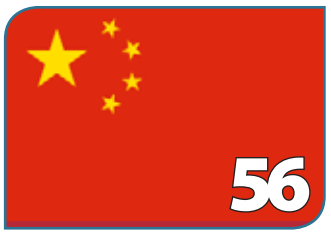

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XXXIII FICEM Technical Congress 2016
5-7 September 2016, Cartegena, Colombia
http://congresotecnico2016.ficem.org/en/

VDZ Annual Cement Conference 2016
27-28 September 2016, Düsseldorf, Germany
www.vdz-online.de

BULKEX 2016
5-6 October 2016, Harrogate, UK
www.mhea.co.uk/bulkex-2016/

16th Global Gypsum Conference & Exhibition
25-26 October 2016, Bangkok, Thailand
www.GlobalGypsum.com

21st Arab-International Cement Conference and Exhibition
16-18 November 2016, Abu Dhabi, UAE
www.aucbm.org

11th Global CemFuels Conference & Exhibition
2-3 February 2017, Barcelona, Spain
www.CemFuels.com

2nd Global SynGyp Conference & Exhibition
30-31 March 2017, Düsseldorf, Germany
www.GlobalSynGyp.com

1st Global CemProcess Conference
24-25 April 2017, London, UK
www.CemProcess.com

12th Global Slag Conference & Exhibition
18-19 May 2017, Düsseldorf, Germany
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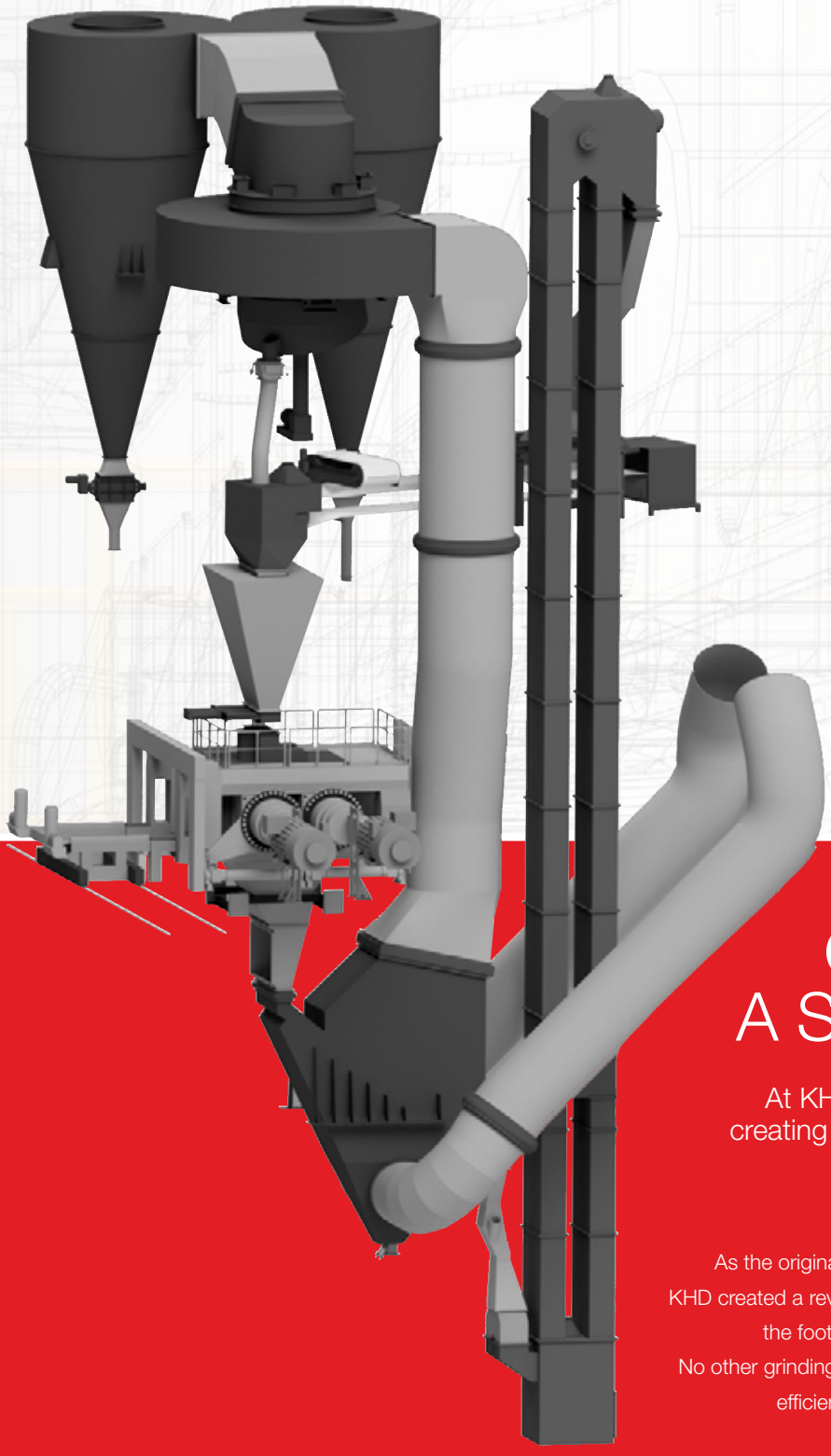

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Interview by Peter Edwards, Global Cement Magazine

Keep calm and carry on - The possible effects of Brexit on the UK cement sector

The UK, EU and much of the rest of the world is still reeling from the UK's shock decision to leave the EU in a referendum held on 23 June 2016. Although the country already has a new Prime Minister and the Pound has fallen somewhat against the Euro and US Dollar, the full economic and political effects of the decision, nicknamed 'Brexit,' will take years to unfold. Here *Global Cement* takes the views of Edwin Trout of the Cement Industry Suppliers' Forum (CISF) in the UK, with his comments coming just days after the vote.

Above: Edwin Trout, Secretary of the Cement Industry Suppliers' Forum in the UK.

***Global Cement (GC):* What was your first reaction to hearing that the UK public had decided to leave the European Union (EU)?**

Edwin Trout (ET): It was one of surprise because, when I went to bed at midnight on the Thursday night, everyone was reporting that there would be a narrow victory for the Remain camp. I had only seen one result come in, for Gibraltar, which predictably enough was for 'Remain.' If I had stayed up for a few more hours, I might have been a little less surprised. There was certainly an element of unease too, because, whatever anyone says, this is a major change for the UK and the rest of the EU.

***GC:* How do you think UK cement production will be affected?**

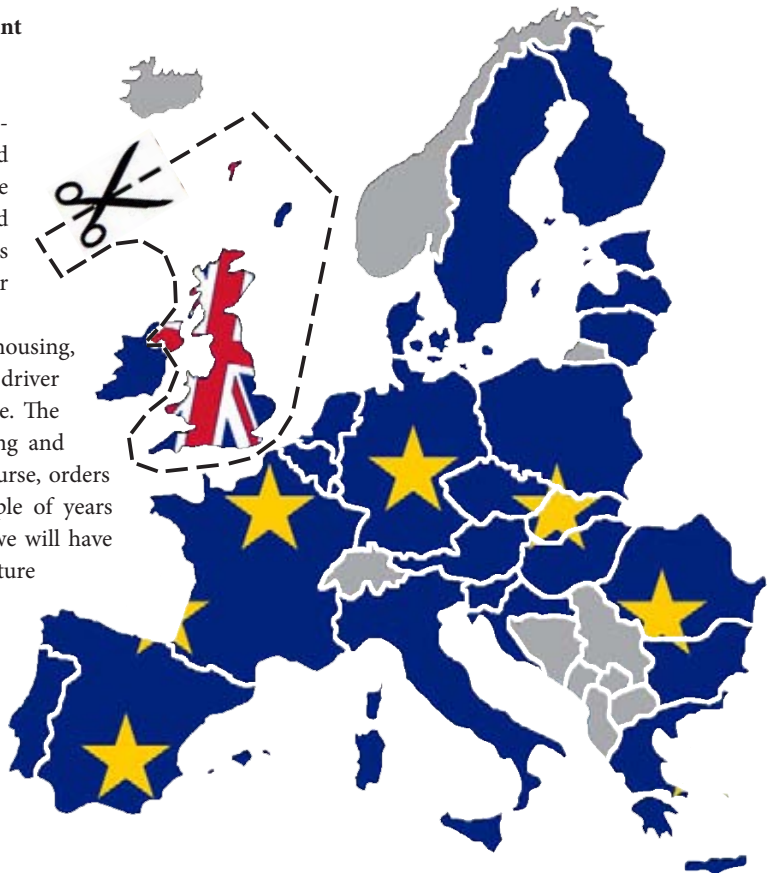
ET: Production is based on demand and the ability to pay and neither is reversed by the Leave vote. I don't see that the UK would stop doing things because of fears over the state of the economy or future trading relationships.

The UK desperately needs housing, which will continue to be a major driver of cement consumption in future. The office sector is similarly booming and I think that will continue. Of course, orders placed recently will take a couple of years to be delivered, by which time we will have a much better picture of the future trading relationship with the EU.

There will certainly be an element of economic 'wobble,' as people postpone short-term decisions, but construction is a long term undertaking. We might see a dip in a year or two but after that confidence will be back up.

The early moves made by the Bank of England and the statements from the government have been quite effective at stemming panic. There have been reassurances that house-building is a top priority and that major infrastructure projects will remain on-track.

> *"There will be an economic 'wobble,' as people postpone short-term decisions, but construction is long term."*



Left: The process of 'unstitching' the UK from the rest of the EU will begin with the triggering of Article 50 of the Lisbon Treaty. At that point a two year negotiation process will begin between the UK and remaining EU members as to future trading and movement rules.

One potential area of concern is the loss of EU-funded projects. We just don't know the point at which the money will get turned off. The extent to which the British government will shift the money that currently goes to Brussels into these projects remains to be seen. The Welsh government is certainly worried about a future shortfall in funding. It wrote to Westminster within hours of the result to request assurances that it wouldn't lose out. This is an area of concern.

***GC:* Will there be changes to imports or exports?**

ET: Imports and exports tend to be a short-term fix to a short-term problem. For example, the 2013 flooding at South Ferriby meant that Cemex was suddenly forced to import into the UK to fulfill its commitments. However, Brexit is not a short-term decision and the industry will adapt to fit the needs of the economy.

With respect to exports, the UK hasn't exported cement in any meaningful quantity since 1984 and it won't suddenly start again unless the Pound crashes very badly indeed. At the moment production is committed domestically and I think that will continue. If there is a big surplus further down the line, the producers are more likely to shut down capacity, as they did in the 2008 crisis, rather than export.

"One potential area of concern is the loss of EU-funded projects. We just don't know the point at which the money will be turned off."

Imports, on the other hand, could be more changeable. If the exchange rate makes for a weaker Pound over the long term, imports will be more expensive, but there will also be less need to import, because the weak Pound would be representative of a weakened economy.

I would say that the single biggest difficulty for international trade could come at the Irish border. Cement currently flows north or south depending on the economic conditions in the UK and the Republic of Ireland. Whether that border will become more 'opaque' again remains to be seen. It could be problematic for Irish producers in particular; Quinn Cement is setting up terminals in England and Ecocem's new terminal in Runcorn has only just come online.

***GC:* What about investment at UK cement plants - Will produers 'hold fire' due to uncertainty?**

ET: I am less confident with my ability to 'forecast' in this area but investment has been down across the industry since the crash in 2008. What we certainly won't see is any multinational rushing to build a new cement works, but that wasn't going to happen anyway!

However, those in a position to invest in existing plants have been doing so. They may well be in good positions to handle lower demand, if we see that.

Hope Construction Materials, for example, has invested heavily in alternative fuels, bagging plants and new terminals. It could be that Hope has come to the end of that period of heavy investment regardless of the Brexit decision, but of course I can't be sure.

HeidelbergCement subsidiary Hanson has also been investing. It has spent a lot of money on its Padeswood facility and has been improving efficiency across its operations. I think that this sort of 'efficiency gain' investment will be increasingly important if demand does fall.

It sounds harsh but, for Cemex, the flood at South Ferriby actually prompted investment. The plant is now refurbished and in great shape for the future. It is unlikely that Brexit will put off investment here, because it's a case of 'job done.'

As for the other players, I don't see CRH rushing to spend new money at the

Left: The Hanson Padeswood plant, like several others in the UK, has undergone significant investment recently.

moment, as it is probably focussed on integration and is spending on other acquisitions around the world. Again, this is due to non-Brexit factors. LafargeHolcim might be the most exposed to the effects of any Brexit-related slowdown.

"I don't think the producers will want to walk away. This is especially the case for those that have just invested."

***GC:* Do you think that there is a risk one or more of the major players could decide to leave the UK as the result of Brexit?**

ET: No, I don't think this is on the radar. The UK population, businesses and economic activity aren't 'going anywhere,' so I don't think the producers will want to walk away. This is especially the case for those that have just invested.

It's worth remembering that the UK cement industry is already quite small per capita compared to that of Germany, Italy, Turkey and quite a few others in Europe. It has already undergone significant restructuring since the 2008 crisis and ownership has increased in three or four spasms of change. The sector is very efficient, with no 'flab' and I can't see that any of the players would want to leave such a market.

I think that the largest threat to the sector could be the imposition of regulations. If it becomes more difficult to make cement in the UK then a multinational might be tempted to scale-down production in the UK and import. It has happened elsewhere!

***GC:* Do you expect that UK cement producers would continue to be bound by EU-wide regulations, for example REACH or those regarding health and safety and chromium VI?**

ET: Again, I don't see this a major area of change in practice. It makes sense for a multinational to operate under similar conditions across its different jurisdictions from an operational perspective. All of the equipment to handle chromium VI, for example, is in place and I can't see that any responsible producer would back-track on such investment, even if was allowed to do so.

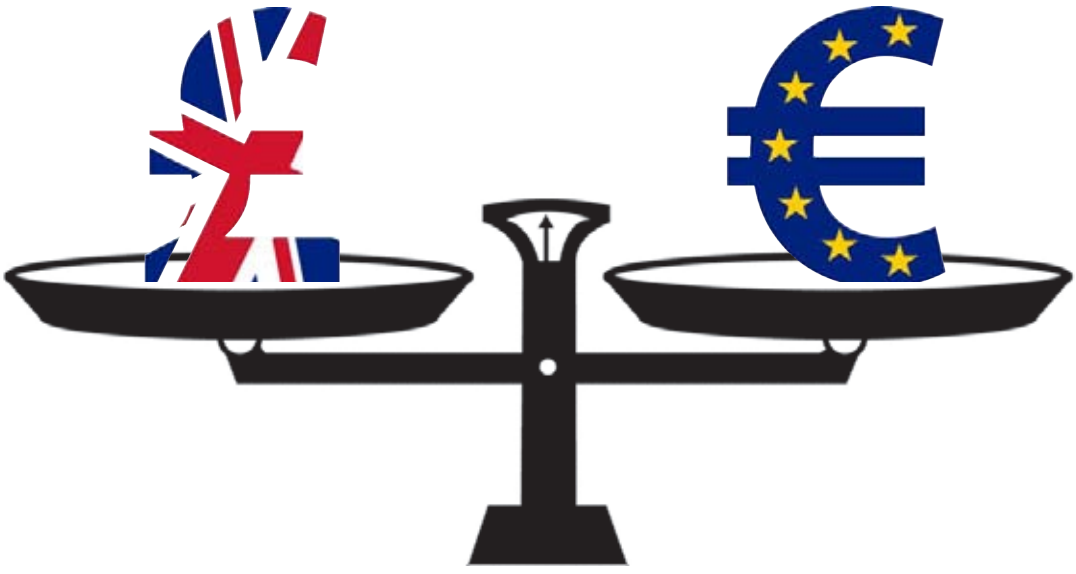
I would like to highlight that the UK has a strong health and safety culture. Taking away a legislative requirement doesn't mean that health and safety stances will be abandoned. We are talking about a culture that is now well ingrained.

***GC:* What about the EU Emissions Trading Scheme (ETS)?**

ET: The EU ETS was based largely on a British initiative. As such it represents a characteristically British response to the problem of CO_2. I don't know how or whether the UK will be allowed to continue within the EU ETS but I would strongly expect that the producers would want to continue with it or something similar. There is little advantage in changing things for change's sake. The UK cement sector certainly won't be pushing for any unnecessary changes.

***GC:* Edwin, Thank you for your time.**

ET: You are very welcome!



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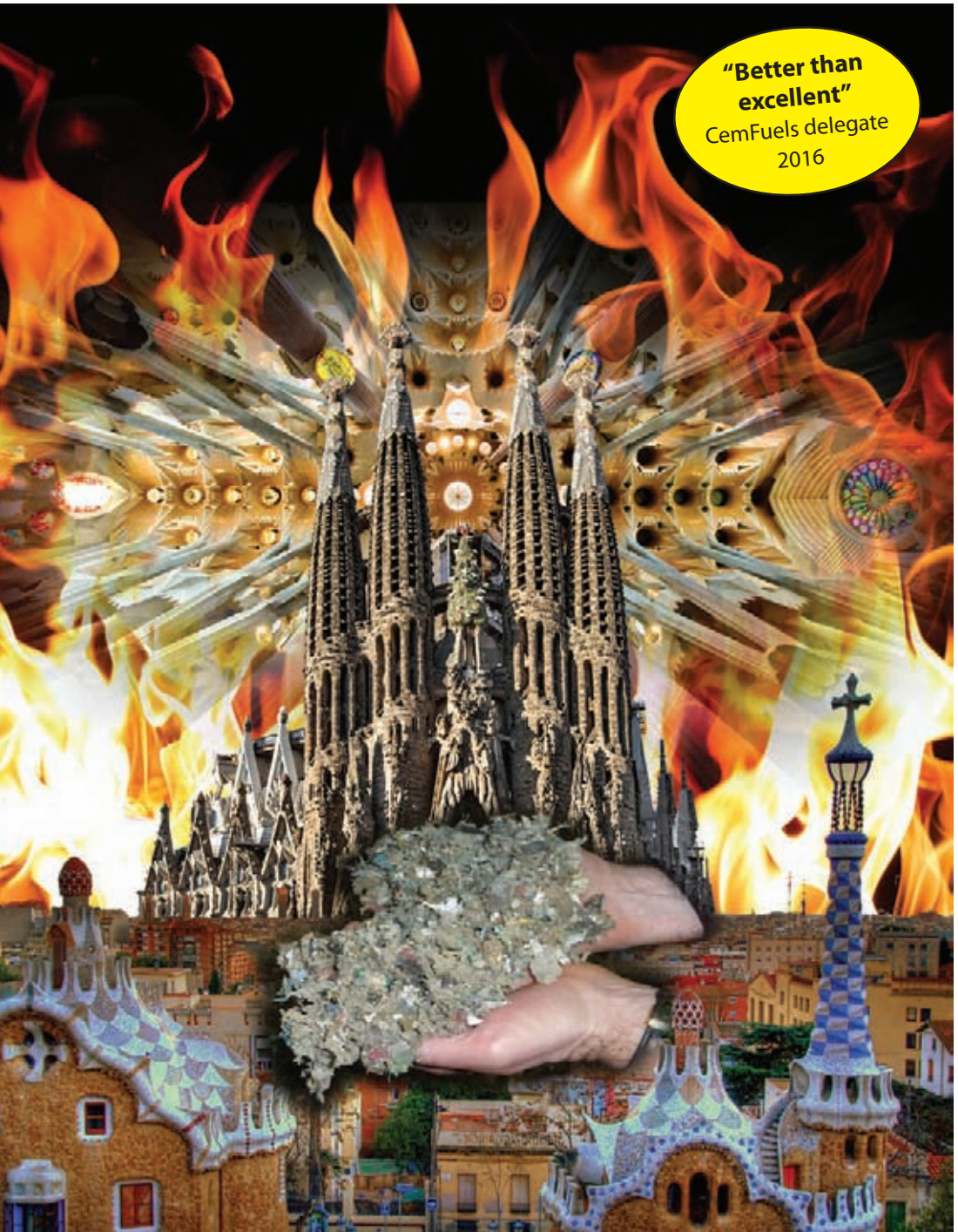

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Pavel Martauz & Július Strigáč, Považská Cementáreň a.s. Ladce, Slovakia

Production of low Cr^{VI} cements at Považská Cement in Slovakia

Commercial success in the cement sector increasingly depends not just on reaching quality and technical parameters, but also on fulfilling the requirements of health and safety regulations, which topically include the level of harmful chromium six (Cr^{VI}) compounds. Here Pavel Martauz and Július Strigáč from Považská Cementáreň a.s. Ladce, in Slovakia, outline the steps that their plant has taken to reduce the level of Cr^{VI} in its products.

This page: The CHROMATMIN range of cements from PCLA in Slovakia.

Chromium is present in cement in two forms: Cr^{III} and Cr^{VI}. Cr^{III} is present in compounds such as Cr_2O_3 and as a component in solid solution of clinker minerals. Cr^{VI} is present in chromates (CrO_4^{2-}). While Cr^{III} is non-hazardous from a health point of view, Cr^{VI} is hazardous to health. Cr^{VI} causes a skin disease known as 'chromium eczema,' is toxic and is a potential carcinogen.

Even if the raw materials for cement production contain mostly Cr^{III} compounds, the Cr^{III} is partially or completely oxidised when exposed to high temperatures, oxidising atmospheres and alkaline environments. This leads to harmful Cr^{VI} chromates.

The total amount of chromium compounds in cement depends on the raw materials and production technology used. The average content of soluble Cr^{VI} compounds in Portland cements produced in various European cement plants is 15-100ppm, as determined according to the methods in EN 196-10.[1]

The limits for low Cr^{VI}

According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on the classification, labelling and packaging of substances and mixtures, the upper limit of Cr^{VI} compounds is 2ppm in packed cements or cement mixtures.

Unless cements or cement mixtures are already classified and labelled as a sensitiser with the hazard statement H317, 'May cause an allergic skin reaction', the label on the packaging of cements and cement mixtures that contain, when they are hydrated, more than 0.0002% soluble chromium (VI) of the total dry weight of the cement shall bear the statement: *EUH203 — 'Contains chromium$^{(VI)}$. May produce an allergic reaction'*. If reducing agents are used, then the packaging of cement or cement-containing mixtures shall include information on the packing date, the storage conditions and the storage period appropriate to maintaining the activity of the reducing agent and to keeping the content of soluble chromium Cr^{VI} below 0.0002%. It also applies to wet ready mixed cement and concrete.

VDZ throws importers a curved ball

In 1999 the German bagged cement market was completely closed to imports of foreign bagged cements that contained more than 2ppm Cr^{VI}, as measured by the German method TRGS 613 developed by Germany's Hazardous Materials Committee in support of Industrial Regulations for Hazardous Materials.[2]

At that time, the Cr^{VI} content of cement was lowered by using so-called 'green salt' - ferrous sulphate heptahydrate ($FeSO_4 \cdot 7H_2O$). The patented method had been bought by the German cement producers association (VDZ) and so this Cr^{VI} reduction method was not available for the foreign bagged cement producers, including Považská Cementáreň a.s. Ladce (PCLA) in Slovakia.

As PCLA exported 40% of its bagged cement output to Germany at that point, a solution had to be found to reduce its own levels of Cr^{VI} as soon as possible. In order to maintain bagged cement exports to Germany, PCLA developed its own patented solution for Cr^{VI}.[3-4] This enabled the company to reduce the level of Cr^{VI} to below 2ppm.

The methods used at PCLA

At PCLA the reduction of Cr^{VI} levels was carried out at three points: **1.** Raw material mixture preparation; **2.** The combustion process; **3.** Cement production and dispatch.

1. Iron carbonates were added between 0.01% to 10% by weight to the raw material mixture. The iron carbonate used was natural siderite (ferrous carbonate / $FeCO_3$), natural calcium ferrous carbonate ($CaFe(CO_3)_2$) or ankerite (calcium magnesium ferrous carbonate / $(Ca,Mg)Fe(CO_3)_2$).

The chemical treatment of siderite $FeCO_3$ is performed by activation with mineral acid such as waste sulphuric acid (H_2SO_4) from the steelmaking process, which converts water unsoluble Fe^{2+} in

the $FeCO_3$ to water soluble Fe^{2+} ions, according to Equation 1.[3]

$$FeCO_3 + (H_3O)^+ \rightarrow 0.5\ Fe^{2+} + 1.5\ H_2O + 0.5\ CO_2 + 0.5\ FeCO_3 + heat \quad (Eq.\ 1)$$

It is best to use industrial waste acids that have anions that are not harmful to cement or concrete, for example acids from spent pickling baths or acids from glass surface treatment processing. By this method, PCLA produces the chromate lowering cement additive Siderox, based on a utility model.[5] This can, in turn, be used for the production of Chromatmin, low chromate containing cements according to Equation 2.

$$Cr^{VI} + 3\ Fe^{II} \rightarrow Cr^{III} + 3\ Fe^{III} \quad (Eq.\ 2)$$

Siderox is so reactive that adding 0.1% by weight to cement reduces Cr^{VI} levels to 5ppm. It is mainly based on ferrous sulphate tetrahydrate ($FeSO_4 \bullet 4H_2O$), with more than 98% rozenite ($FeSO_4 \bullet 4H_2O$) and less than 2% of melanterite ($FeSO_4 \bullet 7H_2O$). The fineness of the $FeSO_4.4H_2O$ component can be adjusted to the same fineness of the cement in order to prevent the formation of efflorescences and brown stains at the building site.

2. Burning the raw mixture at 1450°C causes reduction of Cr^{VI} content in cement clinker to between 0.5-20ppm and Cr^{VI} levels are additionally lowered by the co-combustion of alternative fuels and biofuels. This is due to Equations 3 and 4, which show the conversion of Cr^{VI} to Cr^{III} by carbon monoxide (CO) and the active amine functional groups (NH_2^-) present in selected biofuels.

$$3\ CO + 2\ Cr^{VI} + 3/2\ O_2 \rightarrow 3\ CO_2 + 2\ Cr^{III} \quad (Eq.\ 3)$$

$$2\ Cr^{VI} + 2\ NH_2^- + O_2 \rightarrow 2\ Cr^{III} + N_2 + 2\ H_2O \quad (Eq.\ 4)$$

Commonly-used alternative fuels like waste tyres and municipal solid waste create local reduction atmospheres with increased CO concentration. Biofuels that contain NH_2^- groups include meat and bone meals, the oil seed residues and others.

3. Chemically treated, activated iron carbonates were added during and/or prior to grinding in the amount of 0.01-1% by weight, to achieve a final reduction of Cr^{VI} content to less than 2ppm in the cement product.

Chromatmin is safe and ecologically-sound cement with Cr^{VI} below 2ppm. This cement should be used when there is a high probability of the cement mixture coming into contact with human skin.

Shifting markets

While Chromatmin and Siderox were originally developed for and supplied to the German market from 2000, German pricing policies made the country less attractive for PCLA after 2004. Following a change in market orientation by the company, Chromatmin and Siderox are now widely used in central and eastern European countries like the Czech Republic, Austria, Poland, Hungary and, of course, Slovakia.

Below: Physical appearance of Chromatmin (left) and Siderox (right).

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Feryal Çelik, Mardin Çimento

The effects of silica fume and rice husk ash on compressive strength of cement

Mardin Çimento, part of OYAK Group, operates a 3Mt/yr cement plant in Mardin Province in south eastern Turkey. Here, Quality Control Manager Feryal Çelik describes the company's recent research into the use of silica fume and rice husk ash on compressive strength.

Silica fume and rice husk ash are classified as artificial pozzolans, siliceous and aluminous materials, which in themselves, possesses little or no cementitious value. However, in finely divided forms and in the presence of water, they react chemically with calcium hydroxide ($Ca(OH)_2$) to form compounds that have cementitious properties. As calcium hydroxide is present as an intermediate in the formation of OPC clinker, pozzolans react with this to form calcium silicate hydrates, which act as additional binders in the final cement product.

When added to wet cement mixtures, light-weight and finely-divided pozzolans can replace heavier cement, leading to increased workability. Due to the fact that they react chemically with water, they also reduce the water 'bleed' in fresh concrete mixtures. Pozzolans which are very finely divided and contain large amounts of amorphous silica also have a positive effect on compressive strength of concrete.

In a laboratory study, cement mortars were prepared according to TS EN 196-1, adding 5% or 10% silica fume or 10% rice husk ash and removing the equivalent amount of cement. The effects of silica fume and rice husk ash on early and standard compressive strength were examined.

Effect of adding silica fume

Silica fume is obtained from the reduction of high-purity quartz at about 2000°C during the production of silicon and ferrosilicon alloys. It contains very large amounts of amorphous silica (85-98%) and its average particle size is 100 times smaller than the average cement particle. These characteristics make it a very effective pozzolan.

In this study, silica fume from Eti Elektrometalurji AŞ was used with Portland cement and pozzolanic cements from Mardin Çimento. The effect on cement compressive strength of silica fume and trass, a natural pozzolan was investigated.

Cement mortars were prepared according to TS EN 196-1. Control samples of CEM I 42.5N Portland cement, CEM II/A-M(P, LL) 42.5 R Portland composite cement and CEM IV/B (P) 32.5 N pozzolanic cemen were made and compressive strengths at two, seven and 28 days were determined. Samples containing 5% and 10% silica fume were also made and tested in the same way. The effects on compressive strength are shown in Table 1.

Effect of adding rice husk ash

Rice husk ash is a pozzolan that contains approximately 90% amorphous silica. It is obtained by burning the second husk of rice at 600°C, followed by cooling. Rice husks are used as a fuel in many rice producing countries. The rice husk used in this study, had a gross calorific value of 3000kCal/kg. On average 20% of the rice husk is ash.

In this study, rice husk supplied from a paddy farm in Diyarbakır was used, along with Portland cement and Portland composite cement from Mardin Çimento. Ash was obtained by burning the rice

Mixture composition	Compressive Strength (MPa)			Increase (%)		
	2 days	7 days	28 days	2-7 days	7-28 days	2-28 days
CEM I 42.5N	29.4	40.1	49.9	36.4	24.4	69.7
CEM I 42.5N + 5% Silica fume	31.3	43.4	56.3	38.7	29.7	79.9
CEM I 42.5N + 10% Silica fume	30.1	45.6	60.4	51.5	32.5	100.7
CEM II/A-M (P, LL) 42.5R	28.7	38.4	48.9	33.8	27.3	70.4
CEM II/A-M (P, LL) 42.5R + 5% Silica fume	28.4	40.8	52.1	43.7	27.7	83.4
CEM II/A-M (P, LL) 42.5R + 10% Silica fume	28.5	42.9	59.7	50.5	39.2	109.5
CEM IV/B (P) 32.5N	17.6	26.8	34.8	52.3	29.9	97.7
CEM IV/B (P) 32.5N + 5% Silica fume	17.9	27.1	41.8	51.4	54.2	133.5
CEM IV/B (P) 32.5N + 10% Silica fume	17	29.7	43.9	74.7	47.8	158.2

Mixture composition	Compressive Strength (MPa)			Increase (%)		
	2 days	7 days	28 days	2-7 days	7-28 days	2-28 days
CEM I 42.5N	26.7	37.8	47.0	41.6	24.3	76
CEM I 42.5N + 10% RHA	28.9	47.9	61.5	65.7	28.4	112.8
CEM II A-M (P, LL) 42.5 R	25.1	35.1	44.0	39.8	25.4	75.3
CEM II A-M (P, LL) 42.5 R + 10% RHA	26.0	39.1	49.9	50.4	27.6	91.9

Left: a. Rice husk. **b.** Ground rice husk ash. **c.** Silica fume. Mortars and cement bags are also shown.

husk at 600°C temperature for 3hr. After this period the ashes were allowed to cool. When the temperature fell below 100°C the ashes were removed from the oven and stored in ambient conditions for 24hr. They were then ground for 45s in a laboratory grinding mill.

Cement mortars were prepared using CEM I 42.5N Portland cement and CEM II/A-M(P, LL) 42.5R Portland composite cement. Cement mortars were also prepared by substituting 10% of the cement with rice husk ash. As before, compressive strength measurements were taken at two, seven and 28 days. The results are shown in Table 2.

Results

The addition of the two artificial pozzolans positively influenced compressive strength. Replacing 10% of cement with rice husk ash improved compressive strength for both Portand cement and Portland composite cement. This study shows that rice husk ash is an effective pozzolanic material when also using trass, although it had a greater effect on Portland cement.

Replacing 10% of cement with silica fume improved compressive strength of the Portland cement and two pozzolan additive cements. The greatest improvement was seen with pozzolanic cement.

Sourcing both artificial pozzolans will incur a cost. However if they are produced in sufficient quantities close to a cement plant, the costs can be low enough such that the reduction in the cost of clinker more than pays for the pozzolan. While the benefits of using both pozzolans is clear in terms of improved cement performance, the economics are currently not in place to make their inclusion a commercial possibility for Mardin Çimento.

Left: The Mardin Çimento plant in Mardin Province, Turkey.

Michael Jakob, LECO Corporation - Europe & John T Riley, PhD, Professor Emeritus, Western Kentucky University

Monitoring with a macro TGA system

Flue gas desulphurisation (FGD) gypsum is a by-product of some industrial coal-fired flue gas scrubbing systems and is widely used as an additive in cement production. In Europe, more than 15Mt/yr of FGD gypsum is produced. A large portion of this material is used in the cement and gypsum wallboard industries.

A method for the characterisation of FGD gypsum by-products (and those of many other mineral products) is thermogravimetric analysis (TGA). In this analytical technique, mass loss is measured as a function of temperature and time.

Several micro TGA instruments exist that use less than 50mg of sample mass. However, the LECO TGA701 is a macro system that uses gram-sized samples and is able to analyse up to 19 samples within one batch analysis sequence. The macro sample size allows for a more accurate sample mass and better representation of heterogeneous materials, while the batch analysis increases the throughput potential for the instrument. A paper by Riley, Marsh and Lawrenz that was recently published in the *Journal of Testing and Evaluation* describes the analysis of FGD solids using a macro TGA system, which we use here to demonstrate the broader uses of this type of analysis.

Right - Figure 1: LECO TGA701 thermogravimetric analyser.

Wet limestone scrubbing

Wet limestone scrubbing with oxidation, using limestone forced oxidation scrubbers (LFOS) is the most common method of making FGD gypsum. The SO_2 present in the flue gas reacts with the limestone ($CaCO_3$) to form gypsum ($CaSO_4 \cdot 2H_2O$) as the predominant and desired product, according to the following reaction equations:

$$SO_2 + H_2O \longleftrightarrow H_2SO_3 \longleftrightarrow H^+ + HSO_3^-$$
$$CaCO_3 + 2H^+ \longleftrightarrow Ca^{2+} + H_2CO_3 \longleftrightarrow Ca^{2+} + H_2O + CO_2$$
$$Ca^{2+} + HSO_3^- \longleftrightarrow H^+ + CaSO_3\ (s)$$
$$2HSO_3^- + O_2 \longleftrightarrow 2SO_4^{2-} + 2H^+$$
$$Ca^{2+} + SO_4^{2-} \longleftrightarrow CaSO_4\ (s)$$

Limestone ($CaCO_3$), gypsum ($CaSO_4 \cdot 2H_2O$), calcium sulphite ($CaSO_3 \cdot ½\ H_2O$), free moisture and moisture in hydrates are present in the reaction mixtures. Monitoring these products is important for quality control and characterisation of FGD gypsum.

Figure 1 shows a LECO TGA701. This system uses up to 19 sample crucibles to make TGA measurements in many applications like LOI in cement samples, moisture/volatile/ash determination in coal and carbon fibre volume content in plastics. The system uses a carousel to load one sample crucible onto an integrated four-place balance (0.0001g) for mass measurement. The mass of every sample crucible is measured every three minutes. A temperature–weight loss curve is produced.

Normally several steps with a fixed temperature are used during an analysis. Every step is fully documented and the instrument can also run unattended overnight. Table 1 lists the steps in the full programme for the analysis of FGD solids. The fourth step in Table 1 is redundant, as it measures the same parameter as step 3. It can be used occasionally to check questionable results.

Figure 2 shows typical mass loss rates for some products formed during the FGD process. Table 2 shows the mass calculations for the decomposition products from the pure components. Excellent agreement between the determined percentages and the true values is typical of TGA701 measurements.

A typical thermogram of an FGD sample analysed by the method outlined in Table 1 is shown in Figure 3. The red curve shows the five temperature steps to determine free moisture, gypsum, calcium sulphite, lime and, finally, calcium carbonate. With some calculations based on chemical composition, a full range of compounds in the FGD gypsum sample can be determined.

Table 3 lists the percentages of the principal components determined for nine FGD solids using the five-step macro TGA method. The mass balance summaries in Table 3 attest to the overall accuracy of the measurements. The details of the calculations for the components in the table are given in the literature.[1]

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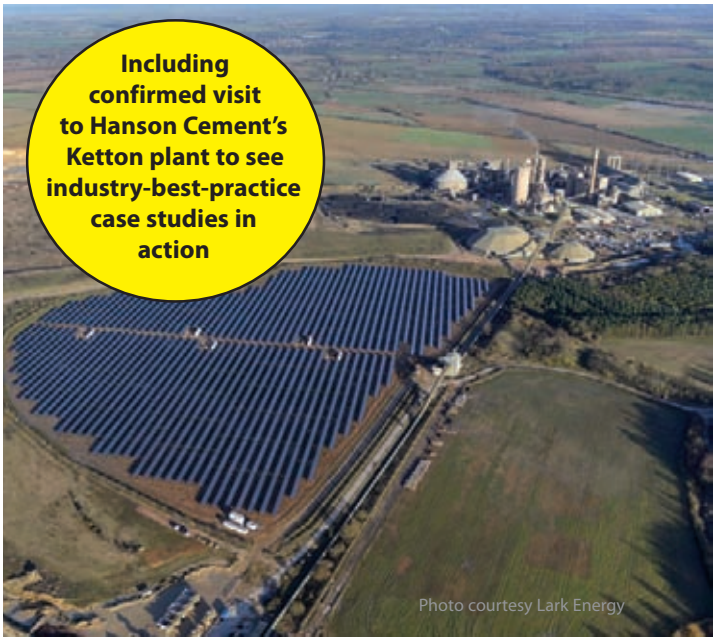

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Macro TGA step	Parameter measured	Thermal ramp (°C)	Ramp rate (°C/min)	Hold time (min)	Atmosphere	Final Weight
1	Free moisture	RT to 50	1	15	Nitrogen	At constancy
2	$CaSO_4 \cdot 2H_2O$	50 - 240	17	15	Nitrogen	End of step
3	$CaSO_3 \cdot 1/2H_2O$	240 - 400	17	5	Nitrogen	End of step
4	$CaSO_3 \cdot 1/2H_2O$	400	0	15	Oxygen	End of step
5	$Ca(OH)_2$	400 - 550	10	25	Nitrogen	End of step
6	$CaCO_3$	550 - 950	25	15	Nitrogen	End of step

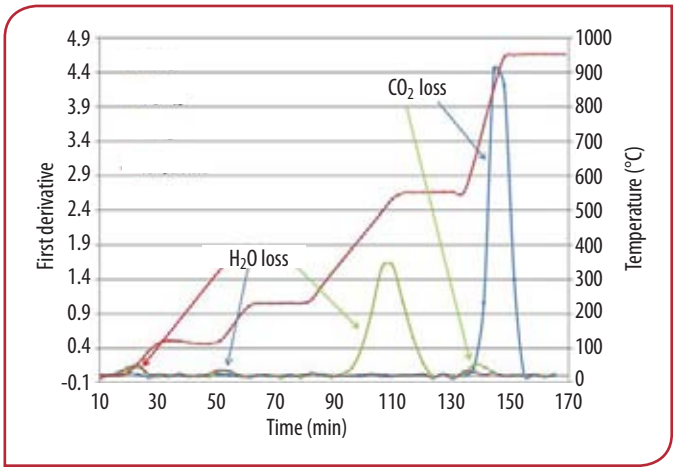
Above - Table 1: FGD method step programme for the TGA701 showing the parameters that are measured. RT = Room temp.

Compound	Product	Calculated (%)	Experimental (%)
$CaCO_3$	CaO	56.03	56.05
	CO_2	43.97	43.91
$CaC_2O_4 \cdot H_2O$	CaO	38.38	38.33
	H_2O	12.33	12.02
	CO	19.17	19.19
	CO_2	30.12	29.86
$CaSO_4$	$CaSO_4$	100.0	99.60

Above right - Table 2: Decomposition products from the pure materials used.

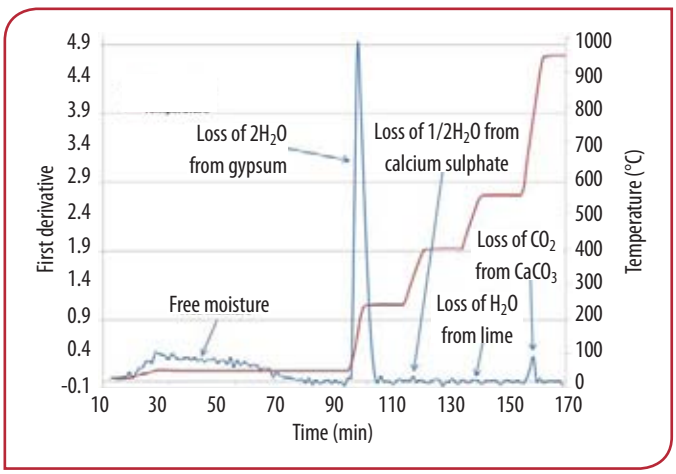
Right - Table 3: Examples of results from a five-step macro TGA programme.

Sample	Compounds				Determined Ash	Calculated Ash	Calculated Fly Ash	Mass Balance
	$CaSO_4 \cdot 2H_2O$	$CaSO_3 \cdot 1/2H_2O$	$Ca(OH)_2$	$CaCO_3$				
TVA 120	70.98	1.72	1.15	10.59	80.19	64.75	15.44	99.88
TVA 130	70.83	2.58	1.03	11.47	79.77	65.94	13.83	99.74
TVA 140	70.71	1.58	1.19	11.54	79.84	64.95	14.89	99.91
TVA 220	66.38	2.01	1.48	14.36	79.42	63.78	15.64	99.87
TVA 230	67.28	2.01	1.19	12.35	80.17	63.14	17.02	99.85
TVA 240	64.16	0.86	1.40	18.39	78.12	63.01	15.12	99.93
TVA 250	67.95	1.29	1.32	13.06	79.88	63.41	16.47	100.09
MC1	96.56	1.83	0.33	1.87	78.83	79.59	-0.76	99.84
MC2	95.98	2.32	0.33	1.74	79.18	79.58	-0.60	99.77



Right - Figure 2: Differential thermogram showing mass loss rates for pure components.

$CaCO_3$
$Ca(OH)_2$
$CaSO_4$
Temperature



Right - Figure 3: Differential thermogram of a typical FGD gypsum sample.

Mass loss rate
Temperature

Reference

1. Riley, J.T.; Marsh, M & Lawrenz D; *J. Test. Eval.*, **2016**. http://dx.doi.org/10.1520/JTE20160079. ISSN 0090-3973.

From a practical standpoint only the content of $CaSO_4 \cdot 2H_2O$ needs to be known to determine the acceptability of a gypsum product as suitable for use in cement. For this purpose a two-step programme with a shorter runtime is sufficient. The last two samples in Table 3 (MC1 and MC2) are suitable for inclusion in cement. Figure 3 shows the first two steps are completed in 3.5hr. At this point the amount of $CaSO_4 \cdot 2H_2O$ is known. This means at least two runs can be completed in an eight-hour work day. A third run can be completed in the same day by allowing the system to run overnight. This means a total of 57 samples can be analysed in a day.

Conclusion

The TGA701 system can be used for an accurate quantification of the primary matrix components of an FGD gypsum sample. The system setup is simple and no special adjustments have to be made. Special sample preparation is not needed with the process of weighing a full analysis batch of 19 samples into the crucible carousel.

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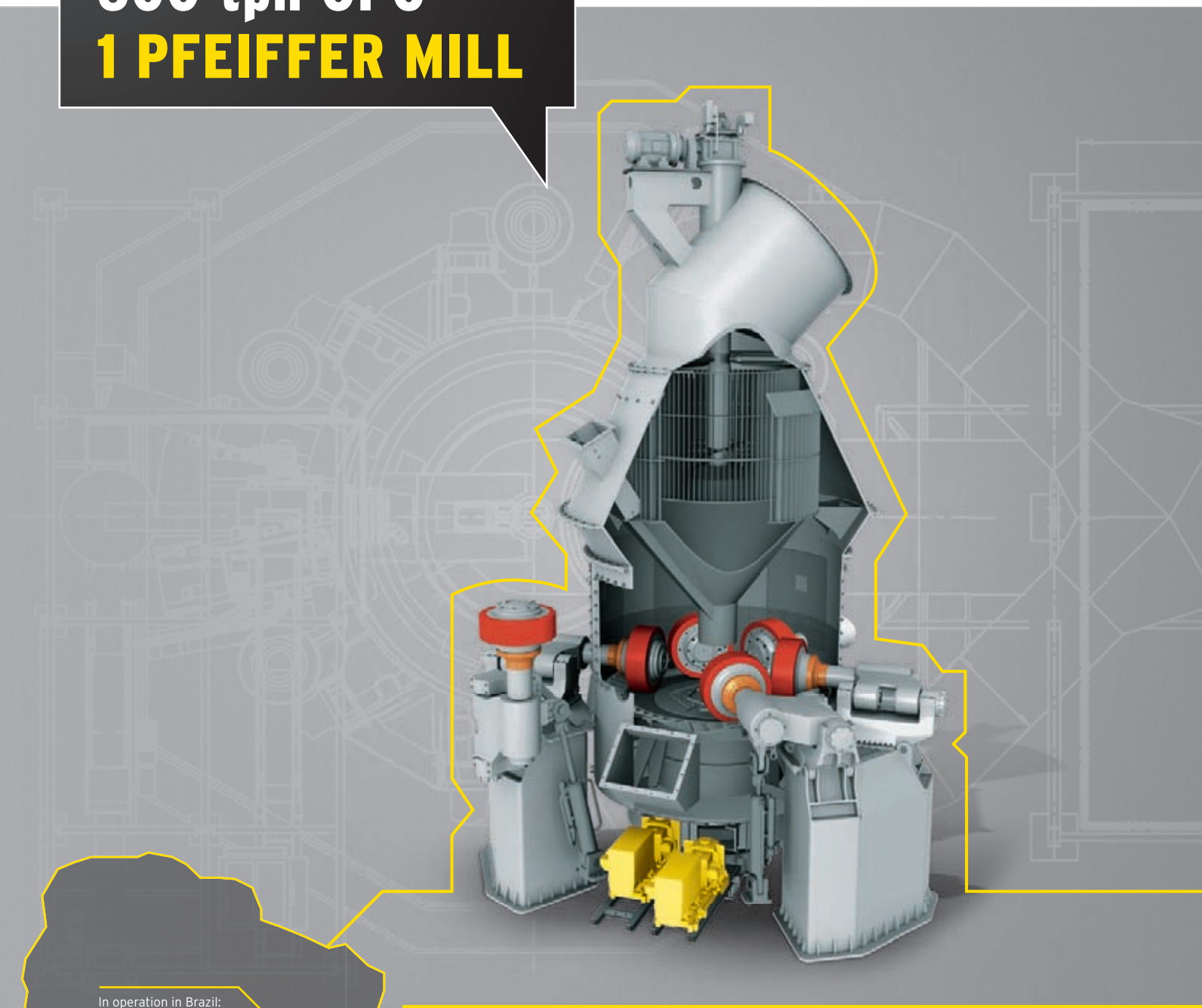

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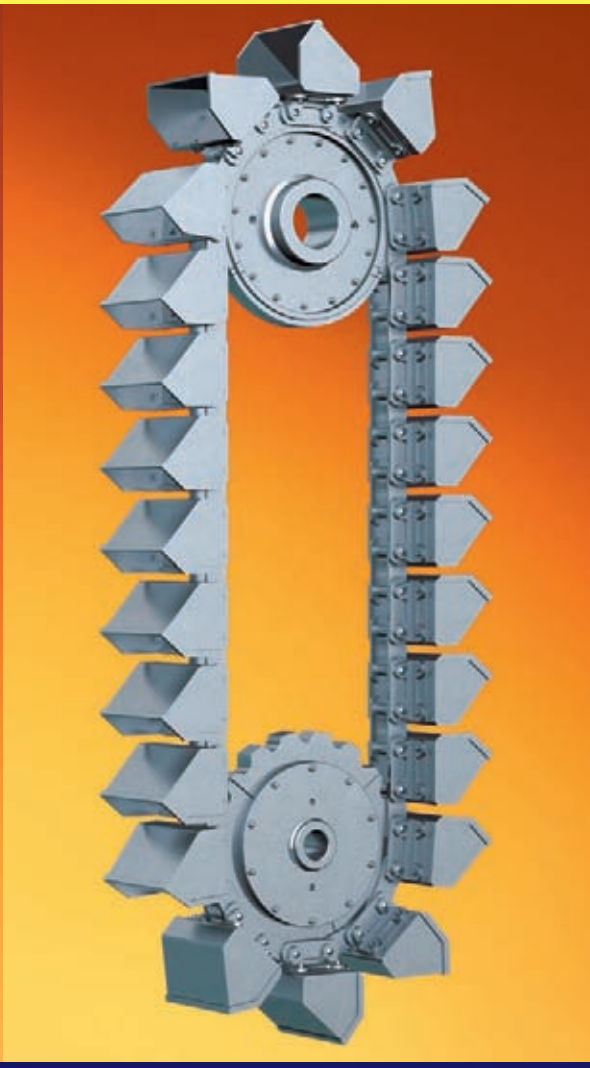

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Dr Radim Skapa, Lucideon

Alkali-activated cements - A clinker-free alternative to Portland cement

The Portland cement industry is facing a key challenge: how to dramatically reduce its CO_2 footprint while satisfying a growing global demand. In order to meet environmental targets, a range of new technologies, including low CO_2 cement(s), will need to be adopted over coming decades.

This enormous challenge has started a race within the scientific community to develop a new generation of environmentally-friendly cements. A number of materials have already been developed, although none of them alone is likely to change the industry on a global scale. Long term, there is likely to be more than one 'winner,' as sustainability can only be achieved by adopting an increasingly diverse range of cements that takes advantage of the chemistry and availability of local raw materials.

Alkali-activated cements (AACs), often called geopolymer cements, are recognised as one of the most viable alternatives to ordinary Portland cement (OPC) due to their low embodied CO_2 and cost. Since their discovery in the 1950s, AACs have been commercialised on a relatively small-scale and used mainly for non-structural applications. In general, they are competitive on cost and performance in comparison with OPC, and have environmental and technical benefits, including significant reduction in CO_2 emissions and increased fire and chemical resistance. In recent years, there has been an increase in the use of AACs due to their scientific and technological advancements. Lucideon has developed MIDAR, a range of geopolymers that deploy and exploit AACs on a commercial scale in general construction, nuclear waste immobilisation and other niche applications.

One of the main barriers to widespread adoption of AACs has been the lack of building standards for cement and concrete. Recently the BS PAS 8820 standard was developed in the UK to remove this obstacle and encourage the use of AACs in the construction sector. The new standard specifies the performance and durability requirements and acts as an important guide for producers. In the UK, it is a significant milestone for the technology, as it provides AACs with a stronger route to market. There is no indication as to whether or not EU standards will follow this approach in the near future.

In the current market, access to AAC technology is either through: **1.** A commercial producer (provided that the distance is not cost prohibitive), or; **2.** Locally-available materials to formulate AAC and optimise it for a given application.

There is no single geopolymer formula and different mineral precursors may require different levels of activation. Furthermore the producer-user needs to

Below: MIDAR terrazzo is GGBS concrete with decorative aggregate. Ground surface gives a terrazzo effect.

Right: GGBS MIDAR concrete paving slab.

"Long term, there is likely to be more than one 'winner,' as sustainability can only be achieved by adopting an increasingly diverse range of cements..."

have an understanding of relevant performance tests and technical support. Using its MIDAR technology, Lucideon, an international materials technology company, provides support throughout the entire customised AAC product development process.

MIDAR formulations may utilise globally distributed virgin precursors, such as fired clays, as well as locally-available industrial wastes and by-products of different qualities. Suitable raw materials include ground granulated blast furnace slag, silico-manganese slag, fired kaolinitic clays, mineral processing tailings (e.g. coal gangue, red mud, mine tailings, etc.), catalyst residues, coal fly ash and incinerator bottom ash, rice husk ash, palm oil fuel ash, biomass ash, waste glass and ceramic, incineration sludges (e.g. paper sludge ash, sludges resulting from water treatment, etc.) and natural minerals (e.g. volcanic ashes). The most readily available aluminium and silicon containing raw materials are fly ash, slag and clays which, in general, require calcination at 750°C to become useful. The alumino-silicate rich material is mixed with a small amount of soluble alkali activator to make a paste that performs in a comparable way to OPC. The alkaline solution decomposes the mineral precursors into silicate and alumina units, which then re-combine in void spaces to produce a rigid inorganic polymer that acts as a strong binder.

The mechanical strength and other properties of AACs arise from the chemical bonds between aluminium and silicon, instead of calcium and silicon in OPC. Depending upon the selection of mineral precursor and by controlling the amount and composition of the activator, the geopolymer can be specifically tailored. This allows a degree of performance control than is available with OPC. It is possible, for example, to achieve a combination of very high early and final strengths in the same application.

Geopolymers, such as Lucideon's MIDAR formulations, have the potential to replace a significant proportion of OPC currently used in general construction. AACs may also find a range of niche applications where their highly controllable properties allow them to go further than OPC. Initial routes to market for concrete products based on AACs could be via simple applications such as precast elements, grouts, rapid set sealing formations or ultra-low viscosity products to seal porosity.

Right: Aerated fly ash MIDAR concrete.

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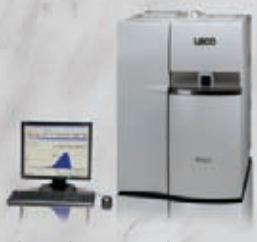

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UNTHA

Mexico's first commercial waste-to-energy facility to supply fuel under agreement to the cement industry

Mexico's first commercial waste to energy facility is now fully operational, with Promotora Ambiental SAB de CV (PASA) having built a sophisticated RDF production plant to supply alternative fuel under agreement to the cement industry. *Global Cement* recently found out about this new, state-of-the-art operation…

The transformation of waste into energy is one of the most rapidly-evolving markets in the world. Europe has long dominated the global playing field, with readily-available technology aiding the careful processing of municipal solid waste (MSW) and commercial and industrial (C&I) waste into alternative fuels for domestic and overseas cement and power industries. In fact, Global Market Insights recently claimed that the European waste-to-energy sector will be worth Euro14bn by 2023.[1]

However, ever-increasing waste generation means the waste to energy sector will have to play a much more prominent role in resource strategies worldwide. The same Global Market Insights report highlighted the changing nature of the waste market in Latin America, for example, with Mexico and Brazil cited as now developing smarter renewable energy policies. It's therefore no surprise that numerous waste-to-energy plants are expected to be commissioned in Latin America in the coming years. Mexico has already welcomed its first commercial plant, thanks to total waste management specialist PASA, a part of the Promotora Ambiental group.

Founded in the early 1990s, the environmental company employs 6500 people across Mexico and the wider region, including in Costa Rica and Panama. With 43 waste management facilities in Mexico, as well as 12 hazardous waste collection centres and five transfer and recycling stations, PASA handles 25,000t/day of waste.

In 2014, PASA began to expore the waste-to-energy market. It wanted to design a facility that could transform Mexico's residual C&I waste into refuse derived fuel (RDF). The plant would be built in Hermosillo, Sonora. However, it was unlikely that the best-fit technology would be found locally.

A robust, proven waste shredder was sought that could handle a variety of input materials with ease. The chosen solution had to demonstrate proven excellence in this complex area of waste management, as well as operational simplicity and consistent output fraction properties. However, the over-riding

Below: The UNTHA XR shredder has been in operation since June 2016.

Left: Trucks offload C&I waste at PASA's facility in Hermosillo.

factor was the 'whole life' cost of the machine. With landfill gate fees only US$6-12/t in Mexico, there is little incentive for domestic contractors to devise environmentally-smart waste strategies. Cement kilns are also currently reluctant to pay for RDF, which means waste to energy production margins are low. Indeed the Global Market Insights report states that, 'High costs associated with plant commissioning as well as component installation may hamper waste-to-energy market size'.

PASA therefore sought a robust waste shredder that could achieve the output RDF specification in a single pass, avoiding the need to double the capital expenditure otherwise required for two machines. The ongoing running costs would also need to be factored in. If the plant's operating costs proved high, the project would not be financially feasible. However, if PASA could find the right technology, capable of achieving an uninterrupted, hassle-free output of 20,000t/yr of RDF, a return on investment could soon be recouped.

The search for such shredding technology brought PASA to UNTHA, an Austrian-headquartered firm with additional subsidiary companies in the US, the UK and Poland. UNTHA's XR shredder has been supplied for use in waste-to-energy projects worldwide, in countries ranging from the US to Vietnam. Such international acclaim has stemmed from the machine's ability to produce a high quality, homogeneous fuel in a single pass, with double the output per tonnage of competing machines.

Yet of primary importance to PASA was the fact that the XR's typical wear costs are significantly less than Euro1/t (US$1.11/t). This, combined with ease of maintenance, strong uptime performance and accessibility to local after sales support, would remove any cost concerns that would otherwise prohibit the project's success in Mexico.

The XR was therefore shipped via sea-freight container complete with a discharge conveyor and over-band magnet to ensure the extraction of any remaining metals. Once installed, the shredder produced 12t/hr during testing. It was therefore handed over and fully operational by June 2016.

Given the cement industry's growing demand for renewable energy feedstock in Mexico, the team plans to further refine the RDF manufacturing process and heighten the plant's capacity to 200t/day by June 2017.

It's safe to say, this milestone project could mark the start of a significant revolution across both the cement and waste landscapes in Latin America.

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EKON & Geometrica

Carthage Cement's new storage buildings: A case study

Carthage Cement is Tunisia's largest and most technologically-advanced cement plant, originally designed to produce clinker at a rate of 5800t/day. Located approximately 25km southeast of Tunis, the plant was planned and built near an existing quarry. The greenfield project began to take shape in late 2010 and was completed in 2013. Here authors from contractor EKON and dome experts Geometrica describe the installation of the plant's storage facilities.

Carthage Cement's civil and structural contractor EKON drafted a performance specification that included all dimensional and loading requirements for three stockpile covers: for additives, coal and limestone. Each would have to allow ample clearance for the stacker-reclaimer system, provide openings for multiple incoming conveyors as well as multiple entrances for off-road vehicles. In the circular dome, there would have to be space for traffic lanes around the ring rail for the reclaimer.

During the supplier selection process, EKON examined a number of parameters before deciding on Geometrica. Table 1 compares the final two, short-listed alternatives for the limestone stockpile cover. The structure weight for a conventional-steel dome would have been over five times that of Geometrica's light-steel dome.

The associated initial and lifetime costs of the two options were also evaluated. Ultimately, Geometrica's light-weight galvanised steel solution was selected. Galvanised steel provides corrosion resistance for years of worry-free storage with minimal maintenance. The company supplied three bulk storage structures, as shown in Table 2.

The domes were pre-fabricated at Geometrica's plant, located in Monterrey, Mexico with a high-quality, computer-controlled process. Every single component was custom-made, marked and sorted into substructures in the exact order that the structures were to be built. The modules were packaged into 2t crates, then containerised and shipped to site.

Construction was carried out entirely with locally-sourced labour and supported with a site-consultant from Geometrica. No welding was required,

Right - Table 1: Comparison of conventional steel storage facility and Geometrica's light steel facility.

	Conventional Steel Dome	Geometrica's Light Steel Dome
Length (m)	94	94
Structure weight (t)	754	135

Right - Table 2: Summary of Carthage Cement's three Geometrica storage domes.

	Additives (Longitudinal)	Coal (Longitudinal)	Limestone (Circular)
Plan Dimensions (m)	53 x 298	53 x 209	94 Ø
Height (m)	23.7	23.7	29.2
Material	Galvanized steel	Galvanized steel	Galvanized steel
Openings	3 Conveyor 3 Vehicle	3 Conveyor 4 Vehicle	1 Conveyor 1 Vehicle
Structural bars (qty)	38,500	29,000	21,000
Hubs (qty)	16,600	11,800	7900
Covered area (m^2)	15,800	11,100	7000
Cladding area (m^2)	24,000	16,800	9700

Below: Carthage Cement has Geometrica storage domes for Limestone, coal and additives.

as all of the structure's connections were joined with Geometrica's efficient, mechanical hubs.

All domes were reinforced with arch ribs. "We assembled the domes in half-arch segments on the ground, then lifted the arches into place and stitched them to the growing structure," explained Fernando Gracia, Geometrica's lead engineer for the project. "This minimised the amount of time spent working at heights. Oval hubs in the bottom chord of the domes' ribs allowed us to use two rectangular bars in parallel, reducing the overall arch count, increasing structural efficiency."

"Geometrica's structures were light and easy to install, like Lego®!," said EKON Project Manager, A Cem Sevük. "Because the components are light and packaged efficiently we saved money on transportation as well. Those savings in time and money, combined with their cooperative and professional approach, confirmed that we'd made the right decision in choosing Geometrica."

Since its commissioning in 2013, Carthage Cement has continued to grow and improve its position in the cement sector. Now with a clinker production rate of approximately 7000t/day, the plant is supplying 50% of Tunisian demand.

The bulk storage structures contain the dust from stacking and blending of raw materials and fuel, helping meet the plant's environmental goals. "The new buildings are, aesthetically, very nice, and we definitely will consider Geometrica for future structures," said Sevük.

The environment, including neighbouring olive groves, livestock and nature preserve, are protected by Geometrica's structures. This three-structure project exemplifies the ability to promote environmental responsibility in an industrial setting.

Project summary

Owner:	Carthage Cement
Contractor:	EKON, Ankara, Turkey
Location:	Djebel Ressas, Tunisia
Highlights:	298m longitudinal dome for additives
	208m longitudinal dome for coal
	94m circular dome for limestone

Top: Construction of one of the longitudinal domes.

Below: Inside the circular limestone storage dome.

Dominik Stracke, Kobo USA - The Chain People

New Köbo chain solution for American Cement

In spring 2015 American Cement Company, based in Sumterville, Florida approached Kobo USA, a manufacturer of chains, sprockets, rollers, pans, shovels and attachments for help with its limestone reclaimer system. Here Kobo USA, a subsidiary of German-based Köbo Group, describes the installation of a chain system with an improved design.

A survey of the limestone reclaimer at American Cement revealed that it was experiencing increased wear and failure of the chains and shovels due to large size rocks in the limestone pile. These larger pieces come from the crusher and were also formed from smaller pieces due to the high humidity and stickiness of the limestone in Florida. When the shovels hit these 10-12cm (4-5") rocks, shock loads caused damage to the chain system. The bushes of the chains had cracked and the shovels were breaking at the seams of the welded chain attachments.

The original design had attachment plates welded to one link plate of the chain. It had an alternating attachment plate that was welded to only one side of the chain. Due to this arrangement, the sequence of the attachment alternated from the inner to outer link. The outer links were especially badly affected by the shock loads. The chain had an outside-mounted maintenance-free roller with ball bearings and sealing technology to protect the internal components.

Right - Figure 1: Shock loads, which were being caused by large chunks of limestone, were damaging parts of the previous system.

"Due to the circumstances with the crusher and limestone moisture around 15%, because of the underwater mine, this chain system had to be improved," said Carlos Soteldo, Engineer and Sales Manager at Kobo USA. "We cannot say that the chain was manufactured incorrectly, but we saw a chance to improve the design to make it last in these difficult environmental conditions."

Kobo USA analysed the existing chain and its failure modes at its in-house laboratory. It provided detailed reports to the customer. It had determined that the breaks were caused by very high peak loads, which caused the materials to bend before they cracked.

In coordination with American Cement, Kobo USA provided an improved chain design. Most of the dimensions were kept, but the bushing size was increased to create more strength for the dynamic shock loads. Furthermore, the sequence of the attachment was changed from every third link to every second link. This means that every shovel now has to drag less material. Also, the attachment is welded on both sides to the inner link plates. This stiffens the construction of the attachments. Weight and working load calculations were done for the new design and approved by the customer. The existing motor and gearbox could handle the new design of the chain and shovel spacing without requiring an upgrade.

"Our customers have the experience with the machines, we are the experts for the chains, sprockets and attachments. Therefore it is important for us to work hand in hand with our customers and develop solutions together," says Dominik Stracke, CEO Kobo USA.

Kobo USA also provided a stiffer support for the shovels. The existing design had seen breakages at the centre guide rollers. Due to the inclusion of a thicker stiffening rib, larger rocks can no longer damage the shovels. Also, by using steel with a high tensile strength no expensive hard face welding needs to be

"After the initial break-in period, the system is operating well without any problems..."

Osmarino Rogacheski, American Cement

Above left - Figure 2: Damaged brushing on the original chain system.

Above - Figure 3: Damaged link plate on the original chain system.

applied. Replaceable scraper wear bars were attached to the sides of the shovels. These parts can easily be replaced by loosening two bolts.

Finally, Kobo USA provided the tooth rims for the new chain design, as the drive and return tooth rims were worn. By supplying the chain and sprockets, Kobo USA could ensure that hardness specifications of both parts were balanced to give optimal lifetime for all components.

The full system was supplied in the autumn of 2015, around six months after the initial contact. The installation was completed by American Cement without problems. Even with a slightly higher chain weight, the energy consumption and chain pull was reduced. This is related to Kobo's special outside mounted rollers with lifetime lubrication. These rollers help minimise friction and, in case of roller replacement, they can be changed without disassembling the chain. American Cement reports that its limestone output is more balanced than the previous design and that the system now runs remotely without problems. This continuous flow of material has helped with downstream processes. "After the initial break-in period, the system is operating well, without any problems. We are happy with the results and with the support provided by Kobo USA," said American Cement's Maintenance Manager Osmarino Rogacheski.

Left - Figure 4: The new, optimised solution from Kobo USA has operated for nine months without problems.

AMF-Bruns

Cooling down at the cement plant

Operators of cement plants have to deal with an increasing amount of bypass dust. This dust has to be safely transported within the cement plant if it is to be recycled...

With the increased use of secondary fuels in the cement industry, there has been a rise in the amount of bypass dust produced. Only recently has it been possible to usefully recycle bypass dust, either in cement or other construction products, as well as in fertilisers and animal feeds. However, such dust is far from easy to handle. Generally speaking it is abrasive, bakes easily onto surfaces and is very hot.

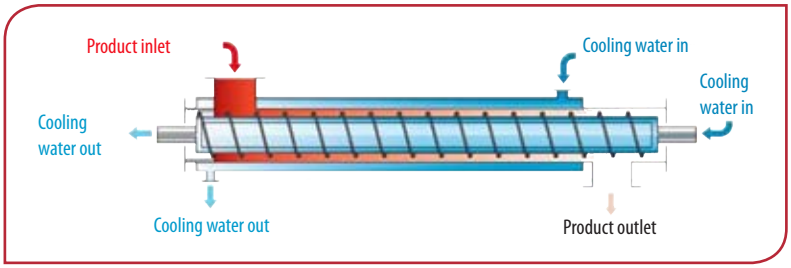
AMF-Bruns has been offering a number of solutions to the cement industry for several years. Since 2012, six cement plants have been equipped with custom conveying systems. The latest of these was a plant in the east of Germany that specialises in cements for prefabricated components. At the plant, standard cements are augmented with specialised products for road-building, cavity backfilling and other specialised uses.

The plant needed to be extended to cope with increasing demand, which placed new demands on the conveying of hot bypass dust within the plant. Some of the kiln exhaust gas is drawn off by suction and the dust is removed from it using a bypass filter. The bypass dust produced is stored in silos and dosed into the cement. This plant had not yet worked with AMF-Bruns, but its parent company had. AMF-Bruns' experience and the fact that its conveyors are also known for their gas-tightness were major factors in winning the bid.

The toughest challenges when transporting bypass dusts are its high temperature and the fact that its varying composition means constantly-changing abrasive behaviour. The system, comprising a number of AMF-Bruns components, was initially sketched out by the client. AMF-Bruns then assembled it and optimised the cooling lengths.

In this system, some of the dust is conveyed from a hopper using a screw conveyor with a cooled screw shaft, after which it is cooled from 600°C to approximately 90°C by two cooling screw conveyors.

Below: Schematic of AMF-Bruns"s cooling screw conveyor.



Elsewhere in the system, dust is also removed by an electrostatic filter at a temperature of 180°C by a chain conveyor, and carried to a third cooling screw conveyor. The total trough-length of the cooling screw conveyors is 16m. Throughput is 2 x 2t/hr. The third cooling screw conveys 4t/hr.

The advantage of AMF-Bruns' cooling screw conveyors is that heat is constantly exchanged. They can even carry products at over 1000°C. Designed to be dust-proof, impact-resistant and gas-proof, they are ideal for extracting and dosing products from combustion processes and are designed and manufactured in compliance with AD regulations.

Other elements needed for the overall solution were rotary feeders, valve plates, switching valves, a screw conveyor and various compensators and chutes. These were required in part for a second inflow. At this inflow, the dust from the other two cooling screw conveyors is picked up and cooled to approximately 80°C together with the dust from the electrostatic filter, and then passed on to the downstream pump. This pump then conveys the bypass dust to the silos. A switching valve allows the dust after the third cooling screw conveyor to be filled into road-going tankers via a tubular auger. The pipes to supply cooling water to the cooling screw conveyor, and the safety devices were all provided by the client.

Special protection

Bypass dust poses another problem, as even slight variations in composition can quickly bring about vastly different levels of abrasiveness. This makes it difficult to know how long components will last. For instance, the screw shafts used to convey bed ash can last anything from three months to three years, depending on the ash. Service life is also hard to predict for bypass dust. Cooling screw conveyors without wear protection used to be fitted to the electrostatic filters. However, because these exhibited traces of wear, AMF-Bruns chose a safer, hard cladding version. This means that there is hard cladding on some of the screw shafts and troughs, particularly in the inflow area, where it can extend service life considerably. All of the components were supplied and fitted at the plant in February 2015. The conveyors began operation in July 2016 and have been running smoothly ever since. The additional expense of providing wear protection has also paid off.

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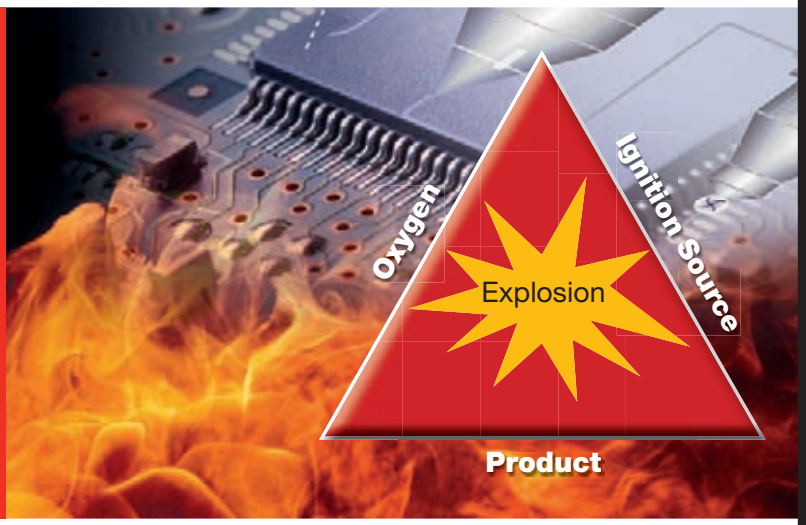

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Lukáš Steiner, Wikov Industry

A fresh wind for the cement industry

Wikov, a Czech based company, has recently launched a new series of epicyclic Orbi-fleX branded gearboxes. The product features a flexible pin and overload stop technology to minimise failure rates and increase savings in operating expenditure.

Planetary gearboxes play an ever more important role in the global gearbox market, in which they are experiencing the most rapid growth. Despite the often conservative approach to the technical upgrades in many industrial sectors, planetary gears are well established and are becoming a standard drive. For many applications they definitely represent the future of the gearbox market. Aside from their well-known benefits, such as their small size and high power density, some types of planetary gearbox provide end-users with extra features that offer additional value.

Wikov has long been aware of this indisputable potential and recently brought to the market a brand new series of 22 ready-to-deliver designs for planetary gearboxes with flexible pin technology. Their application is not just limited to cement, as they find use in mining, wind power and other applications where longer lifetimes and limited downtime are prerequisites for successful daily operation. The technology of the flexible pin applied in Wikov's planetary gearboxes enables a 40-50% reduction of the gearbox weight in comparison with conventional gearboxes of the same power and shock load resistance, as well as extended gear and bearing lifetimes.

We use flexibility, rather than fight it

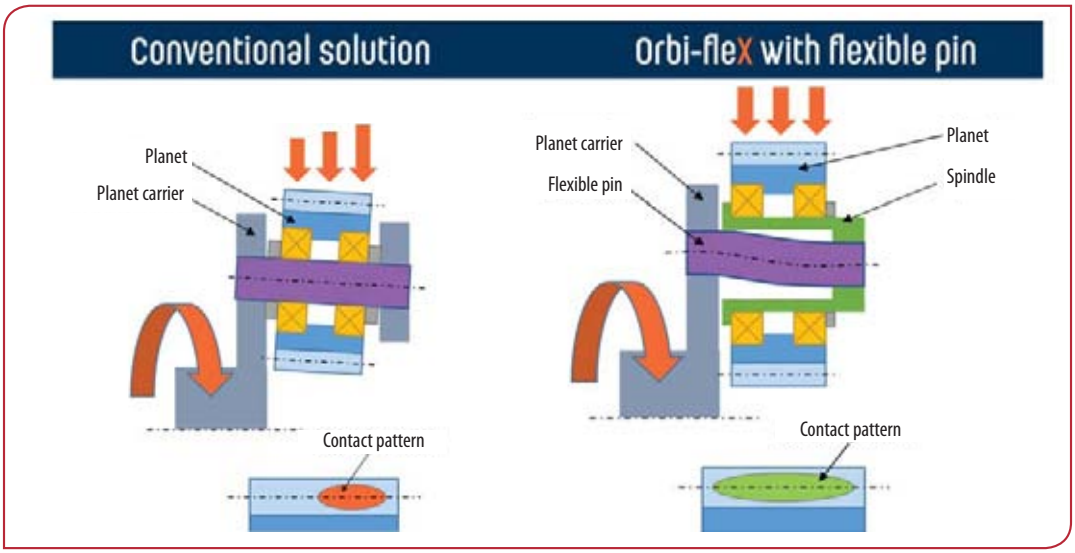
This all sounds impressive, but how did this technology come to be at Wikov? To answer this, a deeper look into history of the flexible pin is required.

Flexible pin was invented over 50 years ago by British engineer Ray Hicks, who started working with gears in 1954. Ray founded Compact Orbital Gears in 1964, when he patented his own epicyclic gear system that used compound cantilever flexible planet spindles known as flexible pins. The pins enable the planets to float and thus ensure perfect alignment. This reduces the stresses and makes the construction of smaller, lighter and more reliable planetary gearboxes possible.

The 'Hicks Flexible Pin' was successfully applied to a wide variety of industrial and aerospace gearboxes, ranging up to 48,000hp and with speeds up to 100,000rpm. To date, over 2000 such gearboxes have been made and installed worldwide.

Ray is a long-term friend and associate of Dr Frank Cunliffe. The two founded Orbital2 in 2002 to design and license the manufacture of flexible pin epicyclic gearboxes for the renewable energy industry, specifically wind power applications. Two years later, Orbital2 was acquired by Mr Wichterle, the owner of the Czech holding company Wikov. He financed this unique technology into the wind energy market. Since then, Orbital2 has deployed gearboxes for 1.5-7MW wind turbines around the world under the Wikov brand, with some 1.5-2MW Asian projects deployed through licensed manufacturers.

This is how Wikov came to be the only owner of the original flexible pin technology and explains how it developed the technology further. The



Right - Figure 1: A comparison of conventional and flexible-pin planetary gearboxes and their behaviour during a shock load.

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Above: An Orbi-fleX with flexible-pin integrated into a bevel-helical planetary gearbox for a bucket wheel drive.

developments since acquiring Orbital2 have added further value and bring a top-quality solution to the market.

Flexible pin with overload stop

A flexible pin with patented overload stop was introduced to the market by Wikov in 2005. The overload stop protects the flexible pin against possible mechanical damage that could happen when the driveline experiences high peak loads. This could happen in wind turbine applications, where very extreme shock loads may occur in some cases.

Figure 1 shows a comparison of conventional (left) and flexible-pin (right) planetary gearboxes and their behaviour during a shock load. The structure of the conventional solution, when it experiences higher than nominal loads, tends to deform and thus forces planets to tilt from ideal positions. This causes unequal loading of planet bearings and worsens the gear mesh contact pattern. Preventing such phenomena usually means adding more stiffness through more material but movement cannot be completely stopped. However, with the flexible pin solution, the planet is released to move in a controlled manner and stays parallel. Perfect bearing load distribution and contact patterns are assured.

"The Overload Stop helps to keep the stress in the flexible-pin during the peak load situations within acceptable material limits by increasing the stiffness of the system. This reduces the deflection of the flexible pin while still keeping the parallel motion of the planet wheel and perfect load distribution across the facewidth of the gear," explains Vilem Rosko, Engineering Manager of Orbital2. This is in stark contrast with conventional planetary gearboxes, in which the system deflections are not compensated for in any way and the gears experience high edge contact stresses that lead to the premature teeth failure.

Overload Stop installations in wind turbine gearboxes provided very strong evidence of the effetiveness of this solution. A gearbox opened after 10 years of operation in a wind turbine uncovered the condition of the key components such as gears and bearings. They appeared to be untouched.

However, this achievement took some years as Wikov 'mined' the experience from the rapidly expanding wind power sector. "Over the course of time, Wikov became the leader in the flexible pin technology," says Jan Vosatka, Technical Director at Wikov Industry. "However, after the dramatic decline of the wind turbine sector in around 2012, we decided to apply flexible pin technology to other industrial applications, where we felt flexible pin can be beneficial for gearbox durability and lifetime."

The development of the flexible pin technology has included continuous, intensive research and development into increased capacity and reduced complexity and costs for the gearbox. This has made the technology suitable for the cement and mining sectors under a new product range, the Orbi-fleX.

Orbi-fleX planetary gears with flexible pin have been installed in cement roller presses, as drives for the bucket wheel and track drive for the excavators used in open pit mines and mobile shredders in the wood processing sector. These dynamic applications are prone to shock loads that can have a significant impact on the lifetime of the gears and bearings. A conventional gearbox suffers from overloads and its internal components become damaged or worn out, which soon reduces their efficiency, increases maintenance costs and/or exposes the end-user to replacement costs. All of these issues are eliminated with the Orbi-fleX, a solution that has already proven itself in harsh real-world operations.

Right: Orbi-fleX planetary gearboxes driving a roller press in a cement plant.

2016 Entrant: ***'Clinker'*** **-** Krzysztof Burek, Caspi Cement (HeidelbergCement), Kazakhstan

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Petr Rayman, RAYMAN spol s.r.o.

Pneumatic conveying of cement from a purge silo

When cement plants switch from grinding one type of cement to grinding another, there is a period of transition in which cement of intermediate composition is produced. Traditionally this cement has been discarded. In order not to waste resources, the LafargeHolcim Čížkovice plant in the Czech Republic recently installed a purge silo and pneumatic conveying system to remove and reuse cement from the transition period.

To build the new purge silo for cement from the transition period the Čížkovice plant co-operated with two main suppliers: TI-Centrum a. s. Plzen (as main contractor) and RAYMAN spol. s r. o., the designer and supplier of the equipment. The plant wanted to use existing equipment as far as possible and have the possibility of filling cement from transition period into silo-trucks.

Purge cement silo

A purge silo with a diameter of 4600mm and a volume of 150m^3 was built, mounted at the loading bay steel structure. The silo was fitted with a mechanical feeding system that combined a screw feeder and a bucket elevator. A pneumatic conveying pipeline to unload silo-trucks into the mentioned purge silo was included. The silo equipment contains a filter installed at the top of the silo, aerating system (including a fluidising air source), one limit level indicator and one continuous level indicator, a release device and hand-operated slide valve at its outlet.

Pneumatic conveying equipment

The task of the new pneumatic conveying system was to transport cement from the grinding transition period into the existing dosing bin, with the possibility of emptying the cement into silo trucks. This is why a slide valve with a two-way diverting chamber and aerated bottom with 90° angle between its outlets was installed underneath. One of the chamber outlets was equipped with a pneumatic discharger valve to close and limit the material flow into a filling spout. The second chamber outlet was used to connect the pneumatic conveying system.

The silo outlet flange is situated relatively high, 7600mm from the ground, so as to have sufficient free height for silo-trucks. This meant that using a pneumatic conveying system with a Flow Feeder was a great advantage (Figure 1). So that silo-trucks could pass under the silo, the feeder was placed out of the silo between the supports of the steel structure of the bucket elevator. A pressure resistant Fluid Conveyor (Figure 2) was used for the horizontal conveying of cement from the silo outlet into the gravimetric chamber of the Flow Feeder. This allows the pressure of the aerated cement to be transferred from the silo space into the Flow Feeder.

The Fluid Conveyor consists of a circular body with fluiding elements at its bottom. The elements divide fluidising fabric into relatively short sections. This design permits, in contrast with air-slides, full and continuous filling with material. The Fluid Conveyor is equipped with a bending chamber, which changes its direction to meet the inlet of the Flow Feeder gravimetric chamber. The Fluid Conveyor is installed with declination of 6% (3.4°) to its end. This allows it to be emptied if necessary.

Below Left - Figure 1: Flow Feeder installed at the Lafarge-Holcim Čížkovice plant.

Below Centre - Figure 2: The pressure-resistant Fluid Conveyor.

Below Right - Figure 3: The Flow Feeder uses pressure columns of material in a fluid state collected in the gravity chamber.

The Flow Feeder (Figure 3) uses pressurised columns of material in a fluidised state collected in the gravimetric chamber. The material creates a 'hydrostatic' pressure, which is approximately in balance with the connected conveying pipeline pressure drop. In the case of the Čížkovice plant, the Flow Conveyor additionally transfers the hydrostatic pressure of the material from the silo into the top of the gravimetric chamber. This means that the Flow Feeder also uses the potential energy of the conveyed material collected in the silo, which reduces the energy needed to convey the material by 20-50% compared to other types of pneumatic conveying feeders.

The gravimetric chamber is designed with a slightly conical shape with diameters of DN250/DN300 and it is 5750mm high. The PP300 Flow Feeder is located on the ground between the supports of the steel structure of the elevator. The pipeline is routed into the neighbouring building and it is terminated in a terminal box located on the dosing bin roof. The diameter of the conveying pipeline was calculated with respect to required conveying capacity, conveying distance and elevation, material features and also a capacity of the existing blower to be used. The conveying pipeline has an optimal design and includes only five bends, all of them less than 45°.

A ROOTS blower has been used as a common conveying air source for the whole pneumatic conveying system. This was the existing blower with an outlet pressure of only 60kPa.

The pneumatic conveying system is equipped with a Remote Pneumatic Release System (RPRS) in the event of a blocked conveying pipeline. The RPRS system removes material plugs from the pipeline without the need to detect its position or remove parts of the line.

Process experiences

The equipment was put into service in a one day period in May 2014. Since then it has run broadly trouble-free, with only one issue. Lumps of cement occasionally fell into the Flow Feeder in front of the material orifice plate from time to time, reducing the capacity.

To remedy this, an additional segregation chamber was installed in February 2016 (Figure 4). It was inserted into the Fluid Conveyor line. The segregation chamber is equipped with a fluidised bottom. The material is fluidised in the chamber, which caused heavier lumps to fall to the bottom. They must still be removed from time to time. The segregating chamber has very low consumption of the compressed air so it could be connected to the blower of the silo aerating system. The equipment has worked without issues since the time of installation of the segregating chamber.

Due to the fact that the built pneumatic conveying system does not contain any movable parts that are in contact with the conveyed material, conveying velocities are very low and the conveying pipeline is as straight as possible, the whole system is highly wear-resistant. Neither the Fluid Conveyor nor the Flow Feeder have shown any sign of wear so far.

Above Left - Figure 4: An additional segregation chamber was installed in February 2016.

Parameter	Value
Material	Cement from transition period
Bulk Density	1000-1100kg/m^3
Temperature	<80°C
Capacity	15 t/hr
Distance	41m
Elevation	23.4m
Bends	1 x 15°, 4 x 45°
Blower electrical input	45kW
Blower input clutch	31.9kW
Spec. Energy Consumption	2.1kWh/t

Above - Table 1: Summary of project parameters.

Conclusion

The installation by RAYMAN and TI-Centrum at the LafargeHolcim Čížkovice cement plant has proven the ability of the pneumatic conveying system with the Fluid Conveyor and Flow Feeder to convey cement from a grinding transition period. Like most other pneumatic conveying equipment it is prone to problems with lumps. However, these types of failure were easily removed by installation of the segregating chamber in this case

The built pneumatic conveying system has the following positive features:

- It saves energy due to the use of considerable heights and transfers the pressure from the silo to create high pressure in the Flow Feeder;
- It is almost maintenance free;
- It is wear resistant;
- It is completely leakage free.

The pneumatic conveying system combining Fluid Conveyors with the Flow Feeder also saves significant energy compared to other pneumatic conveying systems (particularly screw feeders and vessel feeders) because its uses the potential energy of the stored material.

The project realised LafargeHolcim's request to use the existing ROOTS blower, which was originally intended for another pneumatic conveying system. This significantly reduced the investment cost. Since the one minor modification described above, the equipment has worked reliably at its design capacity.

Czech Republic/Austria: BSW Machinery to expand Czech production facility

BSW Machinery, the Vienna, Austria-based subsidiary of Windmöller & Hölscher (W&H), reported more than 20% growth in orders in 2015, which has resulted in group approval for yet another building expansion at the company's production facility in the Czech Republic. BSW reported strong growth in demand for its woven polypropylene sacks in some countries that had previously been marred by political crises, as well as increases in orders for new products such as its new four or six colour printing servoTex machine.

In response, German parent company W&H will allocate more production load to BSW following a two-stage approach. One strategy is to improve sales per square metre and construct additional assembly space. More personnel and mezzanine constructions will boost the productivity per square metre and current storage areas are being converted to assembly space. Secondly construction of a new logistics centre has begun. It will be completed later on in 2016.

Australia: Schaeffler's announces FAG SmartQB condition monitoring system

Schaeffler Australia Pty Ltd has launched the FAG SmartQB, a ready-to-use monitoring solution for electric motors, pumps and fans that is easy to install and does not require any specific knowledge about vibration diagnosis. Major applications include machinery widely used in industries such as cement, pulp and paper, steel and water management, among others.

The FAG SmartQB system comprises an FAG SmartQB sensor unit (a variant of the FAG SmartCheck), a cubic housing with a touch panel and a cable for power and data transmission. The system was specially developed for detecting irregularities in electric motors, pumps and fans, plus the roller bearings of the same.

Five causes of faults can be identified and displayed using the condition monitoring system: bearing damage, imbalance, friction/cavitation (for centrifugal pumps), temperature increases and all general changes in vibration patterns that cannot be clearly attributed to one of the aforementioned causes that require additional analysis.

Above: The FAG SmartQB is a ready-to-use condition monitoring solution for electric motors, pumps and fans that is very easy to install and use.

Russia: KZSU opens Ad Star plant

Kazanskiy Zavod Sovremennoy Upakovki (KZSU) officially inaugurated its new production plant in Kazan for Ad Star block bottom sacks in late May 2016. Austrian bagging machine manufacturer Starlinger supplied the equipment for the plant. KZSU will produce Ad Star block bottom sacks for use in the cement, gypsum, chemical, fertiliser, animal feed and other dry bulk goods sectors. The plant will produce 44 million sacks per year for local and foreign markets. The investment includes extrusion, weaving, coating and printing lines, as well as two Ad StarKON sack conversion lines and a Recostar universal recycling line for treating production waste from Starlinger.

Above: Tatar President Rustam Minnikhanov (left) and KZSU CEO Roman Vyalkin (right) inspect an AD*STAR® sack. ©KZSU

UK: Hanson tankers scoop safety award

Hanson UK, part of HeidelbergCement, has been awarded with a Tanker Safety Award at the 2016 Tip-ex and Tank-ex awards. The award was for the development of the company's 'Run Lock' integrated emergency shut-down system, which operates in conjunction with the Pulse lighting system. This links the trailer and tractor units, meaning that if any of the four stop buttons on the tanker are pressed, the emergency shutdown is initiated.

Germany/Italy: HeidelbergCement completes acquisition of 45% share in Italcementi

HeidelbergCement has completed its acquisition of a 45% share in Italcementi from Italmobiliare. All conditions for the closing of the transaction have been fulfilled following the approval by the relevant competition authorities. The purchase triggers a mandatory tender offer to the remaining shareholders of Italcementi. HeidelbergCement expects the entire transaction to be completed in the second half of 2016.

"By adding Italcementi to our group, we are considerably strengthening our global footprint and innovation capabilities," said Bernd Scheifele, chairman of the management board of HeidelbergCement. "We see significant potential for value creation with the realisation of synergies and by learning from each other's best practices."

On 28 July 2015, HeidelbergCement and Italmobiliare entered into a share purchase agreement about the acquisition of a 45% shareholding in Italcementi. On 1 July 2016 HeidelbergCement acquired 157.17 million ordinary shares, representing 45% of the share capital of Italcementi for a total consideration of Euro1.67bn. 82.82 million ordinary shares were acquired against cash. The remaining 74.35 million ordinary shares were acquired against the assignment of 10.5 million newly issued shares of HeidelbergCement. Following this, Italmobiliare has become the second largest industrial shareholder of HeidelbergCement, with a stake of 5.3%.

In the share purchase agreement, Italmobiliare agreed to purchase certain non-core assets of Italcementi, including Italgen, Bravosolution and certain non-core real estate. Italcementi had sold these assets to Italmobiliare on 30 June 2016 for total proceeds of Euro237m.

The acquisition of the 45% stake in Italcementi triggers the obligation to execute a mandatory tender offer to the remaining shareholders of Italcementi. The offering document was filed with the Italian Securities and Exchange Commission (CONSOB), within 20 days after the closing, and will be published upon completion of CONSOB's review period. The acceptance period will be agreed with Borsa Italiana. At the time of going to press, the acceptance period was expected to commence at the end of August 2016.

Meanwhile, HeidelbergCement has made a shortlist of potential bidders for assets in Belgium and the US that will be divested as part of the acquisition. Bidders for the US$400m Belgian assets include Çimsa Çimento and Cementir Holding. Bidders for Italcementi's US assets, valued at around US$600m, include Summit Materials and CRH.

Norway: Full CCS by 2022

The Ministry of Oil and Energy of Norway has announced that it expects to complete every step in the development of carbon capture and storage (CCS) by 2022. The project could use CO_2 from the Norcem Brevik cement plant, which has done extensive CCS research in recent years, although CO_2 from waste incineration and/or chemical production may also be used.

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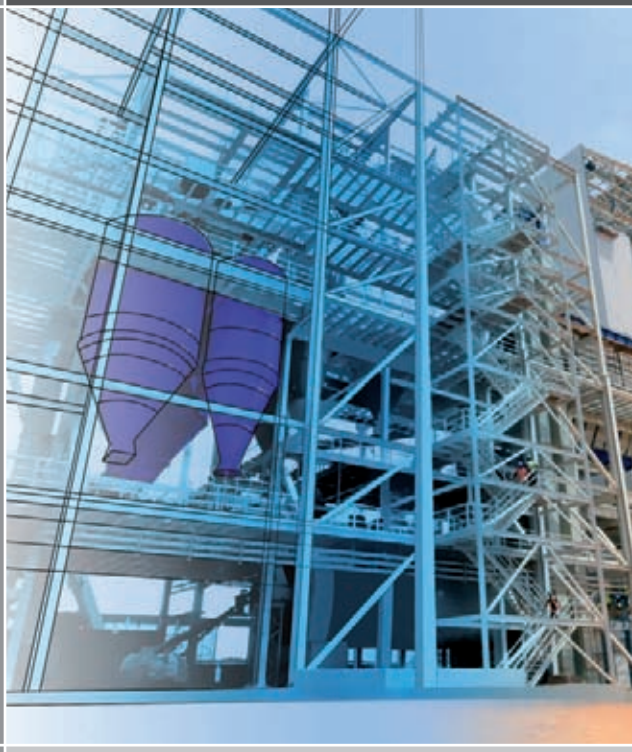

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UK: Hope acquisition approved

The Competition and Markets Authority (CMA) has approved the acquisition by Breedon Aggregates of Hope Construction Materials, subject to a sale of selected assets. Breedon has offered to sell 14 ready-mix concrete sites to Tarmac and the Concrete Company, which has been accepted by the CMA.

With the acquisition of Hope, Breedon Group, as the company has been named since 1 August 2016, has become the UK's largest independent construction materials group, with the country's largest cement plant, around 60 quarries, nearly 30 asphalt plants, approaching 200 ready-mixed concrete plants, some 2100 employees and approximately 750Mt of mineral reserves and resources. The enlarged group's strategy will be to continue growing organically and through consolidation of the UK heavyside building materials sector.

France: Vicat hit by falling prices

Vicat's sales revenue from cement fell by 1.5% year-on-year to Euro761m in the first half of 2016 from Euro773m in the same period in 2015. The group has blamed the decline on a fall in selling prices in most of its market regions, except for the US. It was also hit by negative currency effects in relation to the high value of the Euro. Overall, Vicat's sales fell by 0.4% to Euro1.24bn but its EBITDA rose by 2.3% to Euro208m.

Despite this, its cement sales volumes rose by 12.1% to 11.1Mt from 9.88Mt. Volume increases were noted in India, Turkey, Egypt, France, the US and, to a lesser extent, by Kazakhstan, Italy and West Africa. Switzerland was the only country to record a fall in cement sales. Alongside this, Vicat reported that its earnings before interest, taxation, depreciation and amortisation (EBITDA) rose by 3.3% to Euro168m from Euro163m. It noted particular profit indicator gains in Egypt, due to sales volumes growth and lower energy costs, as well as higher sales volumes and prices in the US.

Italy: Italcementi loses ground ahead of acquisition

Italcementi's sales revenue has fallen by 2.1% year-on-year to Euro2.12bn in the first half of 2016 from Euro2.17bn in the same period in 2015. Its sales volumes of cement rose by 2.8% to 22.3Mt from 21.7Mt. Earnings before interest, tax, depreciation and amortisation (EBITDA) fell by 44% to Euro177m from Euro316m.

The company blamed the revenue drop on negative currency effects, although sales volumes rose notably in North America. Its fall in EBITDA was attributed to group restructuring costs and an impairment on operations in Belgium for approximately Euro320m.

Italy: Buzzi makes gains

Buzzi Unicem's sales rose by 1.9% year-on-year to Euro1.26bn in the first half of 2016 from Euro1.24bn in the same period of 2015. Its cement sales volumes rose by 2.7% to 12.2Mt from 11.9Mt and its earnings before interest, tax, depreciation and amortisation (EBITDA) rose by 33.5% to Euro223m from Euro167m.

Italy: Cementir buys Sacci

Cementir Italia has acquired Sacci's cement and ready-mixed concrete business division for Euro125m. The acquisition has been made by Cementir Sacci, a wholly owned subsidiary of Cementir Italia.

Switzerland: LafargeHolcim takes a knock

LafargeHolcim has blamed lower prices and gas shortages in Nigeria for a drop in its adjusted operating earnings before interest, taxation, depreciation and amortisation (EBITDA) in the first half of 2016. Its adjusted operating EBITDA fell by 6.7% year-on-year to Euro2.33bn from Euro2.5bn in the same period in 2015. Net sales fell by 6.2% to Euro12.3bn from Euro13.1bn.

"Without the effect of Nigeria, where our plants were affected by gas shortages, adjusted operating EBITDA would have increased by 13%," said Eric Olsen, CEO. "Nigeria is a high growth market and we are adapting our plants to reduce our dependency on gas to restore supply and capture growth. We expect these measures to take effect by the end of the year."

LafargeHolcim's cement sales volumes fell by 3.7% to 119Mt from 124Mt. Its Asia Pacific business region reported that cement sales remained stable during the half year at 60.7Mt as markets in the Philippines, Bangladesh, Vietnam and Sri Lanka increased volumes and markets in Indonesia and Malaysia declined. European cement sales fell by 2.7% to 19.6Mt from 20.1Mt. In Latin American sales fell by 13.2% to 11.8Mt from 13.6Mt mainly due to the poor market in Brazil. The Middle East Africa region remained stable at 21.7Mt, with growth in Algeria, Egypt, Lebanon and Morocco partly compensating for problems in Nigeria. Despite this, sales volumes of cement in this region fell by 2.3% year-on-year to 10.9Mt in the second quarter of 2016. In North America sales volumes of cement fell by 2.7% to 8.8Mt in the half-year from 9Mt due to weaker demand in Canada. However, demand in the US construction industry helped overall sales to rise by 5.1% to Euro2.21bn.

Germany: HeidelbergCement revenue down but profit up

HeidelbergCement's sales revenue has fallen slightly by 1% year-on-year to Euro6.41bn in the first half of 2016, from Euro6.47bn in the same period of 2015. This was blamed on consolidation and exchange rate effects. Otherwise, profit rose by 46% to Euro354m from Euro242m. Clinker and cement sales volumes rose by 2.9% to 39.9Mt from 38.8Mt.

"In operational terms, the second quarter of 2016 was the best since the financial crisis and thus continued the positive trend of the previous year," said Bernd Scheifele, Chairman of the Managing Board of the company. "The positive market environment in our mature markets and the recovery of demand in Eastern Europe made a significant contribution. We were able to raise the margins in operational terms in all business lines thanks to our margin improvement programmes and price increases in core markets. Furthermore, we have benefited from declining fuel costs."

The group's cement sales revenue fell by 3% to Euro2.92bn from Euro3.01bn. Its Northern and Eastern Europe-Central Asia and Africa-Eastern Mediterranean Basin areas both reported falling revenue from cement sales. However, the Asia-Pacific area saw its cement sales fall by 11% to Euro675m. Sales in North America partially offset this, with cement sales volumes growing by 4.7% to 5.9Mt from 5.6Mt.

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Greece: Titan revenue continues to rise

Titan's turnover has risen by 7.6% year-on-year to Euro724m in the first half of 2016 from Euro673m in the same period in 2015. Its earnings before interest, taxes, depreciation and amortisation (EBITDA) rose by 13.5% to Euro120m from Euro105m. However, its net profit fell by 62% to Euro9.2m from Euro24.2m for the half-year period. The construction materials company benefited from growth in the US and Egypt but currency exchange rates, particularly in Egypt, hit its profits.

In the US Titan reported that sales revenue increased by 18.8% to Euro373m despite a long second quarter maintenance period at its Pennsuco cement plant in Florida. Turnover in Greece and Western Europe fell by 9.1% to Euro133.4m. In South-eastern Europe it rose by 6.7% to Euro97m. In Egypt turnover rose by 11.7% in local currency but fell by 0.6% in Euro terms to Euro121m.

UK: Hope to use Haver & Boecker Adams bags at Dagenham terminal

Hope Cement will use polyethylene (PE) packaging with the Adams 10 Roto-Packer from Haver & Boecker at its Dagenham terminal near London, UK. The site started starting using the Adams system and a palletiser made by Newtec in June 2016, with an operation speed of 1200bags/hr.

Turkey: Bedeschi terminal for Sönmez

Italy's Bedeschi SpA has been awarded a contract by Turkey's Sönmez Çimento to help build a clinker and cement export terminal with a loading capacity of up to 1000t/hr. The terminal will serve a new 1.7Mt/yr integrated cement plant being built by Sönmez Çimento in the Adana Yumurtalık Free Zone. A slewing, luffing and travelling type shiploader will be installed at the plant's port terminal.

Turkey: Beumer contract at Elazig plant

General contractor Bilim Makina has commissioned Germany's Beumer to supply and mount equipment at a 5000t/day cement plant project in Elazig for Sycs İnşaar Çimento Madencili. The order includes 13 bucket elevators for the transport of cement, clinker and raw meal, six apron conveyors and 13 silo discharge systems for clinker transport.

Sweden: Sandvik to sell mining operations

Sandvik has signed an agreement to divest its Mining Systems operations to the private equity company CoBe Capital. Sandvik will maintain ownership of ongoing projects that are close to completion. The deal is expected to complete during the fourth quarter of 2016. No purchase price has been disclosed.

Ukraine: Cement production up in 2016

Cement production in Ukraine increased by 10.5% year-on-year, to 3.19Mt/yr in the first five months of 2016, according to Roman Skilsky, CEO of the Ukrcement cement producers' association. Skilsky expects the country's annual cement production to grow by 10% to over 9Mt for the whole of 2016.

Exports of cement grew by 71% to 62,700t in January to March 2016. However, Skilsky attributed the rise to the introduction of various restrictions by key export markets, including Moldova and Belarus. Skilsky also said that the introduction of European standards for cement production in Ukraine could help to restrict counterfeit products on the market.

UK: Fire at Cemex South Ferriby

Firefighters were called to a fire at the Cemex South Ferriby cement plant in Humberside, UK on 17 July 2016. A spokesman for Humberside Fire and Rescue Service said that the fire had involved a fuel leak from a pipeline that spread to cables, pipework and a disused control room within the kiln room. Fire damage was reported to the pipework, cables and one wall of the control room. The remainder of the building was damaged by smoke.

Above: The South Ferriby plant suffered the fire only months after the completion of renovation following extensive flood damage.

UK: Record numbers at Hillhead 2016

The organisers of the *Hillhead Quarrying and Recycling Show 2016*, which took place at Tarmac's Hillhead Quarry in Derbyshire, UK in June 2016, reported that the event attracted a record 18,655 unique visitors and a record 476 exhibitors. *Global Cement* met up with established contacts, like John King Chains (below), and made many new quality contacts over the three days.

Above: Rob Wood (left), David Wadsworth (centre) and William Wadsworth (right) are all smiles on the John King Chains stand at Hillhead 2016.

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Peter Edwards, Global Cement Magazine

The German cement sector - Driving to growth?

As VDZ members sit down at the VDZ *Annual Cement Conference* on 27-28 September 2016, they will be doing so in one of the most technologically-advanced, environmentally-conscious and competitive cement industries in the world, as well as in a country where cement demand could be set to increase in light of massive new infrastructure spending...

When the country with the 12th-largest road network in the world decides to undertake its largest-ever road building scheme, you know there's a lot of work to be done. But that's exactly what Germany announced in March 2016 with its *Bundesverkehrswegeplan* (BVWP) 2030. With the aim of renovating existing and building new road rail and waterway capacity, the BVWP was described by Alexander Dobrindt, Germany's minister for transport and digital infrastructure, as 'the strongest investment plan for infrastructure the country has ever seen.'

The BVWP sets aside Euro264bn of funds for use over the 14 years to 2030. Nearly half will be spent on roads, around 41% will be spent on rail and 9% will go on waterways. Approximately two thirds of the money is allocated for renovation, expansion and widening of existing facilities, with one third for entirely new connections.

Reaction

While the Green Party Environment Minister and local groups have already voiced their concerns over the planned works, especially with reference to the

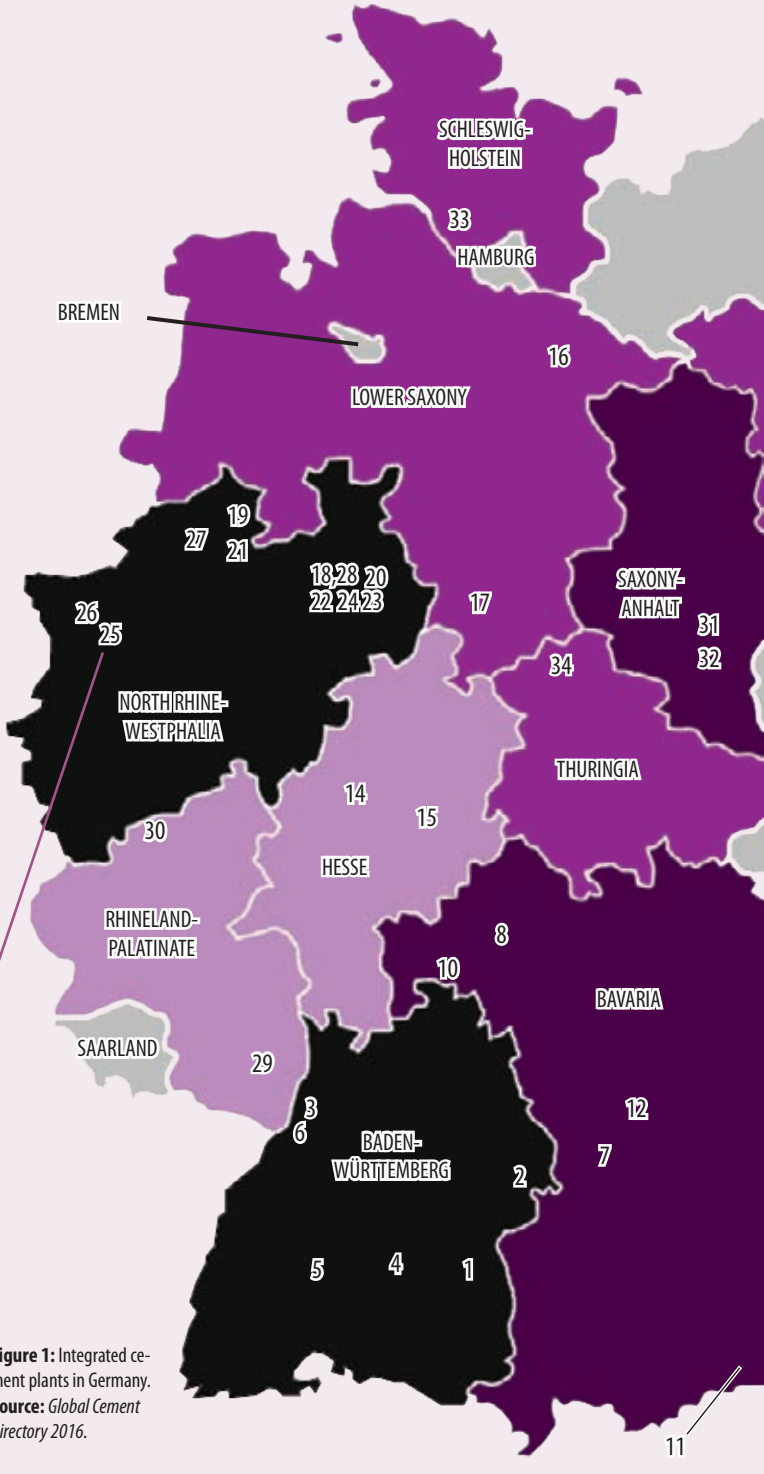


Figure 1: Integrated cement plants in Germany. **Source:** *Global Cement Directory 2016.*

vdz.

Cement Conference

Where: Duesseldorf
When: 27-28 September

"This is the strongest investment programme for infrastructure the country has ever seen..."

Alexander Dobrindt, Germany's Minister for Transport and Digital Infrastructure

high prevalence of road projects, there will be a lot of new capacity to be built. The new capacity will inevitably require cement from Germany's large and capable cement sector, although just how much is not clear at this point.

Speaking to *Global Cement*, Dennis Guhl, Statistical Consultant at the VDZ, said, "VDZ members are not getting too excited yet. The plans are too unspecific and whether BVWP 2030 will result in increased cement sales is not an easy question to answer."

"While the amount of money available from BVWP 2030 is significantly more than in the past, we should remember that it now costs more to build each new km of road, due to rising land decontamination costs. The number of projects that will be built under DVWP 2030 remains to be seen and there is relatively low provision for new construction."

Cement stats at a glance	
Integrated plants	34
Grinding plants	21
All plants	55
Integrated capacity	32Mt/yr
Deliveries*	24.8Mt/yr
Consumption**	27.1Mt/yr
Imports**	1.3Mt/yr
Exports**	6.2Mt/yr

Above: Table 1. * = 2015, ** = 2014

21st Century trends

Whether the BVWP has a noticable impact on German cement production remains to be seen, but any up-tick in fortunes would be welcome. The sector has been in a steady state of low growth in recent years. Despite German GDP (PPP) surpassing Euro3.3tn in 2015 and 1.5-1.6% economic growth in the last two years, cement production by members of the country's cement association the VDZ actually fell to 24.8Mt in 2015 from 25.3Mt in 2014. However, this was due

BADEN-WÜRTTEMBERG 5.9Mt/yr
1. Schwenk Zement, Allmendingen 1Mt/yr
2. Schwenk Zement, Mergelstetten 1Mt/yr
3. HeidelbergCement, Leimen 0.8Mt/yr
4. HeidelbergCement, Schelklingen (Line to be replaced by 2018) 1.5Mt/yr
5. LafargeHolcim, Dotternhausen 0.8Mt/yr
6. Opterra (CRH), Wössingen 0.8Mt/yr

BAVARIA 5.6Mt/yr
7. Märker Zementwerke, Harburg 1Mt/yr
8. Schwenk Zement, Karlstadt 1.2Mt/yr
9. HeidelbergCement, Burglengenfeld 1.1Mt/yr
10. HeidelbergCement, Lengfurt 1Mt/yr
11. Südbayrisches Portland Zementwerk Rohrdorf 0.9Mt/yr
12. Solnhofer Portland Zementwerke, Solnhofen 0.4Mt/yr

BRANDENBURG 1.9Mt/yr
13. Cemex OstZement, Rüdersdorf 1.9Mt/yr

HESSE 0.4Mt/yr
14. Dyckerhoff (Buzzi), Amöneburg (White cement) 0.2Mt/yr
15. Zement und Kalkwerke Otterbein, Großenlüder 0.2Mt/yr

LOWER SAXONY 1.9Mt/yr
16. LafargeHolcim, Höver 1Mt/yr
17. HeidelbergCement, Teutonia 0.9Mt/yr

NORTH RHINE-WESTPHALIA 9.4Mt/yr
18. Dyckerhoff (Buzzi), Geseke 0.4Mt/yr
19. Dyckerhoff (Buzzi), Lengerich 1.8Mt/yr
20. HeidelbergCement, Paderborn 0.4Mt/yr
21. HeidelbergCement, Ennigerloh 1Mt/yr
22. Seibel und Söhne, Erwitte 0.6Mt/yr
23. Portland Zementwerke Gebr. Seibel, Erwitte 0.6Mt/yr
24. Portlandzementwerke Wittekind Hugo Miebach, Söhne, Erwitte 1Mt/yr

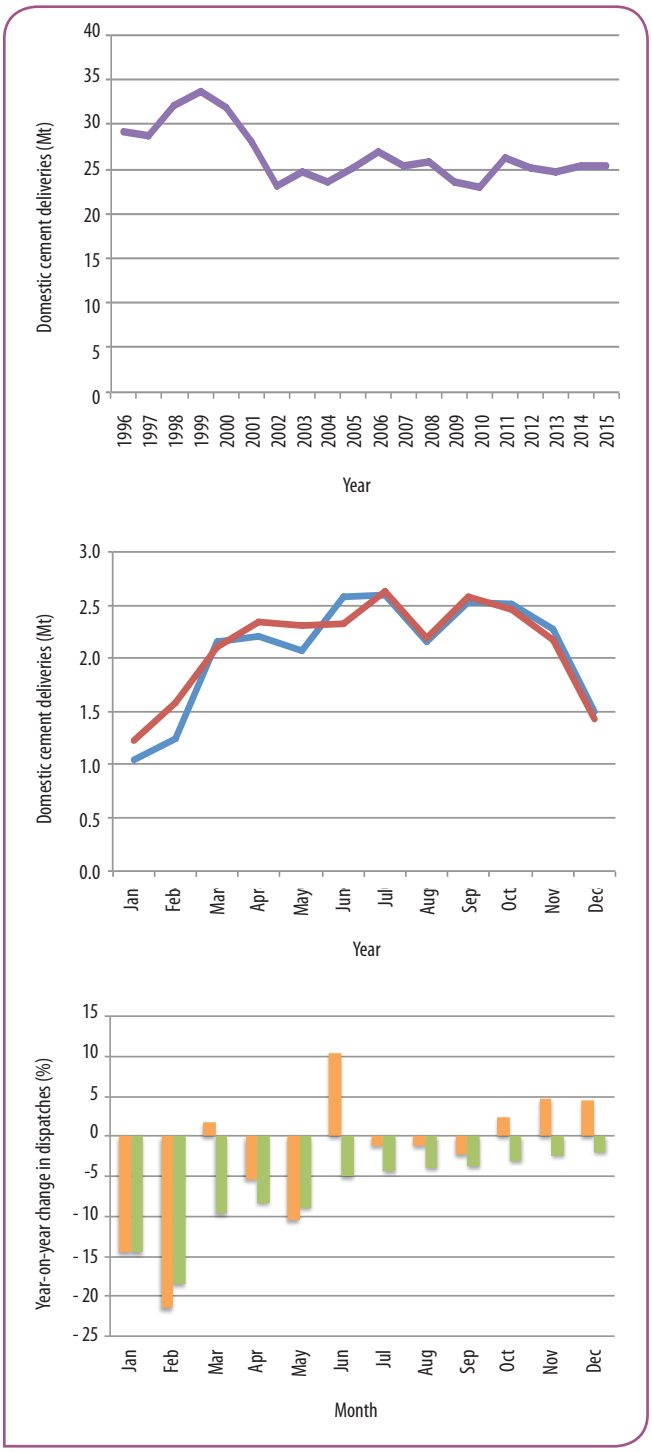
25. LafargeHolcim, Kollenbach 1Mt/yr
26. Spenner Zement GmbH & Co KG, Duisburg 1Mt/yr
27. Phoenix Cement, Beckum 0.5Mt/yr
28. HeidelbergCement, Geseke 0.9Mt/yr

RHINELAND-PALATINATE 1.0Mt/yr
29. Dyckerhoff AG (Buzzi Unicem), Göllheim 0.8Mt/yr
30. Portland Zementwerk Wotan H Schneider, Üxheim 0.2Mt/yr

SAXONY-ANHALT 3.2Mt/yr
31. Schwenk Zement, Bernburg 0.9Mt/yr
32. Opterra (CRH), Karsdorf 2.3Mt/yr

SCHLESWIG-HOLSTEIN 1.5Mt/yr
33. LafargeHolcim, Lägerdorf 1.5Mt/yr

THURINGIA 1.3Mt/yr
34. Dyckerhoff (Buzzi Unicem), Deuna 1.3Mt/yr



Right - Figure 3: Domestic cement deliveries by VDZ member companies, 1996 - 2015. **Source:** The VDZ.

Right - Figure 4 Monthly domestic cement deliveries by VDZ members, January 2014 - December 2015.
Source: The VDZ.

= 2015

= 2014

Right - Figure 5: Year-on-year change in monthly production (orange) and cumulative (year to date) change (green) by VDZ members between 2014 and 2015. **Source:** The VDZ.

to decreased exports year-on-year, as total domestic consumption rose marginally.

Figure 3 shows the amount of cement delivered to domestic consumer by VDZ members, (which represent the vast majority of German cement capacity), since 1996. It shows a significant fall in the early 2000s. In the past 16 years German cement consumption has dropped by around 30% from 35.78Mt in 2000 to 24.8Mt in 2015. This level has remained virtually unchanged since around 2002.

The main reasons for the drop in consumption are a lower backlog of demand from the former East German states than in the 1990s, unfavourable demographic and tax frameworks for residential construction work and restricted government infrastructure spending so far in the 21st Century.

"VDZ members are not getting too excited yet. The plans are too unspecific."

Dennis Guhl, Statistical Consultant, VDZ

Consumption in 2014 and 2015

Figure 4 compares monthly cement production output for VDZ members in 2014 and 2015. This shows the high degree of seasonality of the German sector, which is typical of a temperate European climate. Figure 5 shows the year-on-year change (and cumulative change) in monthly outputs in 2015 relative to 2014. Taken together, these figures show that the first nine months of 2015 were relatively poor, with the exception of March and June. After particularly low despatches in February 2015, the situation improved in the second quarter, with relative year-on-year gains in the final three months of the year. This may be explained by the fact that the weather in the final quarter of 2015 was unseasonably warm, which aided the continuation of construction activities right up to the New Year across much of Europe. Whether or not this trend continued into 2016 is yet to be seen.

Producer highlights

New line and upgrades for HeidelbergCement

In the first quarter of 2016, HeidelbergCement reported improved sales in its Western Europe region, led by improvements in Germany. Sales in the region were up by 3.1% year-on-year for the quarter and cement volumes were up to 17.6Mt across all operations in the first quarter of 2016, compared to 16.8Mt in the same period of 2015. This strong quarterly performance came on the back of a strong 2015.

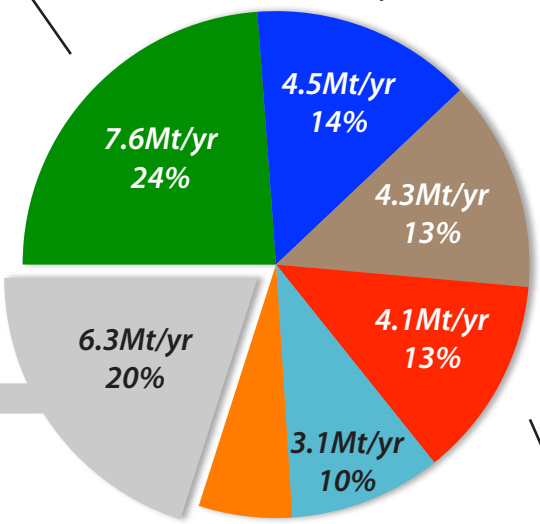
In April 2016, HeidelbergCement also made the unusual step of announcing a new cement production line in Germany, for its Schelklingen plant in Baden-Württemberg. The Thyssenkrupp line will have a capacity of 4500t/day (~1.5Mt/yr) and will replace an existing, less efficient line of the same size. The company is also in the process of upgrading its 1.1Mt/yr

German integrated cement market breakdown

1 HeidelbergCement is the largest cement producer in Germany, with eight plants and a production capacity of 7.6Mt/yr. This home-grown player represents 24% of the country's integrated cement capacity.

2 Dyckerhoff, part of Italy's Buzzi Unicem, is the country's second-largest cement producer, with five integrated plants and 4.5Mt/yr of capacity. This equals 14% of national capacity. The company also has three grinding plants.

Right - Figure 2: Breakdown of German integrated cement capacity by producer. **Source:** *Global Cement Directory 2016.*



3 LafargeHolcim is Germany's third-largest cement producer. It has four integrated plants, with a combined production capacity of 4.3Mt/yr and a grinding plant in Bremen. This gives it around 13% of national capacity.

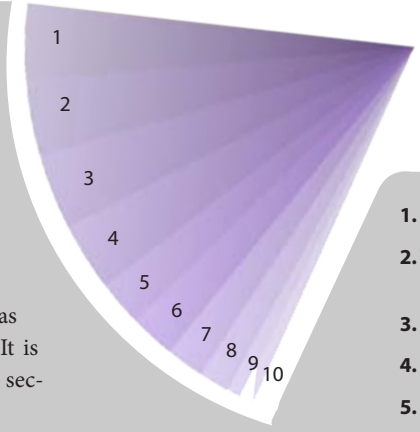
4 Schwenk Zement has an installed capacity of 4.1Mt/yr across four cement plants, enough for around 13% of national capacity.

5 Opterra (CRH) operates two integrated cement plants that have a combined production capacity of 3.1Mt/yr. This gives it 10% of national capacity. It also runs the Sötenich grinding plant in North Rhine-Westphalia.

6 Cemex Deutschland has one cement plant in Germany at Rüdersdorf with 1.9Mt/yr of production capacity, making it Germany's sixth-largest cement producer. It has 6% of Germany's integrated capacity. The company also operates three grinding plants.

'One man bands'

6.3Mt/yr (20%) of German cement capacity is held by producers with just one integrated plant. This high proportion of independent and family-owned cement producers is highly unusual in a cement market as large and as developed as that of Germany. It is one of the most diverse cement sectors in Europe.



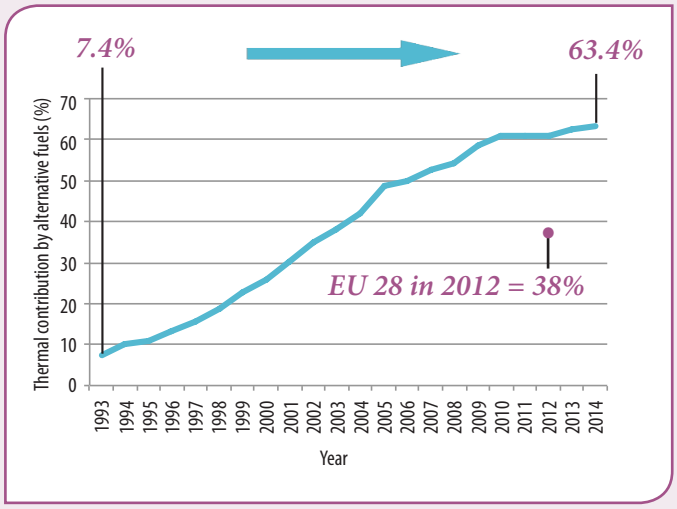
1. Märker - 1Mt/yr - 3.1%
2. W H Miebach Söhne 1Mt/yr - 3.1Mt/yr
3. Spenner- 1Mt/yr - 3.1%
4. Südbayrisches - 0.9Mt/yr - 2.8%
5. Seibel & Söhne - 0.6Mt/yr - 1.9%
6. Gebr. Seibel - 0.6Mt/yr - 1.9%
7. Phoenix - 0.5Mt/yr - 1.6%
8. Solnhofer - 0.4Mt/yr - 1.3%
9. Z&K Otterbein - 0.2Mt/yr - 0.6%
10. Wotan Schneider - 0.2Mt/yr - 0.6%

Light my fire - Germany has a huge track record in alternative fuels

German cement manufacturers were among the very first to pioneer the use of alternative and waste fuels in the cement production process. While the sector is often held up as an example of how the cement sector can become more sustainable, (and indeed it is), it is often forgotten that manufacturers first made the move in response to the oil crises of the 1970s, which caused fossil fuel prices to rise suddenly.

Alternative fuels through the years

Before the 1970s German cement plants traditionally used coal and lignite with small amounts of heavy fuel oil. Coal was partially replaced with petcoke, starting in the 1990s. Selected alternative fuels started to come into their own at around the same time.



Right - Figure 6: German cement sector alternative fuel substitution rates for 1993 - 2014. EU28 substitution rate for 2012 also shown. **Source:** The VDZ (German statistics) and WCSBD Cement Sustainability Initiative (EU 28 in 2012).

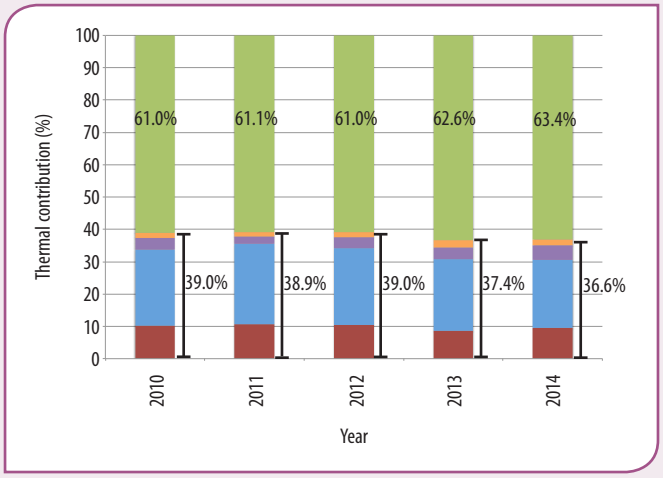
Figure 6 shows how the average alternative fuel substitution rate has increased over the 21 years between 1993 and 2014. The proportion of alternative fuels increased at an almost constant 11% year-on-year in the first 10 years covered here, reaching 38.2% by 2003.

After this point, the rate at which alternative fuels continued to be taken up by the industry slowed somewhat, dropping to an average 2.8% year-on-year in the 11 years from 2003 to 2014. This included a period between 2010 and 2012 when the rate did not rise for three years (See Figure 7). This may have been due to manufacturers halting capital expenditure projects in response to the onset of the global financial crisis.

However, a return to growth in the alternative fuels rate has been seen in more recent years, with producers using alternative fuels for 63.4% of all thermal energy requirements in 2014. This is one of the highest collective alternative fuels rates in the world and is especially significant given the large size of the German cement industry and the many players present in the market. For comparison, the average rate across the 28 EU member states (including Germany's high rate) was around 38% in 2012, according to the Cement Sustainability Initiative's Getting the Numbers Right (GNR) programme.

The situation in 2015 and 2016

Due to the competitive nature of the German cement sector, it has not been possible to obtain up-to-date alternative fuel use information from a significant number of plants. However, Schwenk Zement has previously stated that it uses over 90% alternative fuels across all of its operations. The Cemex Rüdersdorf plant reported using 75-80% alternative fuels in our February 2014 issue. In its 2016 Environmental Statement it stated that it used alternative fuels for 72.4% of its thermal energy requirements in 2015. One of Germany's single-plant operators reported using just shy of 60% alternative fuels in 2015, meaning that the range of alternative fuel substitution rates across the sector is at least 30%. *Global Cement* estimates that, for 2015, the average alternative fuel substitution rate will have been similar to that of 2014, with possible slight upward movement year-on-year.



Right - Figure 7: Breakdown of fuel sources used in German cement industry by thermal contribution (%), 2010-2014. **Source:** The VDZ.

Alternative fuels
Other fossil fuels
Petcoke
Lignite
Coal

Burglengenfeld cement plant in Bavaria. The plant will be fitted with a new clinker cooler from IKN by the close of 2016, with new pyroprocessing equipment from A TEC and mills from Gebr. Pfeiffer.

Dyckerhoff sees improved performance

In the annual report of parent group Buzzi Unicem, Germany was highlighted as a strong performer in 2015, with growth driven by domestic demand due to higher disposable income, lower unemployment and low inflation.

Holcim to supply 0.26Mt for A7 expansion

In 2015 Holcim Deutschland was awarded the contract as a cement supplier for the largest ongoing infrastructure project in Germany (prior to the BVWP). The A7, which bisects the country between the Danish and Austrian borders, is undergoing a Euro600m expansion to a 65km stretch between Hamburg and Bordesholm. The six-to-eight lane expansion will be completed by the end of 2018.

The project will require 0.26Mt of cement, with 90% of the total distance being built and topped with concrete due to superior durability over asphalt. The cement being supplied is specially developed by Holcim to meet strict alkali, set time, compressive strength and low thermal expansion requirements.

Upgrades at Schwenk Zement

Schwenk Zement has installed a Beumer Pipe Conveyor at its Bernburg plant in Saxony-Anhalt to feed increased amounts of fluffy refuse-derived fuel (RDF) to the main burner. The company also brought two Liebherr R 980 SME crawler excavators into operation at its limestone quarry in Heidenheim an der Brenz in October 2015.

Opterra supplies 'Germany's largest subway'

Opterra has been supplying a range of cement and pre-cast concrete products to the high speed ICE rail line project between Berlin and Munich, Bavaria. The controversial new line seeks to cut the travel time between the two cities to less than four hours from over six at present. It is slated for completion in 2017.

Described as one of Deutsche Bahn's most ambitious projects ever, the line includes three tunnels in part of the route between Erfurt and Leipzig, including one that is 6.8km in length. This part of the line has been dubbed Germany's 'largest subway.'

Opterra has supplied 96,000m^3 of concrete made from CEM II / AS 52.5 R Portland slag cement. In one section, where the line goes under the water table, the project has used Opterra's CEM III / B 42.5 N-LH / HS / NA blast furnace cement. In addition to the high-strength and favourable setting characteristics, this cement is resistant to sulphate attack and has a low alkali content. The CEM III / B 42.5 N-LH / HS / NA was developed specifically for the project at Opterra's Karsdorf plant.

Cemex HQ to move

Having sold its Kollenbach plant to CRH in 2015, Cemex Deutschland now only operates the Rüdersdorf plant in Brandenburg. To reflect this change the company is moving its headquarters to Rüdersdorf in 2016.

Looking ahead

The IMF expects German GDP to rise by 1.7% for the whole of 2016 (as in 2015) and it is expected to rise by 1.5% in 2017. With major new investments like the BVWP 2030, increased levels of housing starts since the beginning of 2016 and increased manufacturing output, the fundamentals of the German economy appear to be improving.

As far as the cement sector is concerned, each of the above factors is likely to have some positive effect on cement demand. For example, if the major road projects described in Figure 8 were to use approximately the same amounts of cement as the A7 upgrade (3800t/km), they could create additional cement demand of around 2.6Mt. However, this is well within the capabilities of the sector as it stands and new cement production lines like at HeidelbergCement's Schelklingen plant will continue to be the exception, rather than the rule.

The VDZ- Cement Laboratory was equipped by ratioTEC over twenty years ago.

In the new laboratory, which is planned for 2017, many existing system components will be incorporated into a new, highest-quality laboratory that will be complemented by new units. This demonstrates the high quality of the installation, when one considers the intense daily testing conducted in the laboratory.

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Canada: Developments at McInnis

The Quebec government has said that it has no plans to invest further into the McInnis Cement plant on the Gaspé Peninsula. Dominique Anglade, the province's Economy Minister, said on 29 June 2016 that she was confident that the US$854m project would be profitable and there will be no further investment on the part of the government. Key investors, including the Bombardier-Beaudoin family and the Caisse de dépôt et placement du Québec, are facing additional costs of up to US$350m. The cement plant has a planned launch of operations set for spring 2017.

The provincial government says it has taken action since learning of the cost overrun, including securing guarantees regarding the financial package needed in the short term to ensure completion of the project. Other unspecified 'additional conditions' have also been attached to the government's financial contribution. Quebec is a major equity partner in the project, with a US$78m investment. It also provided a US$194m loan on commercial terms.

Meanwhile, Christian Gagnon, McInnis' president and CEO, has left the company. A new executive committee has been put in place to take over the management of the company until the position has been filled once more. In other changes to the company's executive team, Ronald Bougie has been appointed as the Executive Vice-President, Engineering, Construction and Operations. Bougie has experience in the construction of large industrial projects including the Stornoway site, a project in which Caisse de dépôt et de placement du Québec invested. Until a new president and chief executive officer is appointed, Bougie will report directly to McInnis Cement's Executive Committee. He will have direct access to the Board of Directors to provide progress reports.

Brazil: Cement technology agreement

The International Finance Corporation (IFC) has signed an agreement with the National Union of Cement Industry (SNIC) and the Brazilian Portland Cement Association (ABCP) to support the preparation of a Cement Technology Roadmap in Brazil. The project is being developed in partnership with the International Energy Agency (IEA) and the Cement Sustainability Initiative (CSI).

The Brazilian edition of the Cement Technology Roadmap will map current and future technologies and their potential for energy efficiency improvement and greenhouse gas emissions reduction per tonne of cement produced up to 2050. Its main objective is to contribute to the development of the cement industry in Brazil towards a low CO_2 economy, using technical solutions allied to a range of recommendations from the academic, government and financial sectors. In addition to co-financing the initiative, IFC will also use its experience to help produce two of the project's technical studies: energy efficiency and the use of alternative fuels. The preparation of the roadmap is being supported by more than 90% of the country's cement producers.

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Brazil: Votorantim inaugurates Primavera

Votorantim Cimentos has inaugurated a new cement plant at Primavera in Pará state. The US$258m plant has a production capacity of 1.2Mt/yr. It will serve the North and Northeast regions of Brazil.

"This plant in Primavera is part of Votorantim Cimentos' major investment plan. Despite the challenging situation in Brazil, we are moving forward with our long-term vision and our confidence in the development of the country," said Walter Dissinger, CEO of Votorantim Cimentos. Construction of the plant also included a social investment programme in the local area that invested US$3m towards a local library, schools and a health centre.

The new operation is part of the company's expansion plan, which will increase its global capacity to approximately 59Mt/yr by the end of 2018, in line with the company's plan of geographic diversification. This expansion plan adds to investments of US$3.6bn made between 2007 and 2015, which resulted in a 94% increase in global production capacity.

The investment plan to 2018 also includes expansions at Charlevoix in the US, Sivas in Turkey and a new cement plant at Yacuses in Bolivia. The company is also expanding in the San Luis region of Argentina.

Peru: Yura's profit up in first half

Cementos Yura's income has risen by 10% year-on-year to US$141m in the first half of 2016 from US$127m in the same period of 2015. Its net income rose by 21% to US$29m from US$24m.

The Peruvian cement producer's sales volumes grew by 11% to 608,923t of cement in the second quarter of 2016 mainly due to a rise in local demand. Clinker sales volumes remained stable. Yura increased its market share to 22.4% in the quarter from 20.4% in the same period in 2015. Peru's total domestic cement sales remained stable at 2.33Mt.

Canada: Association joins CO_2 price coalition

The Cement Association of Canada has become a member of the Carbon Pricing Leadership Coalition (CPLC) as a strategic partner. The CPLC is a voluntary initiative that supports and encourages the implementation of CO_2 pricing around the world. It was initiated by the World Bank at the 2014 United Nations Climate Change Summit in New York City and officially launched in 2015 at COP21 in Paris.

"Well designed CO_2 pricing systems can drive innovation and prepare companies and communities to prosper in a competitive, low-CO_2 and climate-resilient economy," said Michael McSweeney, President and CEO, Cement Association of Canada. "We have long advocated for carbon pricing in Canada and globally and are eager to continue our work with the federal and provincial governments to help them design and implement climate policies that support the goals of the Paris Agreement, protect and enhance the competitiveness of the domestic industry and promote alignment on CO_2 pricing among our trading partners."

Brazil: Barroso gets flyingbelt system

The LafargeHolcim cement plant in Barroso, Minas Gerais has completed the installation of a 'flyingbelt' conveying system. The system was supplied by the Sempertrans division of the Semperit Group and Leitner's Agudio brand.

The conveying belt is suspended on ropes connecting a limestone quarry to the plant. It can convey 1500t/hr of limestone at a height of up to 36m. The 7km belt is the longest of its kind in the world. The conveyor uses only a third of the energy of a similarly-sized ropeway system. According to Semperit's CEO Thomas Fahnemann, the system 'overcomes terrain that can only be accessed with difficulty' and that it saves the need for 40 truck journeys every hour.

Above: The Flyingbelt was shipped from the Sempertrans plant in France to Brazil. ©Sempertrans 2016.

Puerto Rico (US): MHSA fines Cemex

The US Department of Labor's Mine Safety and Health Administration (MSHA) has fined Cemex Puerto Rico US$291,722 in penalties relating to 119 citations and orders issued for safety violations at the company's Ponce Cement Plant and its two Cantera Canas mines. The cement producer must now implement enhanced safety measures at the three facilities.

US: Chromium VI investigation

The Oregon Department of Environmental Quality (DEQ) is working with Lehigh Cement to investigate a potential source of hexavalent chromium (chromium six) emissions from a cement terminal in Portland. The environmental agency suspects that cement dust may be a contributing source of chromium six that it has monitored since March 2016 in southeast Portland. The DEQ is working with the cement company to improve its dust-capturing efforts when unloading cement from railcars.

"We're concerned about the persistence of elevated levels of chromium," said Pete Shepherd, interim DEQ director. "We are making every effort to bring those levels down." The DEQ has also required a nearby glass manufacturer to clean its exhaust stacks to tackle the problem.

Mexico: Cemex revenue falls in first half

Cemex's sales revenue fell slightly year-on-year to US$6.88bn in the first half of 2016. Its net income rose to US$242m from a loss of US$31.6m. Its cement sales volumes rose by 2% to 33.6Mt from 32.9Mt.

"Our solid second quarter and first half 2016 results demonstrate the resilience of our portfolio, which largely comprises high-growth markets that are experiencing attractive supply-demand conditions," said Fernando A Gonzalez, Chief Executive Officer of Cemex. The cement producer attributed the increases in sales in the second quarter to high prices overall and increased high sales volumes in Mexico, the US and Europe.

By region, Cemex reported a rise in cement sales volumes in all territories except Mexico. Here, cement volumes started to rise in the second quarter of 2016. The highest half-year increase in cement sales volumes was reported in the US at 7%, driven by residential and infrastructure activity.

Barbados: Strong exports for Arawak

Arawak Cement recorded its highest exports in three years when it exported 20,000t of cement in June 2016. The figure contributed a 27% year-on-year increase in exports to 90,000t for the first half of 2016.

The cement producer said that the boost in export sales was due to improvements to its jetty and dust emissions control systems at its St Lucy plant. The changes have allowed it to improve its cement loading rates and receive larger ships.

Jamaica: Caribbean Cement profit rises 21%

The Caribbean Cement Company's net profit has risen by 21% year-on-year to US$832,000 in the first six months of 2016 from US$686,000 in the same period in 2015. Revenue grew by 10% to US$65.6m from US$59.4m. The rise in profit was attributed to increased revenue and reduction in costs but was tempered by stockholding, inventory restructuring and manpower restructuring costs. Cement export and clinker volumes fell by 8% and 77% respectively in the period, despite the increases in revenue.

Brazil: Titan buys stake in Cimento Apodi

Greece's Titan Cement has agreed to acquire an equity stake in Companhia Industrial de Cimento Apodi, a Brazilian cement producer that operates in Ceará in Northeast Brazil. Through a joint venture agreement, Cimento Apodi will be jointly owned and controlled on a 50/50 basis by the Dias Branco Group and a Titan-Sarkis subsidiary, in which Titan is the majority shareholder. Titan's investment in the purchase will be determined when the deal closes but it is expected to be about US$100m.

The assets of Cimento Apodi include an integrated cement plant in Quixeré that has operated since 2015 and a cement grinding plant in Pecém port, near to Fortaleza, that has operated since 2011. Cimento Apodi has cement production capacity of over 2Mt/yr.

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Comment: Nirma joins ranks of Indian cement producers as consolidation continues

On 11 July 2016 Nirma Ltd was announced as the winning bidder in the battle for 11Mt/yr of cement production assets held by Lafarge India, following days of intense discussion between LafargeHolcim and five final candidates in London, UK. After the collapse of an earlier deal between LafargeHolcim and Birla Corporation the sale, for around US$1.4bn, was above the top end of estimates at US$127/t of installed capacity.

Eric Olsen, CEO of LafargeHolcim, said, "This agreement is an important step in our US$3.6bn divestment programme. With this deal, two thirds of the programme has been secured and it is well on track. We are confident that we will meet our target by the end of 2016. With the proposed buyer we have found the right partner who will be able to develop the business further in the interest of all of our stakeholders."

LafargeHolcim will continue to operate in India through its subsidiaries ACC and Ambuja Cements, which have a combined cement capacity of more than 60Mt/yr. The assets that Nirma has agreed to acquire include three integrated cement plants, two separate grinding plants and a wealth of concrete and aggregate assets in Jharkhand and Chhattisgarh.

The move into cement marks a radical departure for Nirma, which produces well-known soaps, detergents, salts and scouring products for consumers as well as a range of industrial chemical intermediates for other companies. On its website Nirma describes itself as 'one of the few names which is instantly recognised as a true Indian brand.' It may well find this public trust to be very helpful in a market where cement companies advertise heavily on television and sponsor teams in the popular Indian Premier League cricket competition.

While the public may welcome Nirma there are still bureaucratic hurdles to overcome. The deal is subject, as usual, to approval by the Competition Commission of India (CCI). As well as this, officials in Jharkhand have said that the sale will require state approval to transfer land at the Jojobera cement plant. Previously, the district administration served a notice to Lafarge India on 10 October 2015 when Lafarge India was in talks with Birla Corporation regarding its earlier deal.

"It is mandatory to seek state government's prior approval for third-party transfer of leased land, in this case leased to Tata Steel. The district administration had informed this to the company, requesting it to seek government's approval," said K K Sone, the state land and revenue secretary. "It has to comply with the administration's notice. Any violation would draw administrative, civil as well as criminal actions."

The Jojobera plant was built on government land leased to Tata Steel. Tata Steel then signed a business transfer agreement for its Jojobera plant with Lafarge India in March 1999.

The Lafarge / Nirma deal is not the only big cement sector deal in India at the moment. The long-running agreement by UltraTech to buy cement plants from Jaiprakash Associates reached its latest 'revision' in July 2016 when UltraTech upped its offer to US$2.40bn from the US$2.36bn offered at the end of March 2016. Along with a US$70m grinding plant under construction in Uttar Pradesh, the deal now covers a total of 21.2Mt/yr of capacity at US$118/t of installed capacity.

UltraTech has described the purchase as a 'geographic market expansion,' which will allow its entry into markets of India including the Satna cluster in Uttar Pradesh and Madhya Pradesh, Himachal Pradesh, Uttarakhand and coastal Andhra Pradesh. It has also stated that its cement production capacity (clinker and grinding) will rise to 91.1Mt/yr following the deal.

As ever, the latest revised agreement is dependent on shareholder, creditor, high court and regulatory approval. UltraTech plans to complete the transaction by July 2017. But with so much already having happened during this deal, there may yet be further changes. Watch this space.

Vietnam: Government to sell Vicem stake

The Ministry of Construction is planning to sell its stake in cement producer Vicem through an initial public offering in the fourth quarter of 2016. The state is planning to reduce its stake to 51%. There has been interest from investors from Indonesia and Thailand.

Vicem, which has stakes in 31 companies, mostly cement producers and distributors, currently controls 34% of the cement market in Vietnam. Its gross profit reportedly doubled to US$105.2m in 2015.

Pakistan: EPA calls for two plants to shut

The Environmental Protection Agency (EPA) has issued directives to the Hazara and Kohat administrations to stop production at two cement plants in breach of EPA dust regulations. Muhammad Bashir Khan, the director general of the EPA, has issued directives to shut down the Dewan Hattar Cement plant and the Kohat Cement plant. Khan said that the Dewan Hattar plant had requested an eight-month period to install dust control measures but had failed to do so and that the Kohat plant's dust control unit is currently out of order.

Georgia: Black Sea Construction starts

Construction has started on a new US$120m cement plant in Senaki, Samegrelo. The project, Black Sea Cement, is a joint venture between China's Hualing Group and a Georgian construction company. The plant will have a cement production capacity of 1.5Mt/yr.

Uzbekistan: New Titan plant commissioned

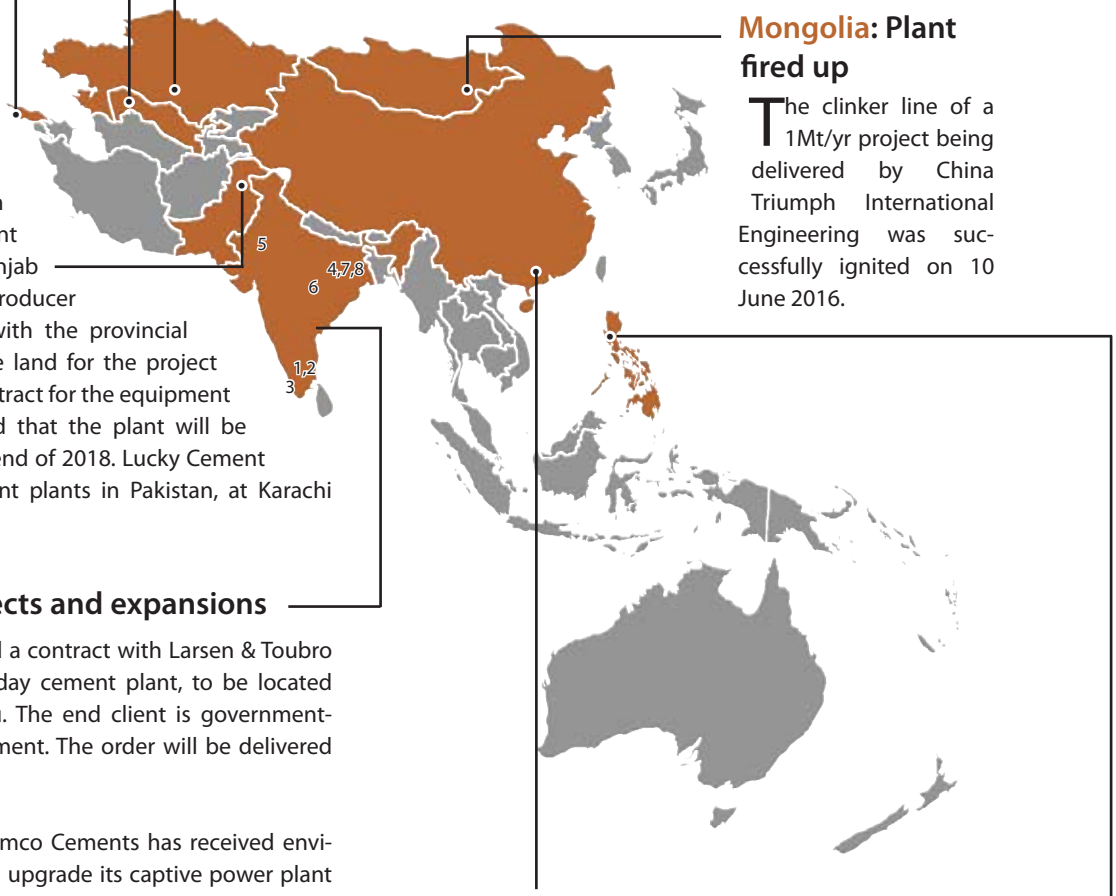
Titan Cement has started production at a plant in Karauzyak, Karakalpakstan, an autonomous republic within Uzbekistan. The plant has a production capacity of 0.2Mt/yr and 200 new jobs have been created.

Kazakhstan: New Kyzylorda plant

Chinese investors have proposed to build a 0.75Mt/yr cement plant in the Kyzylorda region of Kazakhstan. The proposal was revealed as part of US$451m of deals signed between the Kyzylorda region and the People's Government of Jiangxi Province, China.

Pakistan: Punjab to get Lucky plant

Lucky Cement will spend US$190m on a new 2.3Mt/yr cement plant at Chakwal, Punjab Province. The cement producer is currently working with the provincial government to acquire land for the project and it is finalising a contract for the equipment supplier. It is expected that the plant will be commissioned by the end of 2018. Lucky Cement already has two cement plants in Pakistan, at Karachi and Pezu.



Mongolia: Plant fired up

The clinker line of a 1Mt/yr project being delivered by China Triumph International Engineering was successfully ignited on 10 June 2016.

India: Plant projects and expansions

1. FLSmidth has signed a contract with Larsen & Toubro for a complete 3000t/day cement plant, to be located in Ariyalur, Tamil Nadu. The end client is government-owned Tamil Nadu Cement. The order will be delivered by the end of 2017.

2. Also in Alathiyur, Ramco Cements has received environmental clearance to upgrade its captive power plant at a cost of US$3.18m.

3. Malabar Cements will restart operations at its Cherthala, Kerala grinding plant. This follows permission from the state's High Court to produce Portland pozzolana cement, which had previously not been granted.

4. Shree Cement has signed a memorandum of understanding with the Jharkhand government to build a US$73m, 2Mt/yr grinding plant in Sarai Kale Karasawa.

5. Shree Cement has also completed an upgrade on the preheater of its Unit-I line in Beawar, Rajasthan, increasing the clinker capacity from 1.1Mt/yr to 1.4Mt/yr.

6. ACC has started production at its 2.8Mt/yr Jamul, Chhattisgarh plant.

7+8. ACC will complete work on two grinding plants in Jamul and Shindri, both in Jharkhand, in September 2016.

China: Fengkai Expansion completed

China Resources Cement (Fengkai), a subsidiary of China Resources Cement, has started operation of its sixth 5000t/day clinker production line at its cement plant in Fengkai County, Guangdong Province. The site has a total clinker production capacity of 9.3Mt/yr and a cement production capacity of 8Mt/yr. The plant mainly serves the Pearl River Delta area of Guangdong Province.

Philippines: New Cemex plant by 2019

Cemex Philippines plans to build a US$300m cement plant with a production capacity of 1.5Mt/yr in Antipolo, Manila. The plant will be in operation in the second half of 2019. Company president and chief executive Pedro Jose Palomino made the announcement amid the company's initial public offering on the Philippine Stock Exchange.

India: ACC profit up

ACC's net profit after tax has risen by 26% year-on-year to US$69.3m in the first half of 2016 from US$55.1m in the same period of 2015. The cement producer's sales revenue fell slightly to US$863m and its cement sales volumes rose by 3.8% to 12.48Mt from 12.02Mt. The subsidiary of LafargeHolcim reported that it made an overall cost reduction of 9% in the second quarter of 2016 by optimising its fuel mix through higher rates of petcoke, by lowering costs of input materials such as slag, fly ash and gypsum and by improving its gypsum-mix optimisation.

Thailand: Siam Cement revenue falls

Siam Cement Group's sales revenue from its cement and building materials division fell by 4% year-on-year to US$2.54bn in the first half of 2016. Profit for the half-year period fell by 11% to US$165m. The company reported that Thailand's total domestic cement demand decreased by 3% year-on-year in the second quarter of 2016 due to soft demand from non-government sectors.

Overall, Siam Cement Group saw a 2% fall in revenue across all business lines to US$3.11bn and a rise in profit by 18% to US$843m. It attributed the rise in profits to the performance of its chemical business.

Vietnam: Siam City picks up LafargeHolcim assets

Siam City Cement has signed an agreement to buy LafargeHolcim's entire 65% stake in LafargeHolcim Vietnam, which operates one integrated cement plant and four grinding plants with a total capacity of 6.3Mt/yr, for US$890m. The company is also a leading ready-mix concrete producer that operates seven plants in southern Vietnam. The sale is subject to regulatory and shareholder approvals and gives first refusal to LafargeHolcim's joint venture partner. The deal will complete by the end of 2016.

Taiwan: Taiwan Cement to capture more CO_2

Taiwan Cement plans to expand its microalgae unit to boost astaxanthin production from waste CO_2. The cement producer intends to invest US$6.25m towards enlarging its existing microalgae unit into a 20-hectare outdoor microalgae farm with an estimated annual production value of about US$12m. The upgraded farm will start operation in 2017.

Indonesia: Semen Indonesia sales edge upwards

Semen Indonesia's cement sales rose by 1.2% year-on-year to 12.4Mt in the first half of 2016. Local sales rose by 1.6% to 12.2Mt but export volumes fell by 20.1% to 0.19Mt. The decline in export sales was attributed to the Indarung cement plant in Padang Province.

Cement consumption for the country as a whole rose by 3.1% to 29.5Mt for the first half of 2016, according to Indonesian Cement Association data. Increases in consumption were noted in most regions, with the exception of Kalimantan, where consumption fell by 16% to 2Mt. Notable increases in consumption were recorded in Sulawesi, Maluku and West Papua. Overall exports of cement fell by 19.3% to 0.21Mt but clinker exports rose by 380% to 0.42Mt.

India: Coal contracts for Shree and Prism

Shree Cement has won its bid for a coal contract from South Eastern Coalfields Ltd (SECL) for 80,000t/yr. The cement producer will gain the supply from the New Kusmunda mine in Chhattisgarh for US$14/t.

Meanwhile, Prism Cement has purchased 120,000t/yr of coal from SECL, following an auction. The company said that it has secured part of its fuel requirement for the next five years and that the allocation was made at the floor price.

Japan: Taiheiyo to build biomass plant at Ofunato

Taiheiyo Cement plans to build a 75MW biomass power plant at its Ofunato cement plant in Iwate Prefecture, Japan. The new unit will burn both domestic and imported biomass fuel. The new power plant will replace units damaged at the site during an earthquake in 2011. As such the plant has not required new environmental clearance.

Fiji: Pacific Cement sales increase

Pacific Cement's sales volumes of cement have increased by 45% to 150,561t in the last year. 104,000t of cement was sold locally, according to the Fiji Times newspaper. General manager Sowani Tuidrola attributed the boost in sales to growth in the local market. At present Pacific Cement's plant produces 500t/day of cement. The cement producer exports cement to Vanuatu, Tonga, Samoa, Tarawa, Solomon Islands, Cook Islands, Wallis and Futuna, Papua New Guinea and Timor Leste.

Bangladesh: Premier Cement to upgrade plant

Premier Cement has approved plans to more than double its cement production capacity to 16,000t/day from 6000t/day at its grinding plant near Dhaka. The cement producer will invest US$51m in the upgrade to its mill, according to the Daily Star newspaper. The upgrade will be completed by the start of 2018.

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Peter Edwards, Global Cement Magazine

Cement - Not made in China?

Chinese cement production officially decreased in 2015 for the first time in decades. The fact that the government is prepared to announce a reduced figure is significant in itself, whether or not you believe the values themselves...

With an estimated population of 1.4bn in 2015, China is the most highly-populated country in the world. This high population, combined with a low cost of living and a centrally-planned communist economy made the country into a very strong manufacturing hub in the second half of the 20th Century. It produces a staggering number and range of products and is the world's largest exporter. However, rising labour costs, lower demand from export partners and overcapacity in its traditional markets, including for cement, have dampened China's historically rapid growth in recent years.

Cement industry

Chinese cement capacity is the world's largest by a significant margin and, according to official statistics, the sector pumped out an incredible 2.35Bnt of cement in 2015. This is more than eight times more than the second-placed country India (270Mt), according to the United States Geological Survey (USGS).

*A simple calculation reveals an interesting discrepancy: 65% of 2Bnt is **1.3Bnt**, not 2.35Bnt...*

In its report the USGS cites Chinese statistics, as independent data is hard to come by. *Global Cement* has long been suspicious of such numbers, but in January 2016 it took more notice of them than usual. China's official cement production value for 2015 was actually 4.9% *lower* in 2015 than in 2014, the first decrease for decades (See Figure 1). Whether the numbers are a true reflection of actual production or not, the figures are an admission by a Chinese state body that cement production has declined, amid chronic overcapacity.

The fact that China has too many cement plants is not news. Indeed, signs of overcapacity in the Chinese cement market were noted back as far as 2003. In 2012 the National Bureau of Statistics of China (NBSC) warned that China was producing too much cement and in December 2015 reports stated that the country's capacity utilisation was just 65%. Given that the country's official clinker capacity is around 2Bnt/yr, a simple calculation reveals an interesting discrepancy: 65% of 2Bnt is 1.3Bnt, not 2.35Bnt. This raises the alarm on the topic of Chinese statistics. Clinker extenders can't go *that* far.

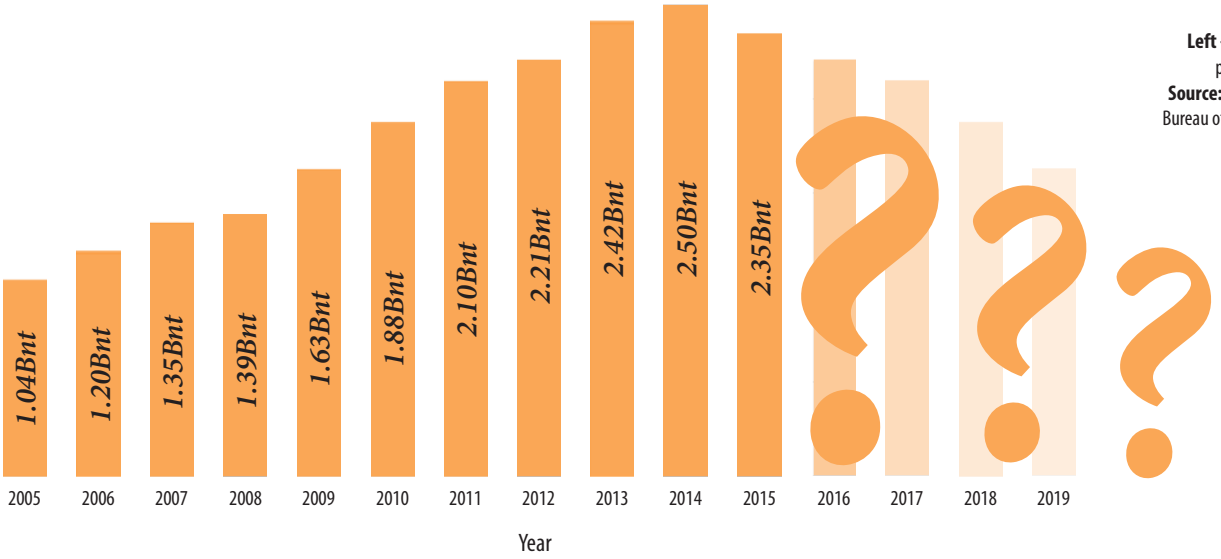
In October 2013 China's State Council issued the *'Guideline to tackle serious production overcapacity,'* while the Chinese Cement Association (CCA) drafted a plan to promote mergers and acquisitions to eliminate out-of-date capacity and increase the concentration of the industry.

Several Chinese regions have now banned the construction of new cement plants, while others have banned the expansion of existing cement plants. In April 2014 the NDRC announced a nationwide ban on 32.5 grade cement production from December 2015. This move alone is thought to have knocked 340Mt/yr (11%) off the total available capacity in the country.

Zombies at the plant gates

While some Provinces have demolished significant numbers of cement plants in order to scale their capacities back towards more realistic levels, the story is not straightforward everywhere. The instructions from the top of the Chinese government can also be in direct competition with some of the aims of local and regional governments. These look to maintain production rates at high levels, support local industries, maintain low unemployment and promote social cohesion. Cement plants that employ lots of people can help achieve these aims, especially in smaller cities and towns where other employment is not readily available.

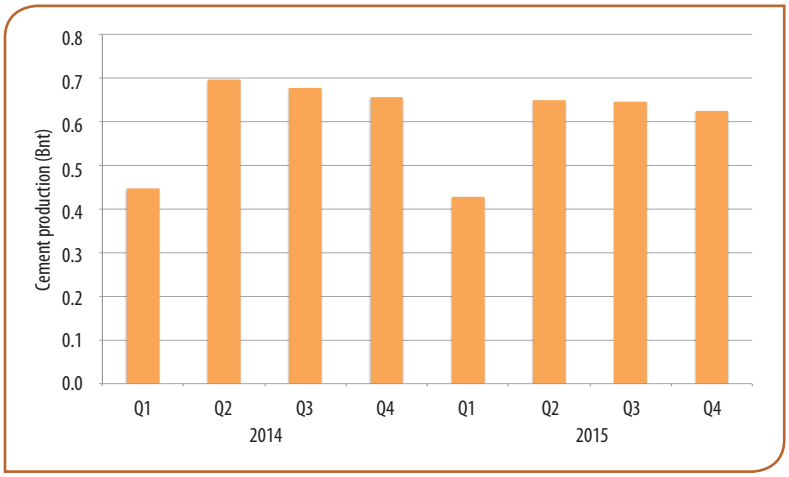
Right: Shanghai skyline.



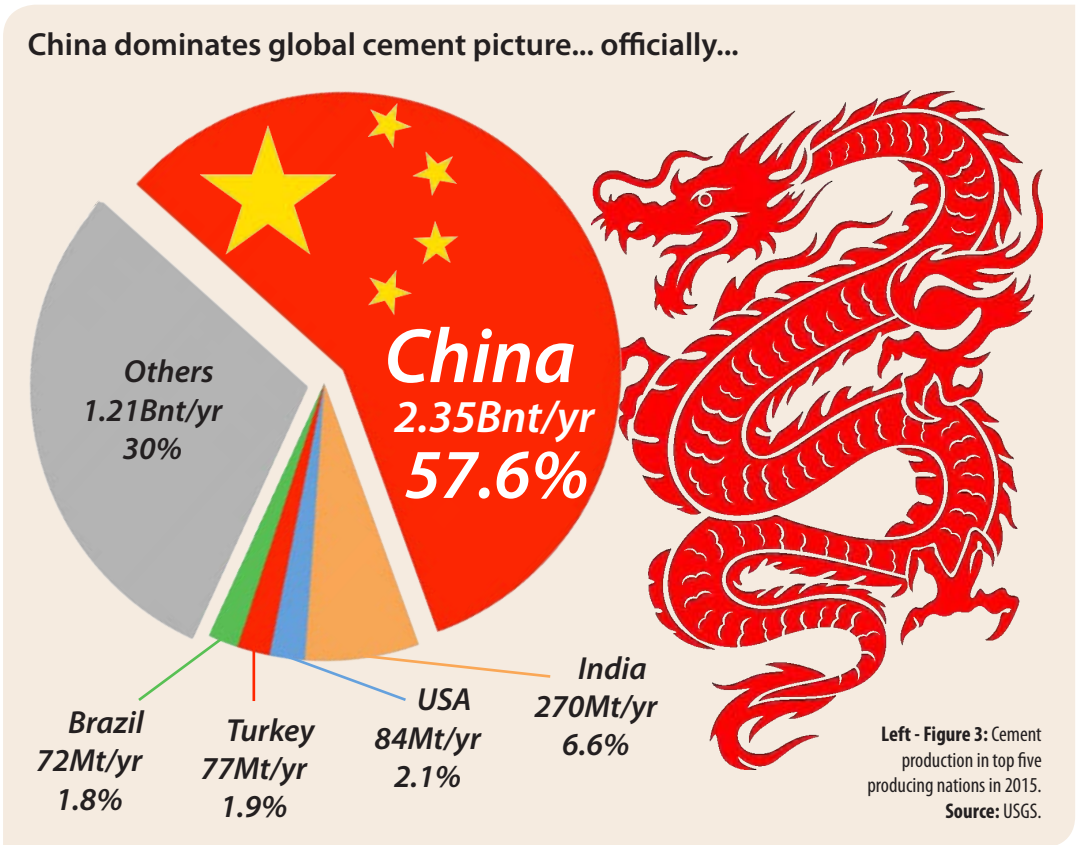
Left - Figure 1: Cement production in China.
Source: USGS and National Bureau of Statistics of China.

In some regions these factors have resulted in bizarre compromises, including scaled back production with full workforces and producing low amounts of cement to meet banks' financing requirements. Essentially, cement plants that are not required to produce cement are being kept running to 'employ' people and to service loans. This gives rise to higher levels of production than is either needed or is economically viable and it contributes to the continued overproduction of cement. These so-called 'zombie' companies are prevalent in regional industrial cities.

Solving the problem of zombie enterprises, also a feature of other industrial sectors, is not easy. The solutions offered to date have, in many cases, only



Above - Figure 2: Quarterly cement production in China in 2014 and 2015.
Source: USGS and National Bureau of Statistics of China.



Left - Figure 3: Cement production in top five producing nations in 2015.
Source: USGS.

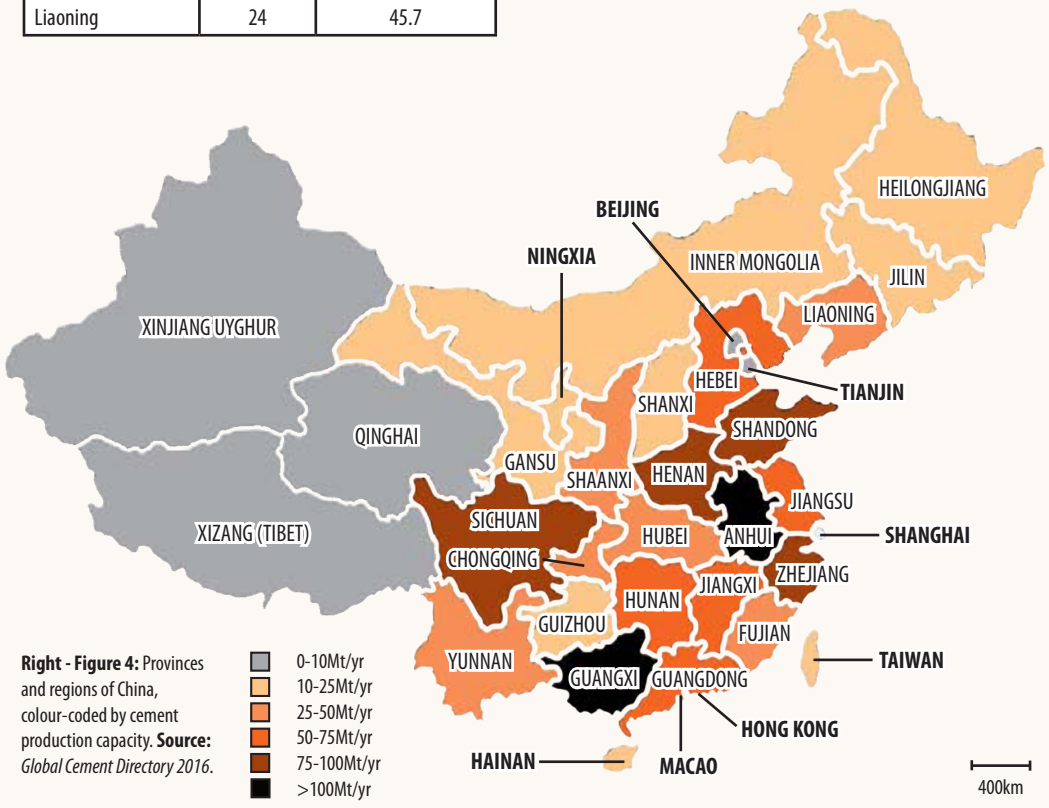
Chinese cement capacity

According to the *Global Cement Directory 2016*, the Chinese cement industry consists of 805 integrated cement plants with a combined production capacity of 1.37Bnt/yr (Table 1, Figure 4). There are also 15 cement plants and 28Mt/yr of cement production capacity in Taiwan.

Given the large number of smaller and remote cement plants and the lack of independent verification regarding the information supplied by Chinese producers, the data regarding plant numbers and production capacity is likely to be incomplete.

Region	Plants	Capacity (Mt/yr)
Anhui	35	193.7
Beijing	6	4.7
Chongqing	19	30.0
Fujian	18	28.2
Gansu	26	19.6
Guangdong	26	69.1
Guangxi	37	106.7
Guizhou	28	21.9
Hainan	7	12.3
Hebei	21	58.5
Heilongjiang	13	12.0
Henan	47	83.6
Hubei	29	47.0
Hunan	30	55.6
Inner Mongolia	14	19.4
Jiangsu	24	71.3
Jiangxi	27	56.2
Jilin	12	33.7
Liaoning	24	45.7
Ningxia	16	17.1
Qinghai	10	4.7
Shaanxi	63	40.0
Shandong	43	81.0
Shanghai	3	1.6
Shanxi	11	13.1
Sichuan	81	93.3
Tianjin	1	1.6
Tibet	9	2.4
Xinjiang	18	11.9
Yunnan	53	31.4
Zhejiang	54	97.6
TOTAL	**805**	**1365**
Taiwan	15	28.0

Above - Table 1: Number of integrated cement plants and integrated capacity of cement-producing regions of China. Hong Kong and Macau do not have cement production facilities.
Source: *Global Cement Directory 2016*.



Right - Figure 4: Provinces and regions of China, colour-coded by cement production capacity. **Source:** *Global Cement Directory 2016*.

served to delay reform. The workforce remains underemployed and cannot be redistributed to other, potentially more profitable, areas of the local and national economies.

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MASSIVE REDUCTIONS

Profits down as 2015 disappoints

Some of the effects of overcapacity and zombie plants can be seen in the financial results of Chinese cement producers in 2015 and so far in 2016. The start of 2016 was awash with profit warnings from China Tianrui, China Resources Cement, Asia Cement and others.

In March 2016, the results for 2015 came in. China's largest cement producer CNBM saw its net profit fall by 83% year-on-year to US$157m. CNBM blamed a national slowdown in fixed-asset investments, infrastructure construction and falling real-estate investments.

Anhui Conch also reported a poorer financial performance in 2015 than in 2014. Its net profit fell by 30% year-on-year to US$1.6bn. Like CNBM, the company cited a slowing housing market. Unusually the company did this while increasing its cement output by 2% to 224Mt. This clearly points to overcapacity and rock bottom selling prices. For the first quarter of 2016 Anhui Conch saw its quarterly profit fall by 45% to US$123m.

In 2015 Asia Cement saw a 22% fall to US$986m and its net profit was down by 50% to US$148m. It said that 'intense' market competition and a 10-year market low cement price in August 2015 had been the main causes of the lower figures.

China Resources' profit fell by 76% year-on-year to US$130m in 2015. Its revenue was down by 18% to US$3.45bn. Despite referring to a fall in demand, China Resources reported a 7% year-on-year rise in cement volumes. Its first quarter revenue fell by 24% to US$609m. It *again* reported increased sales.

Elsewhere, China Shanshui reported a loss of US$998m in 2015, compared to a net profit of US$54m in 2014. Revenues were down by 28% year-on-year. Taiwan Cement's net income fell by 47% to US$178m in 2015 from US$334m in 2014. Its sales dropped by 21% to US$2.89bn from US$3.65bn.

Looking forwards... or back?

As of March 2016 the Ministry of Industry and Information Technology (MIIT) and related departments were considering draft guidelines regarding eliminating outdated production capacity in the

Lef: The average cement sales price of Beijing Building Materials Group in the first quarter of 2016. **Source:** Digital Cement.

See 'A note on prices' below.

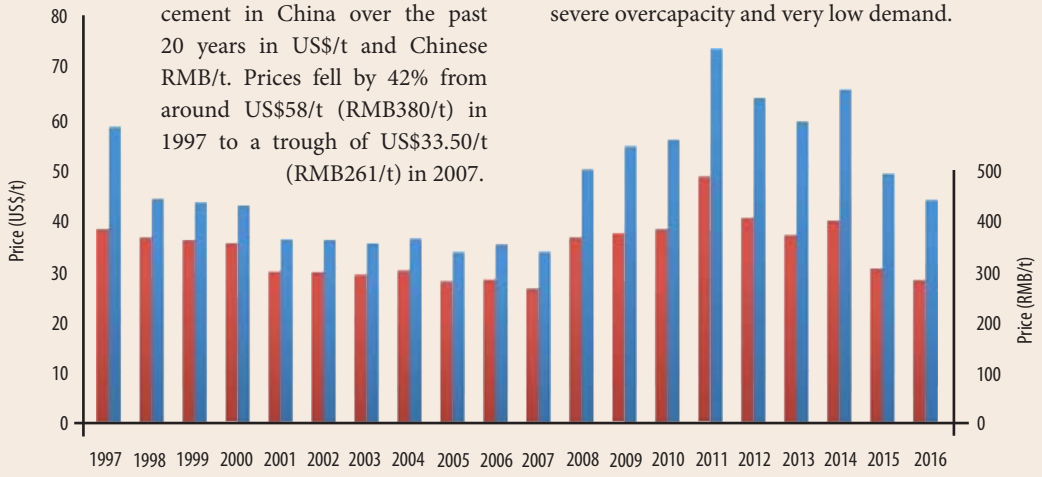
A note on prices

Cement prices have historically been lower in China than in many other places around the world due to its very high cement (over)-capacity. As in other countries, they can tell a great deal about the underlying health of the construction sector and hence the general state of the economy.

Figure 5 shows the price of cement in China over the past 20 years in US$/t and Chinese RMB/t. Prices fell by 42% from around US$58/t (RMB380/t) in 1997 to a trough of US$33.50/t (RMB261/t) in 2007.

In 2008 prices were significantly up, in part due to government stimulus due to the onset of the global financial crisis. They rose to a peak of US$73/t (RMB/t) in 2011.

Since then, however, prices have started to slide once more. By the end of 2012 they fell to US$63/t (RMB400/t) and average prices slid to US$49/t (RMB302/t) in 2014. As of May 2016 the average price had slipped to US$44/t (RMB260/t) amid severe overcapacity and very low demand.



Left - Figure 5: The average cement sales price of Beijing Building Materials Group in the first quarter of 2016.

US$/t
RMB/t

Sources: Prices from Digital Cement, BOCI, CIEC, Bloomberg, Macquarie Research. Historical currency conversion rates (RMB to US$) from xe.com.

cement, ship-making, electrolytic aluminium and glass industries. At least 500Mt of 'low-grade' cement production capacity will be phased out.

The central government decided to promote supply-side reform at the end of 2015. Eliminating outdated capacity is a top priority. However, Kong Xiangzhong, Vice President of China Cement Association (CCA), advised the government to provide certain compensation for the industry and establish a special fund to deal with the re-employment of redundant personnel and enterprise debts. This could slow the pace of reform.

The above provides some hope that the sector can be appropriately re-sized over the coming years. However, the steel sector may offer a warning. In 2013 Li Xinchuang, head of the China Metallurgical Industry Planning and Research Institute, said, "China should not add even a single new steel project for any reason," as he announced 80Mt of capacity to be cut. The amount of steel capacity that has since been added is around 100Mt, according to Free Radio Asia. If this scenario is replicated in the cement sector, the effect of all the government's efforts will be to slow down the rate at which China's cement mountain is growing. It could be a very long time until an appropriate amount of cement is once again 'Made in China.'

Right - Table 2: The top 20 cement producers in China in 2016 by installed production capacity. **Source:** *Global Cement Directory 2016.*

	Company	Plants	Capacity (Mt/yr)
1	Anhui Conch Cement	32	217
2	CNBM	69	132
3	China Resources Cement	16	63.1
4	Taiwan Cement	3	53.1
5	Sinoma	26	48.2
6	Tianrui Group	11	41.5
7	Jidong Development	7	31.1
8	Jiangsu Jinfeng Cement	1	30.8
9	Sunnsy Group	15	30.5
10	Lafarge Shui On Cement	24	28.5
11	Sichuan Esheng Cement	2	25.0
12	Jilin Yatai Group	6	22.6
13	BBMG Corporation	18	20.8
14	Huaxin Cement	11	20.3
15	Asia Cement China	4	17.2
16	Jiangxi Wannianqing Cement	4	16.6
17	Zhejiang Hongshi Cement	8	14.4
18	Shangfeng Cement Group	2	12.3
19	Hebei Quzhai Cement Group	1	11.6
20	Shandong Quanxing Cement	1	10.3
	TOTAL	**261**	**847**

Below: Cement plant silos being demolished in Hebei Province in 2014.

Chinese plant producers go west

Due to the slowdown in the Chinese cement sector, the country's cement plant producers have been looking overseas. In 2015 this included work in Myanmar, Pakistan, Turkmenistan, Kyrgyzstan, Tajikistan, Uzbekistan and Georgia. Dangote Cement alone commissioned Sinoma to build plants in eight African countries. In 2016 projects have been announced in Georgia, Chad, Tajikistan, Kenya, Nepal and Indonesia.

Some of the above countries are in some way historically or culturally linked to China, especially the former Soviet states in Central Asia. This may explain why Chinese companies seem to fare better than their European counterparts. The lower 'face value' cost of Chinese equipment compared to European manufacturers may also have helped Chinese manufacturers gain a hold in developing markets like those in Africa.

According to the *Status Report 2015/2016* of AGAB, the large manufacturing group of Germany's Verband Deutscher Maschinen- und Anlagenbau (VDMA), 82% of members surveyed said that the competitive pressure from China grew significantly between 2013 and 2016. 94% of participants saw increasing pressure from China in the near future, more than from any other country.

The AGAB report also showed the changing fortunes of the global cement sector. Its members' combined cement plant order volume fell by 75% between 2008 (Euro1.2bn) and 2015 (Euro306m). The 2015 figure was, however, a 54% improvement on 2014's Euro198m of booked orders.

However, on the other side of the coin, China remains a significant market for AGAB members, ordering Euro823m of equipment in 2015. This is enough to make it the association's fourth-largest market after Egypt (Euro2.6bn), the US (Euro1.3bn) and Russia (Euro1.2bn), and represents a 27% year-on-year fall compared to 2014. This is 71% less than the peak Euro2.5bn that AGAB members sold to China in 2008.

For more on the German cement sector, turn to Page 42 in this issue of Global Cement Magazine.

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Zimbabwe: PPC cement plant to be completed in 2016

Darryll Castle, the CEO of PPC, has reassured shareholders that the construction of the group's 0.7Mt/yr cement plant in Zimbabwe remains on schedule for completion in 2016. Castle said that the project makes sense from a cost-optimisation basis even if the volume isn't required in the country. He made the comments at PPC's extraordinary general meeting amid reports of rioting in Zimbabwe and import restrictions on some South African goods. The project is one of four cement plants that the cement producer is building in Africa outside of South Africa.

Egypt: Hazemag wins big El Arish order

The government of Egypt has ordered crushers and apron feeders from Hazemag for its El Arish cement plant. The agreement includes six HAF 22116 apron feeders with spillage conveyors and six HPI 2025 primary impact crushers, each for 1200t/hr of limestone with a feed size of up to 1500mm.

In addition Hazemag will supply six HAF 1480 apron feeders with spillage conveyors and six HRC 0816 double roll crushers, each for crushing 400t/hr of clay with a feed size of up to 500mm to D95 <75mm, as well as three HGI 1420 gypsum impact crushers for crushing 350t/hr of gypsum with a feed size of up to 800mm to D90 <40mm.

The cement plant has six new 6000t/day cement lines supplied by Chengdu Design & Research Institute of Building Materials Industry. The plant is expected to be completed in mid-2017.

Nigeria: Dangote to slow growth strategy as Naira devalues

Dangote Cement says that it will slow down its growth strategy in response to 'challenging' markets in Nigeria and the rest of Africa. Chief executive Onne van der Weijde made the comment in the Nigerian cement producer's financial results for the first half of 2016. The group now intends to focus on a five-year building programme to better balance funding and investment.

Dangote Cement's total revenue rose by 20.6% year-on-year to US$926m from US$768m in the same period of 2015. However, its earnings before interest, tax, depreciation and amortisation (EBITDA) fell by 10.2% to US$420m from US$468m.

"We have achieved a commendable result, given the very challenging situation in our main market and general economic weakening across Africa," said Onne van der Weijde. "The devaluation of the Naira will obviously have an impact on costs and our priority will be to protect margins." He added that the group was 'optimistic' that Nigerian infrastructure investment would soon increase demand for cement.

Dangote saw its sales volumes of cement rise by 59.5% to 13Mt from 8.1Mt. The bulk of sales, 8.77Mt, were in Nigeria, with fast increases in South and East Africa as operations in Tanzania started.

Mozambique: Capacity to nearly triple

Cement production capacity in Mozambique is expected to increase to 5.3Mt/yr by the end of 2016, up from 2Mt/yr, with the opening of three new cement plants. CIF-Moz and Limak Cements will be opening plants in the southern province of Maputo and Fabrica Cimentos de Cabo Delgado will be opening a plant in the north of the country. CIF-Moz is owned by the China International Fund and Limak Cements is owned by Turkey's Limak Holding.

Tanzania: Tanga Cement to inaugurate second production line

Tanga Cement plans to inaugurate its second clinker production line in mid-August 2016. The 0.8Mt/yr line will increase production capacity at the cement plant to 1.25Mt/yr. The company has spent US$125m on the upgrade. At the time of going to press it was reported that Minister for Industry, Trade and Investment Charles Mwijage was expected to attend the ceremony.

Qatar: US$100m plant to be built

Qatar National Cement Company (QNCC) has signed a financing deal with Saudi Arabia's Samba Financial Group (Samba) for US$100m. The facility, which has a two-year grace period, will go towards financing the construction of the company's fifth cement plant and should be repaid in three and half years.

QNCC signed a letter of intent with Fives FCB in 2014 to build the 5000t/day clinker production line at a cost of US$261m. The plant was expected to become operational within 27 months, according to local media. The company decided to build its fifth cement plant in response to an expected increase in demand in the run up to the 2022 FIFA World Cup being held in Qatar. In June 2016 QNCC also announced plans to close cement plant 1 with effect from the start of the month.

Jordan: Vortex appoints regional agent

Vortex Global, a US solids and bulk handling components company, has appointed Smart Systems for Factories Operation & Maintenance as its agent in Algeria, Bahrain, Egypt, Jordan, Lebanon, Libya, Morocco, Saudi Arabia, Sudan, Tunisia, Qatar and Yemen. Smart is a Middle Eastern supplier of dedusting systems, including industrial ventilations systems, shut off valves, loading spouts and filters.

Qatar: End of Saudi export ban will help projects

Saudi Arabia's decision to lift its cement export ban may help to meet Qatar's growing demand ahead of the FIFA World Cup 2022. Official data suggests that the peak demand for cement from Qatar's thriving construction and infrastructure industries is expected to reach 5.7Mt in 2017. Due to its population of around 2.2 million, this represents an incredible 2600kg/capita.

The Saudi government previously imposed a ban on cement exports in 2008 to push prices down and accommodate demand from large government-funded infrastructure projects, although some companies were allowed to export at prices lower than those in the local market.

According to market analysts, strong infrastructure spending by the Qatar government on infrastructure development will continue to boost demand for the cement sector. Huge projects are in the pipeline, including the Doha Metro, World Cup stadiums, roads and flyovers and sanitary works.

Saudi Arabia: ABB upgrades two Eastern Province lines

Swiss firm ABB has completed an electrical infrastructure upgrade for the Eastern Province Cement Company's two cement production lines at its plant in Al Khursaniya. The project upgraded the existing 75MV Switchgear Panels and integrated the power supply systems with the ABB 800xA automation system already in place. Commissioning was completed in February 2016.

Zambia: Lafarge rail deal

Lafarge Zambia and Zambia Railways have signed a transport agreement to improve the delivery of production inputs for cement production and to distribute clinker and cement products locally and to neighbouring countries. The deal is intended to complement other modes of transport, reduce reliance on roads and promote sustainability. The agreement will run for three years and is subject to renewal.

Nigeria: Sinoma wins more big Dangote deals

Sinoma International has signed two engineering, procurement and construction deals with Nigeria's Dangote Cement worth a total of US$370m.

The first project, worth US$281m, is to build a 6000t/day clinker production line for Okpella Cement, a subsidiary of Dangote based in Edo state. The scope of the contract covers limestone crushing to packaging cement for shipping. The project is expected to take 30 months to complete.

The second project, worth US$89m, is to build a slag grinding plant at Port Harcourt. The scope of the contract covers unloading slag and gypsum to packaging cement for shipping. The project is expected to take 20 months to complete.

Algeria: Prime Minister lays foundations

The Algerian Prime Minister Abdelmalek Sellal laid the first stone at the Industrial Public Group of Cements of Algeria (GICA) cement plant being built in Sigus, Oum El Bouaghi in early July 2016. Sellal said that his country had invested significantly in the cement sector and that Algeria would export cement by 2019. Polysius won the contract to build the US$310m 2.2Mt/yr cement plant in October 2015. Production will start in February 2019.

Burkina Faso: New CIMAF plant by end of 2017

CIMAF, a subsidiary of Morocco's Addoha Group, has started building a 0.7Mt/yr cement grinding plant in Bobo-Dioulasso. The plant will cost about Euro25m and will be completed by the end of 2017. CIMAF already operates a 0.5Mt/yr grinding plant in the capital Ouagadougou.

Ghana: Dangote steps up distribution

Dangote Cement plans to recruit 5000 workers following its procurement of 1000 trucks to distribute its products in Ghana. The cement producer has started recruiting drivers, truck driver assistants and loaders after the vehicles arrived in Ghana in early July 2016. The drive to build its distribution network complements the company's on-going efforts to build a 1.5Mt/yr clinker grinding plant in Takoradi.

Oman: Raysut's Duqm terminal coming in Q3

Raysut Cement Company's new cement terminal at Duqm Port is likely to start operations in the third quarter of 2016. Reggy Vermeulen, the port's CEO, said that the unit is currently at the pre-trial stage. Trials will take place in the third quarter of 2016 and operations could start in the same quarter.

Kenya: EAPCC to sell land

The East African Portland Cement Company (EAPCC) is waiting for cabinet approval to sell US$98.8m worth of land in Athi River.

The proceeds will be used to retire a US$37.5m debt and partly revamp its ageing plant, which requires US$400m of investment.

Here ***Global Cement Magazine*** presents its monthly review of global cement prices, in US$ for easy comparison. Much more price information (including the latest information on prices and market trends throughout the global cement industry from our price correspondents) is only available to subscribers of ***Global Cement Magazine***.

To get additional prices, you should subscribe - **See page 64**. In this issue subscribers receive more information from 11 more countries, including Kazakhstan, Egypt, Sudan, Cameroon, Ethiopia and Senegal.

India: The retail price of cement in Kerala has soared to over US$5.96/bag (50kg), causing discontentment among builders, who feel that the government must 'step in' as has happened in other states. Dealers have claimed that local producers are taking advantage of the situation in Kochi, as government-owned Malabar Cement has an effective monopoly in the local area.

Philippines: The Department of Trade and Industry (DTI) wants local cement producers to explain the recent surge in retail prices of cement in some key areas in the country.

DTI price monitoring reports showed prices of cement have been consistently high in Region XII, specifically in Cotabato City, where prices are US$5.94-6.11/bag (40kg).

In the National Capital Region, the DTI said cement prices range from US$4.77-5.05/bag while Cebu registered the lowest monitored prices at US$4.71/bag from January to March 2016, before slightly dipping to US$4.67/bag over the two months to July 2016.

The DTI has asked cement producers including Holcim Philippines Inc., Eagle Cement Corp., Lafarge Republic Inc., and Cemex Philippines to respond about the prices of their local brands Holcim Excel, Advance, Republic, and Rizal and Apo, respectively. Cement traders such as Bojourno Trading, Summit Koncrete Products Corp., and Cohaco Merchandising & Development Corp. were also requested to submit their respective response for the prices of the imported Halong, Thang Long and Conch brands.

"We are still waiting for the response from other local cement producers and traders. We will consolidate and review them to come up with concrete actions to ensure that prices of cement are kept at reasonable levels. Meanwhile, we will continue to closely monitor the prices of cement to check for any further movement," said a DTI representative.

Nigeria: The price of cement rose rapidly in some regions of Nigeria in the second quarter of 2016, despite Dangote Cement slashing its prices in the early part of the year.

However, in locations such as Egbeda, Igando, Ogba, Agege, Sango and Ikeja (Lagos), a bag of cement now sells for between US$4.91-6.34/bag (50kg) across all brands. The earlier Dangote price was just US$4.12/bag.

The new prices have slowed down housing construction, real estate activities and increased the prices of other building materials in the areas affected. For instance, manufacturers of cement-based materials, such as ceiling boards, roofing sheets and concrete products like paving stones, have also hiked their prices.

Algeria: The average import prices of cement imported by Algeria fell in the first quarter of 2016 compared to the same period of 2015, according to the Trade Ministry.

Oman: Oversupply in the neighbouring United Arab Emirates is having a long-term effect on the price of cement in Oman. Domestic cement prices have fallen by 3.1% at an eight-year compound annual growth decrease rate from US$80.26/t in 2008 to US$64.42/t in 2015.

Prices are for cement in metric tonnes, unless stated otherwise. Where a source has given a range, the published price is the minimum value.

FOB {+ the named port of origin} = Free On Board: The delivery of goods on board the vessel at the named port of origin (loading), at seller's expense. Buyer is responsible for the main carriage/freight, cargo insurance and other costs and risks.

CIF {+ the named port of destination} = Cost, Insurance and Freight: The cargo insurance and delivery of goods to the named port of destination (discharge) at the seller's expense. Buyer is responsible for the import customs clearance and other costs and risks.

ASWP = Any safe world port.

Conversions to US$ from local currencies are as at the time of original publication.

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We ignore geology at our peril...

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

I originally trained as a geologist, and gained a PhD in mineralogy and geochemistry (studying lignites in Northern Ireland) a long time ago. It's been useful in many ways, not least to give me some insight into the relative magnitudes of things, be they time scales (3.8 billion years since life first evolved), physical scales (the difference between a microgram and a milligram) or the severity of earthquakes. The Richter Scale[1] of earthquake intensity is logarithmic, meaning that for each increase in scale of 1, the shaking, in short, will be ten times bigger. A Richter scale 9 earthquake is 100 times 'bigger' than a Richter scale 7 earthquake (which is already considered a major earthquake).

A recent article[2] has pointed out in graphic detail that the Pacific North West of the US and Canada is now very likely to suffer a 'really big' earthquake: It may range up to and possibly beyond a magnitude 9 earthquake, with continental-scale catastrophic consequences. This counts as one of those 'known unknowns' that the futurologists like to prognosticate upon.

The Cascadia subduction zone is a portion of the continental margin where the Pacific ocean seafloor is slowly sliding under the continental crust. As the oceanic plate descends into the hot Mantle of the interior of our planet, it heats up and melts, creating lava-lamp like blobs of hot molten rock that rise up through the Earth's crust and create volcanoes - like Mount Saint Helens. However, the portion of the Cascadia subduction zone between California and Vancouver Island in Canada (approximately) is stuck - and has been for the last 316 years, since 9pm on 26 January 1700. The scientists worked this out from the oral histories of native Americans, from dating the demise of groves of long-dead trees and from the arrival in Japan of an 'orphan tsunami' - one that arrived onshore with no previous shaking - on the morning of the 27 January 1700 - having taken 10 hours to cross the Pacific.

Looking back at seafloor sediments, the scientists have worked out that the subduction zone moves on average every 243 years (creating underwater landslides that leave a signature trace in the sedimentary record). This portion of the seafloor subduction zone has been stuck since 1700AD, with stress building up since that time. The zone is now 66 years beyond its average date of release: Scientists suggest that' 'the odds of [a] big Cascadia earthquake [8.0-8.6] happening in the next fifty years are roughly one in three; The odds of [a] very big one [8.7-9.2] are roughly one in ten.'[2] The problem is, the longer that the release of tension does not happen, the worse that the final outcome will be.

According to the Mercalli Scale[3], at Richter scale events around 8, few, if any, (masonry) structures remain standing, bridges are destroyed, broad fissures occur in the ground, underground pipelines are completely out of service, earth slumps and land slips in soft ground, while rails are greatly bent. At this level of destruction, structures built of reinforced concrete will certainly be safer than others built of flimsier stuff such as brick and wood. However, at Richter scale events much beyond 8 (that is to say, in all scenarios for the eventual release of the Cascadia subduction zone), objects are thrown upwards in the air, waves are seen on the ground surface, and damage is 'total.' The forecast in this situation is for total devastation.

After the initial shockwaves and seismic destruction, landslides (30,000 are expected in Seattle alone) and fires will then take their toll. On top of this, a very major tsunami is expected to hit the coasts of the US (and of Japan), ranging in size from 6m to 30m in height. Japan's magnitude 9 Tohoku earthquake of 2011 killed 18,000 people and cost around US$220bn - we all remember the horrifying images of the tsunami, relentlessly advancing and destroying everything in its way. The Sumatra-Andaman earthquake and 'Boxing Day tsunami' of 2004[4] caused by a 9.1-9.3 scale earthquake, killed 230,000.

Around 70,000 people live in currently designated 'inundation zones' on the US northwest coast. Many more people visit them (for example the popular beaches of Oregon, where 150,000 might visit on a summer weekend). The Federal Emergency Management Agency (FEMA) has suggested that it may take at least 1-2 months to supply electricity and up to a year to restore water supplies to the previously well-populated areas hit by the disaster.

Enough doom and gloom, for now. The fact is, we know that this disaster will befall us (like the present-day inhabitants of the slopes of Vesuvius and of the city of Naples), but we are content to live in these places and do next to nothing. We humans: how odd we are.

1 http://www.sms-tsunami-warning.com/pages/richter-scale

2 http://www.newyorker.com/magazine/2015/07/20/the-really-big-one

3 https://en.wikipedia.org/wiki/Mercalli_intensity_scale

4 https://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake_and_tsunami

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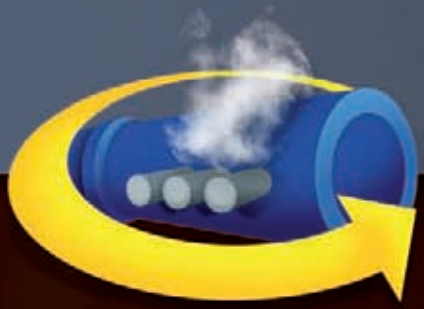

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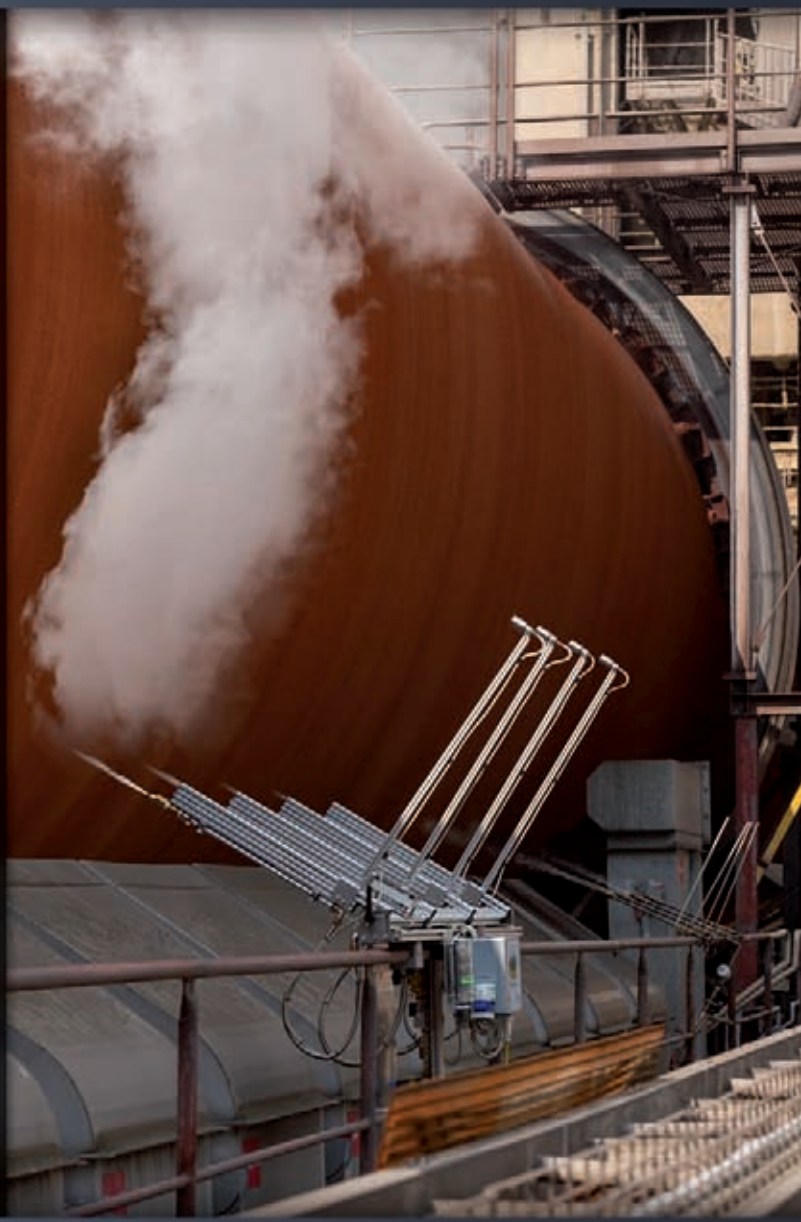

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