CEMENT & BUILDING MATERIALS REVIEW

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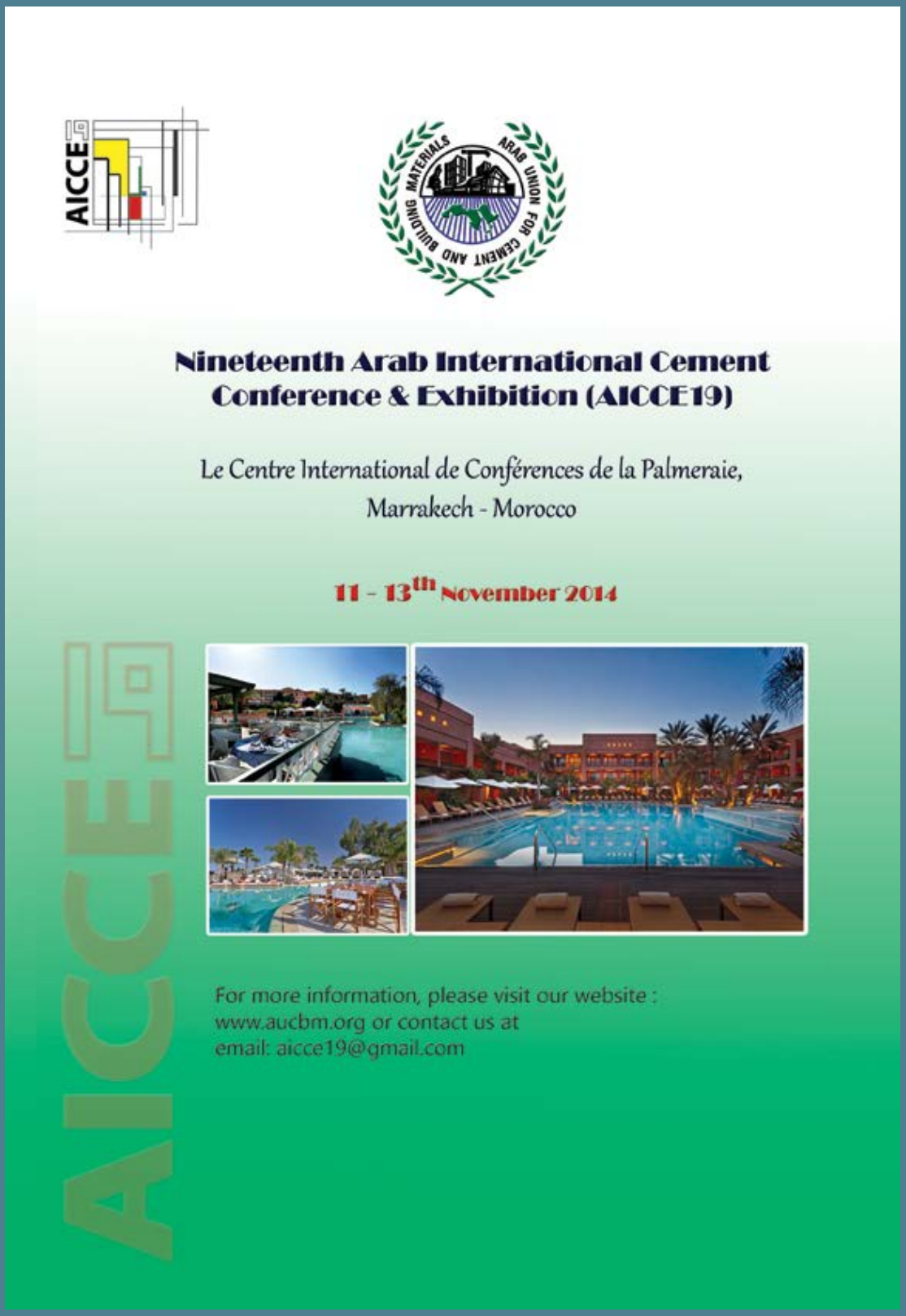


ARAB UNION FOR CEMENT AND BUILDING MATERIALS

Cement and Building Materials Review

Editor-in-Chief Eng. Ahmad AL-Rousan

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NEW PROJECTS AND EXPANSIONS

SAUDI ARABIA

ABB completes upgrade at Eastern Province Cement Company

ABB has completed a process control system upgrade to three cement production lines at Eastern Province Cement Company (EPCC) in Al Khursaniya, Saudi Arabia. Power and automation technology supplier ABB updated the Extended Automation System 800xA to the latest standards.

The scope of supply included the updating the Extended Automation System 800xA licences, computer, laboratory and raw meal proportioning system hardware, as well as project management, engineering and site services, including training. The modernisation follows a previous process control system upgrade of the production lines number one and two in 2003, as well as equipment deliveries for the extension of the plant with line number three in 2005. The contract was booked in June 2013. Commissioning was completed in December 2013.

Source: Global Cement News

Najran Cement launches trial operations at WHR power plant

Saudi cement producer Najran Cement said that it launched trial operations of the first phase of its waste heat recovery (WHR) on 11 January 2014. The US$45m WHR project is being installed by China's Sinoma Energy Conservation on a turnkey basis.

Source: Global Cement News

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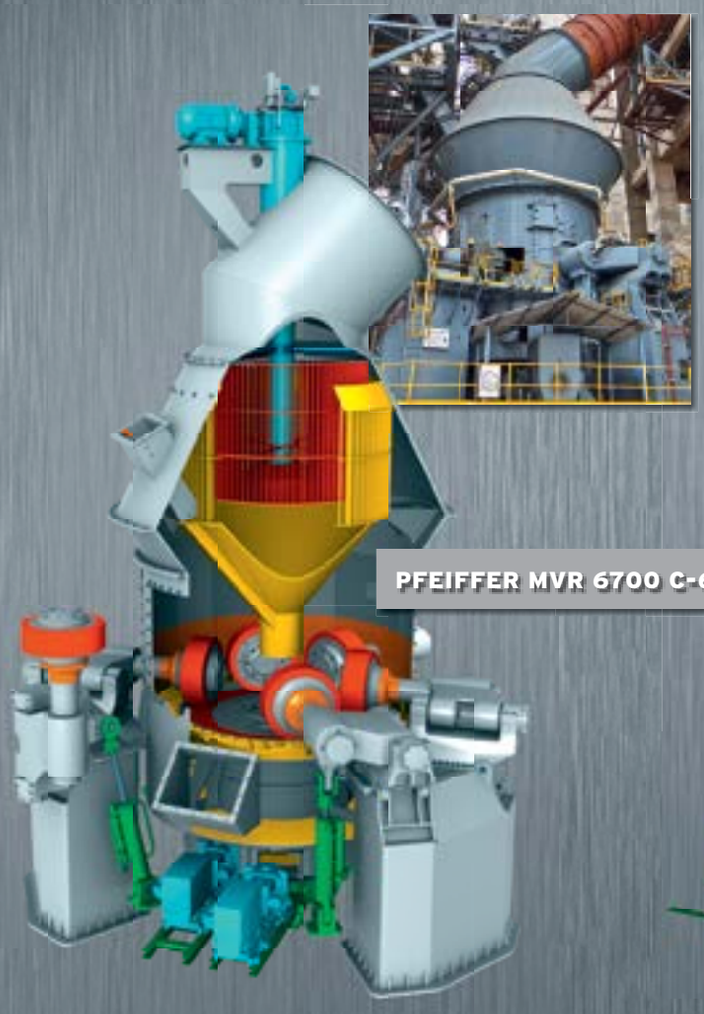

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ARAB CEMENT COMPANIES' NEWS

EGYPT

Egypt's ASEC Cement looking to exit Algeria venture
Firm has expressed desire to divest its stake in Zahana venture to focus on other investments.

Source: CemWeek.com

KUWAIT

Kuwait Cement reports 2013 profit
Kuwait Cement Company announced higher 2013 profits, with net profit registering KWD 17.16 million, an increase of 16%.

SAUDI ARABIA

Al Jouf signs clinker supply agreement with Jordanian producer

Saudi cement producer and trader Al Jouf Cement announced that it has signed a SAR28m (US$7.5m) agreement with Jordan-based Al Rajhi Cement, under which the latter will supply clinker to Al Jouf Cement.

Saudi's SPCC signs financing agreement
NCB supports the company with 700 million riyals.

Source: CemWeek.com

Najran Cement 2013 Results
Najran Cement Company announced its profits for the year 2013, which registered SAR 198.14 million, a decrease of 2.0%.
Source: Gulf Base

Saudi cement sales fell by 3% in February 2014
Data from a recent report released by online financial information company Argaam Business Info (ABI) has revealed that cement manufacturers in Saudi Arabia witnessed a 3% y/y fall in sales in February 2014. Monthly sales stood at 4.59 million t, compared to 4.74 million t in the same month a year earlier.
Ten out of 14 cement firms operating in Saudi Arabia reported a fall in sales in February 2014. Sales of Jouf Cement Company (JCC) and Najran Cement Company (NCC) decreased by 26% and 24%, respectively. However, the report additionally noted that during the period under review sales of Arabian Cement Company

(ACC) and Safwa Cement Company (SCC) grew by 41% and 6%, respectively. Total clinker production of the 14 manufacturers increased by 5% y/y to 4.07Mt during the month.

Source: World Cement

Qassim Cement Gross Profit 2013 Rises

Qassim Cement Company, QCC, stated that its annual gross profit increased by 5% in 2013 to SAR 644 million (USD 171.7 million) from 2012.
The company's net profit increased by 4.2% in 2013 to SAR 584.6 million from the previous year.

Source: Cedar Rose News

UNITED ARAB EMIRATES

Steel, cement prices stable in UAE

Prices of key construction commodities such as steel and cement continue to hold despite the frequency of new project tenders coming to the market in recent weeks, industry sources confirm.

Source: Gulf news

RAK Cement Corporate Announcements

Ras Al Khaimah Cement Company announced its profits for the year 2013, with net profit registering , AED 7.88 million, compared to a loss of AED 7.26 million for the same period last year.

Source: Gulf Base

RAK White Cement profit in FY13

Ras Al Khaimah Co. for White Cement and Construction Materials released financial statements for FY13 which reflected net earnings of AED 50.859.499, compared to AED 37.800.756 in FY12. Net operating income reached AED 33.993.027, compared to AED 35.585.125 in FY12.

Source: Mubasher Info

Fujairah Cement Company's 2013 results

Fujairah Cement Company announced its results for the year 2013. Net loss announced is AED 12.19 million, compared to a net profit of AED 35.16 million for the same period last year.

Source: Gulf Base

Arkan posts 2013 profit of Dh42.76m

Arkan Building Materials Company announced that its net profit for 2013 reached Dh42.76 million compared to a net profit of Dh46.97 million during the previous year. Arkan's revenue from Emirates Cement Factory was Dh166.45 million compared to Dh182.49 million in the previous year. It stated that in spite of the intense competition in the market, the company managed to maintain its sales volume during the year.

Source: Gulf News

Union Cement 2013 results

Union Cement Company announced its results for the year 2013. Net profit announced is AED 40.81 million, a decrease of 16%.

Source: Gulf Base

Dubai's National Cement 2013 Resutls

Dubai-based National Cement Company PJSC, NCC, stated that its gross profit increased by 34.4% in 2013 to AED 36.8 million compared with 2012.

NCC's net profit increased by 32.5% in 2013 to AED 90.5 m

The first 2 Vertical Roller Mills for Cement Grinding in the Kingdom of Saudi Arabia will be supplied by Loesche

Similar mill type LM 56.3 + 3 installed in Dadri, India

Southern Province Cement Co. (SPCC) is building a new brown field cement line in Bisha, Kingdom of Saudi Arabia with a clinker production capacity of 5,000 tpd. The complete plant delivery and execution has been contracted to China National Building Materials Group Corporation (CNBM) from China.

Bisha - As a pioneer within the Saudi Arabian Cement Industry, SPCC decided to install and operate the first two (2) vertical roller mills for cement grinding in the Kingdom. Those two (2) cement mills are both LOESCHE Type LM 56.3 + 3 with a rated capacity of a minimum of 200 tph.

Amongst SPCC'S very good experience with their LOESCHE mills in operation (2 cement raw material mills at their Tahamah site and a 3rd one under erection), a very low specific energy demand of the milling system and the vast experience of LOESCHE with more than 300 vertical roller mills for cement grinding sold worldwide, were major decision factors to trust LOESCHE for the supply of the first vertical roller mills for cement grinding in the Kingdom of Saudi Arabia.

In addition to that, SPCC wanted to be ready for a changing market, requiring not only simple OPC cements but also various types of additive cements with a wide band of different product finenesses.

LOESCHE vertical roller mills are ideally designed for such demands, guaranteeing a quick and simple changeover from one product to another and at the same time ensuring an energy efficient production for all cement types required.

For the grinding of cement raw material SPCC has also decided in favor of a LOESCHE vertical roller mill, type LM 56.4.

Due to the unique modular design concept of LOESCHE vertical roller mills, the major spare parts for the two cement mills are identical with those required for the new cement raw material mill at Bisha site as well as for the existing mills at the Tahamah site, keeping the spare parts demand for SPCC to a minimum.

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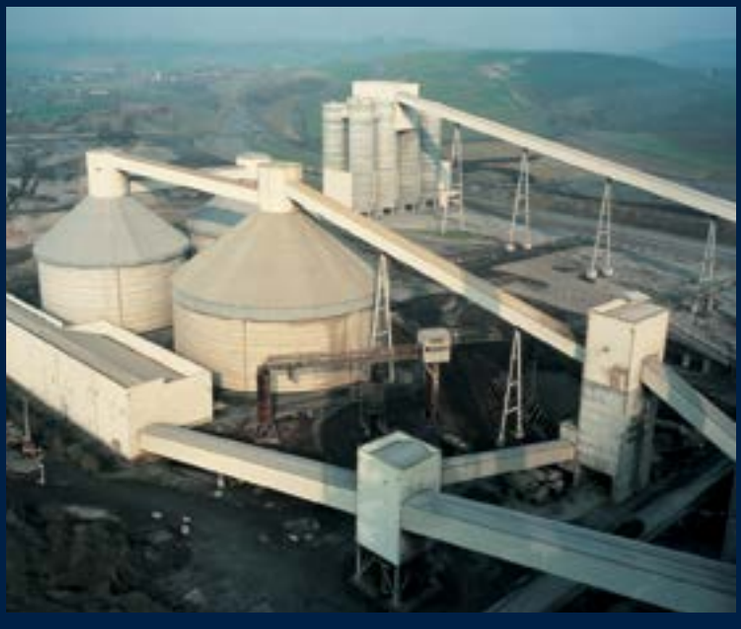

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Mondi's industrial bags plant in Casablanca successfully ISO 9001 certified

Casablanca, February 3, 2014 – Mondi's industrial bags plant in Casablanca has been successfully certified according to ISO 9001:2008 for quality management systems. This adds to the OHSAS 18001:2007 certification that it obtained in 2012 as first industrial bags plant in Morocco.

"We are extremely proud to have achieved the ISO 9001 certification and it complements our OHSAS 18001 certification", states Hicham Jalal, Managing Director Mondi Industrial Bags Morocco. "With this step our plant in Casablanca further strengthens its position in producing industrial bags for the national and international markets. We are striving to provide our customers with high standards of product quality and processes", explains Jalal. "Over the past years, we have clearly shown the commitment to set high standards for industrial bags. We invested in a high-speed production line in 2009 – the world's fastest at the time with 360 bags per minute, we are sourcing high performance paper, we are introducing bag innovations to our markets and now achieved this certification," he elaborates.

ISO 9001:2008 specifies requirements for a quality management system where an organisation needs to demonstrate its ability to consistently provide products that meet customer and regulatory requirements. The standard aims to enhance customer satisfaction through the effective application of the system, including processes for continuous improvement of the system.

About Mondi Industrial Bags

Mondi Industrial Bags, a business segment of Mondi's Europe & International Division, is the leading international producer of industrial paper bags[1], selling around 4 billion bags per year. Thanks to its broad range of bag specifications, Mondi Industrial Bags serves major industries including cement and building materials, chemicals, food, feed and seed. The business segment operates a dense sales and service network, the specialised filling equipment department Natro Tech, as well as its Bag Application Centre, where researchers develop and test innovative packaging solutions.

About Mondi

Mondi is an international packaging and paper Group, with production operations across 30 countries and revenues of €5.8 billion in 2012. The Group's key operations are located in central Europe, Russia, the Americas and South Africa and as at the end of 2012, Mondi employed 25,700 people. Mondi Group is fully integrated across the packaging and paper value chain, from the growing of wood and the production of pulp and paper (packaging paper and uncoated fine paper), to the conversion of packaging paper into corrugated packaging, industrial bags, extrusion coatings and release liner. Mondi is also a supplier of innovative consumer packaging solutions, advanced films and hygiene products components. Mondi Group has a dual listed company structure, with a primary listing on the JSE Limited for Mondi Limited under the ticker code MND and a premium listing on the London Stock Exchange for Mondi plc, under the ticker code MNDI. The Group has been recognised for its sustainability through its inclusion in the FTSE4Good Global, European and UK Index Series (since 2008) and the JSE's Socially Responsible Investment (SRI) Index since 2007. The Group was also included in the Carbon Disclosure Project's (CDP) Carbon Disclosure Leadership Index for the third year and in CDP's Carbon Performance Leadership Index (CPLI) for the first time in 2012.

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[1]*Based on sales volume. Source: Eurosac, Freedonia World Industrial Bags 2011 study prepared for Mondi and management estimates.*

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EKO KILN – The best Sacmi firing technology
New EKO kiln started up successfully

The EKO Kiln is the most technologically advanced member of the Sacmi single-layer kiln family. With a channel width of almost 3 metres and a length of over 120 metres, the EKO kiln with self-recovery burners is the machine that best defines the Sacmi Group's corporate philosophy of great design, quality and technology.

With the EKO, in fact, both energy consumption and installed electrical power are lower, colour and size are more consistent and in-atmosphere fume and CO2 emissions have been reduced by 30%. The percentage of total recovery with respect to an FMS kiln which already has an XTR recovery system may be as high as a further 10% (from burners and cooling).

This impressive result is made possible by the unique work pattern of the machine. Above 900°C, where heat exchange occurs mostly by radiation, the EKO kiln consists of a series of thermal modules known as 'heat cells' in which fumes exchange thermal energy with the material in a way that is, compared to traditional kilns, optimized (transversal flow and increased fume hold time in the firing chamber). Fume evacuation occurs in the cell itself, ceding part of the residual thermal energy to the ceramic heat exchanger inside the burner which, in turn, intensely pre-heats the combustion air (up to 700°C). The average temperature of the evacuated fumes is less than 200°C. Below 900°C, instead, where heat exchange occurs by convection, conventional free-flame burners are installed, the fumes of which are extracted by a flue at the head of the kiln.

Yet perhaps the most interesting aspect of this machine concerns fume control. Compared to a traditional kiln, the EKO releases smaller volumes of exhaust fumes into the atmosphere, thus reducing CO2 emissions per kg of fired product. On the first installations detected fume volumes have been about 30% less than on traditional kilns. Summing up, then, with the EKO solution there are fewer pollutant fumes to be purified and filtration systems are therefore more compact.

Lastly, the EKO kiln is run by a sophisticated control system featuring a dual touchscreen interface. The traditional temperature regulators are now gone and process control occurs by way of innovative temperature-pressure curve control.

Attentiveness to the environment, the product and consumption are Sacmi's key machine design musts. Yet they are also the prime objectives of today's ceramic companies when they make investment decisions - companies like Edimax, which, with a long history of technological innovation, product quality and environmental attentiveness, has decided to equip its plant with an EKO kiln which is now fully operational.

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How a clinker cooler can make your life easy

By: Claudius Peters, Germany

Easy life in a cement plant means fewer repairs and less maintenance. But easy life means as well to produce the clinker in the cheapest way, but reaching the quality demands of your clients. One big cost factor in the cement plant is the energy consumption to burn the clinker. Reducing these costs will give you an advantage against your competition, will help you to sell your cement and will make your life much more relaxed.

But how can a clinker cooler, just one machine in your process, help you?

The success story
Nearly 10 years ago the first Claudius Peters ETA cooler was successfully put into operation. This milestone is a moment of celebration and general reflection of the past with its evolution of the cooler and to report on the experience of 47 ETA coolers currently in operation (beginning of March 2014).

In 2004 the first ETA cooler was commissioned at Holcim Siggenthal, Switzerland. At that time, the ETA cooler was the 1st clinker cooler, which operated according to the moving floor principle.

Since then in total 66 ETA coolers have been awarded to Claudius Peters. Today ETA coolers are in operation all over the world in all types of conditions imaginable ranging from clean and clinical to extremely harsh. This year so far Claudius Peters has received 2 ETA coolers orders (beginning of March 2014), which will be supplied to China. One will be an installation under 5° inclination to use the existing foundation of the old cooler. This shows that the new ETA cooler type is accepted in a wide range of markets and can be adapted to various brown field situations. Especially Holcim and Anhui Conch Cement make the ETA cooler their preferred choice.

Messrs. Anhui Conch Cement is a rising star in the Chinese cement sky with cement sales of 187 mio t in 2012 making it a top member of the world's largest cement producers. Over the past few years Anhui Conch Cement has ordered 20 ETA coolers with CPP, with the largest ETA cooler having a capacity of 12,000 t/d to be commissioned shortly.

Easy life
Claudius Peters can look back on a successful and longtime experience with grate coolers. More than 750 coolers have been commissioned by Claudius Peters worldwide.

In general, these grate coolers have a low kWh requirement for the cooling fans. Furthermore, these coolers require relatively few hydraulic cylinders compared to modern coolers; however, this leads to a reduced flexibility. At first sight low kWh and fewer cylinders, sounds like lower operating costs and less maintenance and repair, so why moving from grate to ETA cooler?
There are two reasons:

1) Higher efficiency
2) Less repair and maintenance

But how is this possible?

Easy life due to higher efficiency – how to safe 450.000 € costs a year
The grate coolers are characterized – due to the aeration system – by a low number of cooling air fans. But grate coolers are limited in their efficiency. Only in ideal circumstances can these coolers achieve efficiency degrees of up to 74 – 75 % at a recuperation air quantity of 0.85 Nm^3/kg clinker. We will see later that this is not state-of-the-art any more.

After 50 years of experiences with grate coolers Claudius Peters recognized that this technology had reached an end-point. It was time to take advantage of new developments with a future-oriented machine, which led to the creation of the ETA cooler with its economic advantages. Today's ETA cooler users have reaped those energy-saving benefits – among many more.

Due to the type of construction grate coolers have a lower clinker transport efficiency leading to a relatively high number of strokes (approx. 13 – 20 strokes per minute). Grate coolers can only be operated with a relatively low clinker bed of up to max. 600 mm. This low clinker bed leads to a low pressure loss and consequently low energy need of the cooling air fans but unfortunately, also to a low thermal efficiency. Finally, the high number of grate strokes leads to a higher wear inside the cooler.

In principle, the thermal efficiency depends on the clinker distribution over the grate width and how the cooling air is brought into the clinker over the whole clinker bed width.

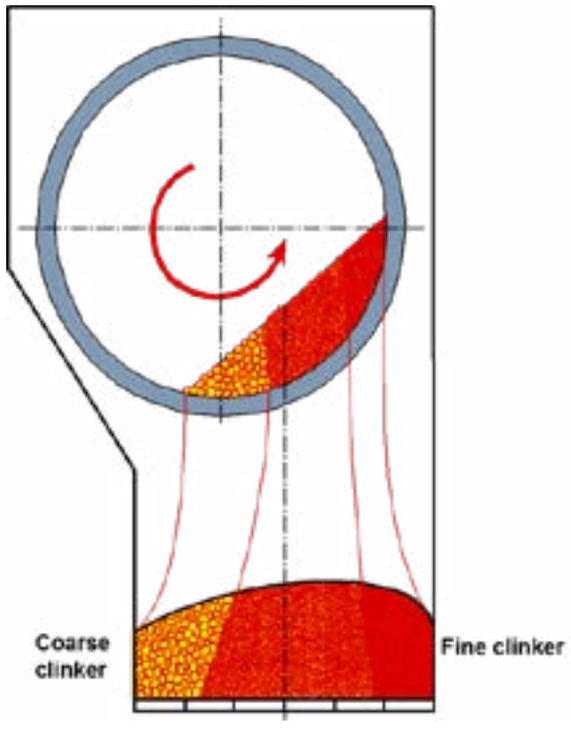
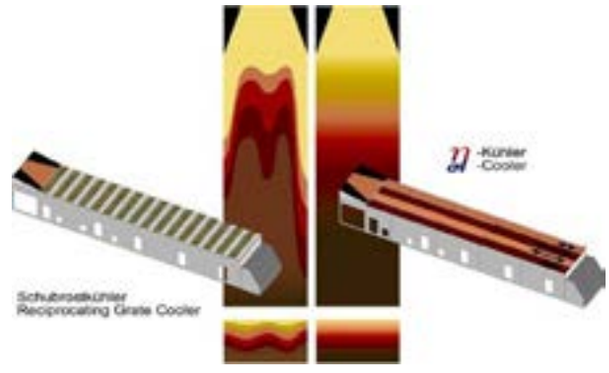


Fig. 1: Clinker distribution over the grate width.

Already starting at clinker bed heights of approx. 300mm the uneven clinker distribution over the width of the clinker bed leads to different cooling air flow resistances inside the clinker. This leads to higher air penetration on the coarse side and lower on the fine side resulting in a lower heat transfer on the fine clinker side. Due to this effect the fine side has more red hot clinker. Both these consequences reduce the thermal efficiency of the grate cooler.

During the last stages of the grate cooler development life we tried to minimize the aeration fields in the cooler to achieve a more homogenous air distribution. This led for some time to more complex grate cooler designs having more direct cooling air to critical areas. But these designs with their complex pipe routings tended to be too elaborate. In the end, the last CP grate coolers were a compromise of the simple chamber aeration in combination with a reduced amount of direct aeration. The disadvantage in the grate cooler design is the missing intervention possibility to reduce the red river effect. A red river reduces the thermal efficiency and leads to increased wear of the grate plates, lateral sealings and the crusher. Fig. 2 shows a typical temperature distribution of a grate cooler and an ETA cooler.

Fig 2: Temperature distribution of the clinker on a



grate cooler and on an ETA cooler

As a result of certain operating conditions of the kiln the red hot clinker can reach in grate coolers the crusher and lead to excessive thermal stress.

In addition to these operational disadvantages of the grate cooler all product developments need to take maintenance and repair costs into account. The grate cooler design had its limitation for further cost reductions.

With the launch of the ETA cooler benefits on these operations cost side could now also be found and realized.

Customers who decided for the ETA cooler had to rethink! They recognized that a high thermal efficiency can only be achieved by means of a high clinker bed. With a clinker bed of 800 – 1000 mm and its clever air distribution an efficiency of 78 % at 0.85 Nm³/kg clinker can be achieved. This 3 % higher

efficiency -compared to grate coolers- leads to fuel savings of approx. **€ 450.000 per year** when having a fuel price of 3 € /GJ and a plant capacity of 5,000 t/d.

The ETA cooler distinguishes itself by a high flexibility when using secondary combustibles, which have been confirmed several times by experts to us. The ETA cooler produces a hotter recuperation air, which results in a faster ignition and a better burnout. The short sinter zone leads to better clinker characteristics.
In the plant Untervaz, Switzerland, savings of 3 kWh/t could be determined for the cement grinding process.
This flexibility is achieved by using relatively more cooling air fans in the recuperation zone.
Fig. 3 shows a typical aeration scheme of the ETA cooler.

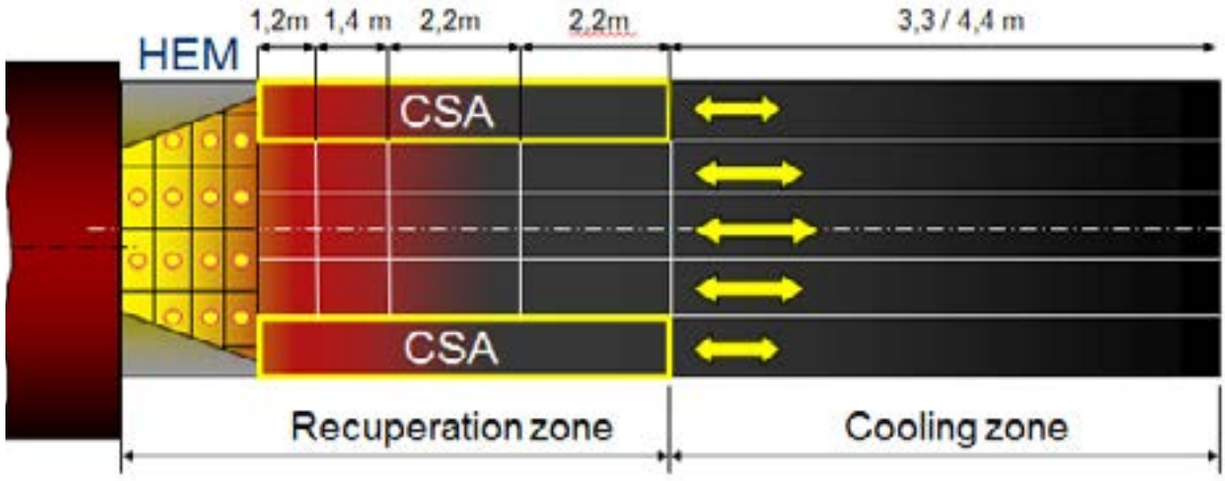


Fig. 3: Typical ETA Aeration scheme.

The ETA cooler starts with a static grate, which is aerated by up to 4 fans depending on the cooler size and followed by the lane area with 4 relatively small chambers. The outer lanes are aerated separately. This simple design targets directly the area where a red river could occur with grate coolers. The fight against a red river is supported by the possibility to adjust the number of lanes and the mode of operation of each lane individually. No grate cooler can offer this chance to any operator.

The variable stroke lane length -together with a clever arrangement of the aeration fields- prevents sticking of hot clinker. This sticking of clinker is a reason why grate coolers cannot be operated with a higher clinker bed. Kiln operators who know and use this possibility are convinced of these advantages.

Easy life – relax instead of repair
How an ETA can come with a 5 year warrantee on nearly all of its parts? It's easy: the low stroke velocity reduces the wear. Furthermore only 7 % of the lane surface is in contact with the clinker. During the first 5 years the operator of the ETA cooler in Siggenthal determined a spare part requirement of 0.012 €/tclinker.

Fig. 4: ETA Cooler Siggenthal at installation/after 4 years/after 7 years

Fig. 4 shows the ETA cooler in Siggenthal from left to right side before commissioning, after 4 resp. 7 years of operation, even the original anti-corrosive paint is still recognizable. A reliable sign that the values obtained in Siggenthal are not an exception, but the rule as more and more customers confirm.

The operating safety of the ETA cooler is guaranteed due to the fact that each lane is equipped with an own hydraulic drive. This leads to the fact that even in the rare case of a breakdown of several lanes the cooler could still be operated with nominal capacity. The transport efficiency of the ETA cooler exceeds easily that of other cooler types. A cylinder break down with a grate cooler would lead to a kiln stop and loss of production.

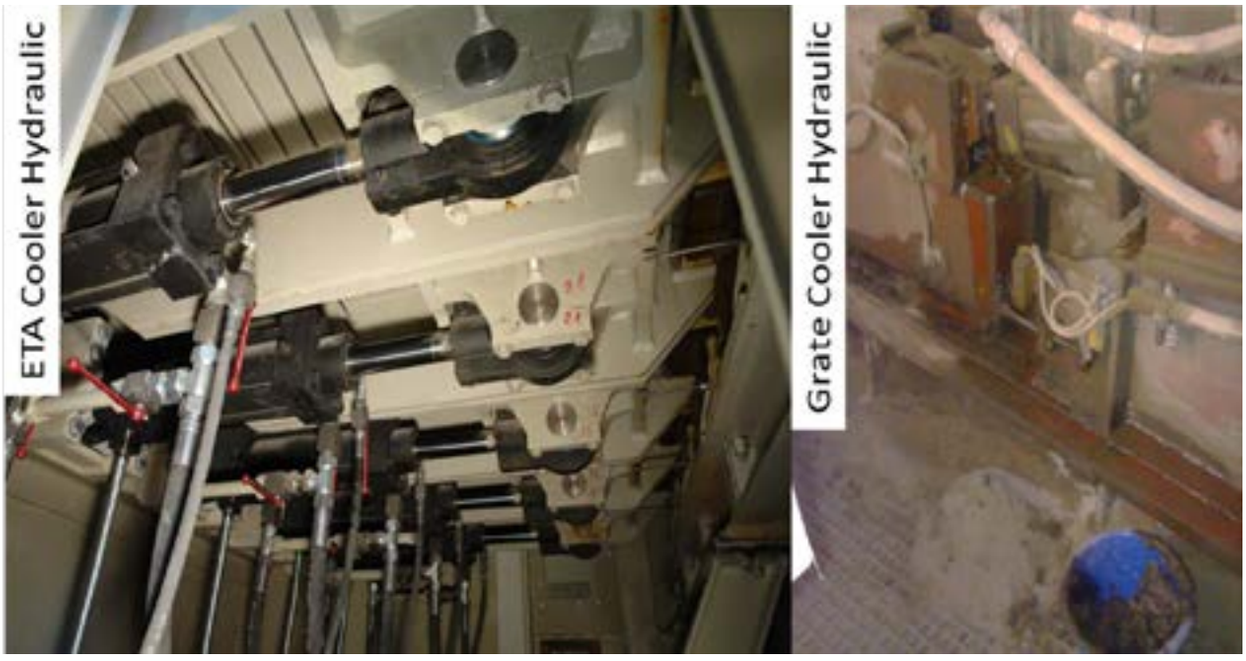


Fig. 5: Comparison ETA Hydraulic and Grate Cooler Hydraulic

At the left side fig. 5 shows the hydraulic cylinder located in a grate riddling free chamber. At the right side the drive of a grate cooler which is often covered by clinker dust. The hydraulic cylinders located in the center are dust resistant. They have an internal flushing of the sealing as well as reliable sealing materials. A cooler breakdown caused by dust at the hydraulic cylinder is nearly excluded.

The easily accessible heavy duty roller in the chamber is similarly protected as the hydraulic cylinder.

Fig. 6: Lane support inside chamber with heavy duty roller.

These rollers are extremely maintenance friendly and up to now no roller has been exchanged.

Relax even more

As described before, the ETA cooler requires a larger number of cooling air fans compared to a grate cooler of the same size. This apparent disadvantage is compensated by a significantly lower cooling air quantity as shown below at the example of the plant Untervaz. This low cooling air quantity does not only reduce the kWh requirement, but also the size of the cooler exhaust air filters and fans.

The ETA cooler goes along with lower

investment and operating costs of the exhaust air treatment. Further savings are made because no hoppers and clinker transports below the cooler are necessary. Fig. 7 shows that e. g. the kiln foundations and the heat exchanger towers are smaller and can therefore be carried out faster. The same applies for the burner platform. The elimination of drag chains, undercut gates or mechanic pipe conveyors reduces additional maintenance.

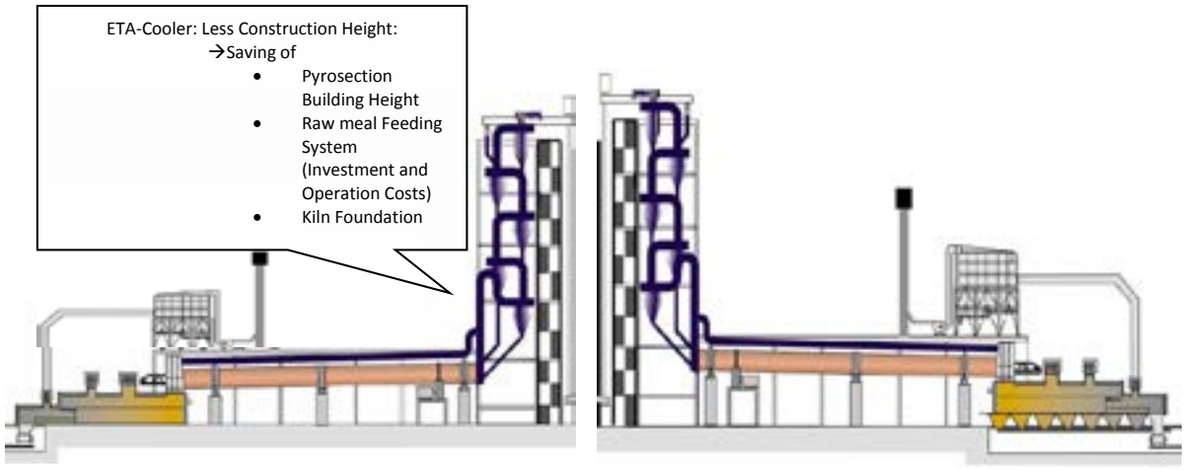


Fig. 7: Comparison Installation ETA versus Grate Cooler

Relaxing reality

Anhui Conch Plant Chongqing

In June 2010 the first ETA cooler was commissioned at Conch. In October 2011 a common inspection was carried out. The guaranteed capacity of 5,500 t/d has been surpassed and 5,919 t/d could be achieved. The guaranteed outlet temperature of 65 °C above ambient was surpassed by 10 °. The cooler efficiency degree of 78 % at 0.87 Nm^3/kg clinker was outperformed and we could even achieve 79.8 %.

For Conch the Chongqing cooler is considered as an internal benchmark. Due to this reason Conch awarded further 6 ETA coolers to Claudius Peters within the first half-year 2013.
Holcim Untervaz

Like Anhui Conch Cement, Holcim is also a supporter of the ETA cooler technology. In 2012 a new ETA cooler was installed at the plant Untervaz. The following table shows the performance test values and why the ETA cooler prevailed over the competitor.

Fig. 8: Pictures of HOLCIM Untervaz

Performance (during official 18 days performance evaluation)		
	Design	Operation
Capacity [t/d]	1950	1917
Clinker Outlet [°C above suction temp.]	90	52
Cooling Air Amount [Nm³/kg cl.]	1,670	1,482
Cooler Efficiency [%]	74,0	75,8
Spec. el. power consumption cooling air fans [kWh/t]	5,3	4,39

Table 1: Results of the performance test.

This plant has high efficiency degrees too and remarkable low cooling air quantities. In October 2013 the ETA Cooler for HOLCIM Philipines at La Union plant was commissioned successfully with a cooler efficiency of > 75% at 0,85 Nm³/kg clinker.

Just relax, you too

When considering investment and operating costs for coolers it is critical not to only consider the energy requirement but also its impact on peripheral units within the complete kiln line. The right economic decision can only be taken when looking at the complete system. The return of investment is short for an ETA cooler due to its high thermal efficiency, low amount of cooling air, high availability and minimization of costs for components and erection.

Taking all this into account it has been the right decision of Claudius Peters and the current cement plant operators and owners to focus on this new future-oriented technology. Grate coolers may have a few sole advantages, but the future belongs to the new clinker cooler generation with its combined benefits for the whole cement plant.

Picture 9: Relaxed part of Claudius Peters clinker cooler team on top on world's largest roller crusher in our workshop in Buxtehude/Germany.

KRONEX® 20 / REFRACLAY 25 series An innovative refractory concept meeting today's challenging demands in the cement industry.

By: Dipl. Geol. Stefan Schwarz, Technical Sales Manager Middle East and Dipl. Min. Dirk Basten, Manager Project Department, both Refratechnik Cement GmbH

In the light of rising energy costs and environmental regulations, factors such as energy savings, usage of alternative fuels and decrease in pollution are becoming more and more main topics in the daily cement industry's business. Even cement plants in Middle East countries and in North Africa, with partly rich local deposits of oil and gas, are forced to increase the proportion of alternative fuels to keep their cement production competitive.

It is a known fact that firing of alternative fuels has a major impact on the process parameters in general and does also influence the lifetime performance of the refractory lining.

Figure 1: Typical appearance of the new products

We, as Refratechnik Cement GmbH, assume responsibility and keep on pushing our developments to cope with increased loads. Many years ago, with the upcoming usage and firing of alternative fuels in European cement plants, we invented our AF (alternative fuel) and AR (alkali resistance) concepts and launched specially reinforced products with increased thermochemical resistance. Today, our well-established brick grades ALMAG® AF, TOPMAG® AF and PERILEX® CF form part of this successful concept.

One of our latest steps in constant development represents the KRONEX® 20 and the REFRACLAY 25 product series. These products contribute to a sophisticated refractory layout considering the aspects thermochemical attack and expansion of refractory lining. Furthermore, they help to reduce the specific costs of operation not only by improving the refractory lifetime, but also by providing low thermal conductivity (energy savings) and reduced density (weight savings).

Particular features of KRONEX® 20 and REFRACLAY 25 / MCG / JC are their alkali resistance, lower density and resistance to unwanted mineral after-expansion.

More than any other refractory producer, Refratechnik Cement GmbH has documented, evaluated, and applied its experience in the design and installation of complete, new plants for the purpose of technical optimization. Also the development of the

KRONEX® 20 and REFRACLAY 25 / MCG / JC product series is based on this wealth of experience. As a result, Refratechnik Cement GmbH now provides a full range of modern refractory linings in the field of highly acid fireclay materials.

Figure 2: Bulging of refractory lining at cyclone sidewall [2].

Problems of AF firing

In the preheater, an unwanted mineral after-expansion of the refractory material in the two lowest cyclone stages as well as in the entire calciner can often be observed after a few years only. Mainly standard alumina materials with an Al2O3 content of at least 35%, which are typically used in these areas, are affected. Bricks as well as refractory concretes show the typical protrusion and bulging of the bricked or casted/gunned wall areas. As expansion continues on the hot side, the expansion joints are closed sooner or later, anchors are torn out completely and even the compensator movement is reduced to zero. Even particularly strong areas lined with tongue and groove bricks, as shown in Figure 2, will finally be destroyed. The result is loss of the wear lining, so that entire segments can drop down and block the cyclone tip. After that, failure of the existing insulating layer – which is mostly made of relatively weak calcium silicate – is only a question of time. Only if suitable insulating gunning concretes such as REFRALITE® 40 G with emergency running properties are used, operations can temporarily be continued.

The crystallization forces due to the mineral conversion are strong enough to bend anchors and supporting brackets, and even burst the steel shell. Probably the most impressive consequence of this phenomenon is the entire calciner housing being lifted by several centimeters (refer to Figure. 3). Unfortunately, this damage is usually discovered only when it is too late for preventive measures. Taking into account downtimes, repair costs, and the considerable safety risk during inspection and repair, one has enough convincing arguments for providing a suitable technical solution right from the start.

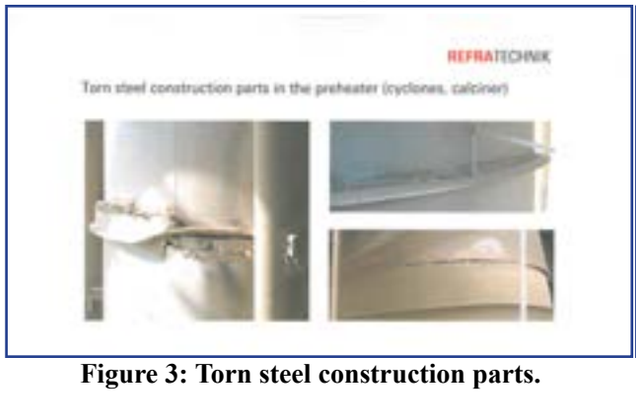


Figure 3: Torn steel construction parts.

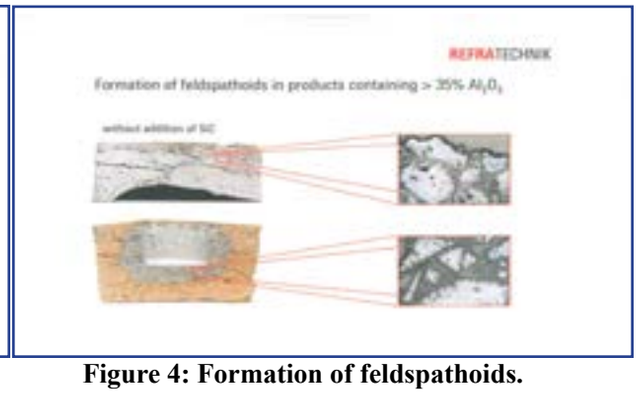


Figure 4: Formation of feldspathoids.

In the temperature range of 700 up to 800°C, refractory concretes and bricks with medium to high alumina contents between 35 and 75% are converted into crystalline alkali-alumina silicates of the feldspar and feldspathoids group (Figure 4). Affected by this is the fine-grained matrix as well as the coarser grains of the alumina carrier. A prerequisite for this is the presence of gaseous alkali oxides. Typical new formed mineral phases are e.g. leucite, kalsilite, and nepheline amongst others. The associated irreversible increase in volume of up to 20% due to recrystallization into feldspathoids leads to the surface cracks and spalling (alkali bursting) known from kiln operation [3]. If the mineral phase conversion penetrates deeper into the refractory lining, this is known as after-expansion. At the start of this relatively slow process, the volume increase is partially absorbed by the existing expansion joints. However, as soon as the expansion joints remain closed also in the cold state, the build-up of stress in the brickwork is inevitable, with the known destructive results. Therefore, regular inspections of the expansion joints during a downtime provide important indications about the progress of after-expansion. Consequently, routine expansion joint inspections are recommended. Especially the critical wall areas in the calciner and the lower cyclone stages should be checked regularly, and be reworked if necessary (cutting free the expansion joints, and refilling with insulating material).

Measures against alkali attack and extensive expansion

Refratechnik Cement developed an alternative technical solution to absorb the growing pressure in medium term. In combination with an optimized refractory design, this instrument is particularly suited for use in the cylindrical sections of the calciner. The friction compensator can be installed together with the initial lining, but it can also be retrofitted easily. The sophisticated design of two rings of special shaped bricks turn the vertical oriented expansion of refractory lining into a horizontal movement and hence compensate the pressure up to a certain degree.

Another option for preventing or at least reducing the after-expansion is a change to higher-grade SiC and zirconium oxide containing AR products. Due to the oxidation of the SiC in the matrix, the proportion of alkali resistant acid components is increased. At corresponding temperatures, a dense glassy protective layer is formed on the material surface, which helps to inhibit the after-expansion process.[1]

A genuine refractory solution is provided by the new products KRONEX® 20 and REFRACLAY 25. Here, the proportion of acid components has been increased so far that only real feldspars with a clearly reduced volume increase of about 1% are formed due to the very low Al2O3/SiO2 ratio. As can be seen in the cup tests (Fig. 5), after-expansion occurs far less or even not at all at temperatures up to 1100°C. This advantage of the acid fireclay material can be used to provide reliable protection against after-expansion in all areas of the preheater as far as permitted by the temperatures

Figure 5: Cup corrosion tests

Fields of application and properties

The fields of application of the new, highly acid fireclay materials KRONEX® 20 and REFRACLAY 25 include all cyclone stages as well as the falling part of the calciner. Basically, all cylindrically shaped areas and - if possible, roofs – are lined using Refratechnik's innovative tongue and groove brick concept. Depending on specifications and possibilities on site, castables, dry gunning concretes or JC concretes are used for all other wall areas. The refractory concept is rounded off by the use of application-specific insulating gunning concretes with emergency running properties, such as REFRALITE® 20 G, 30 G, and 40 G. Nowadays, Refratechnik Cement designs the preheater in all new plants standardly with the new refractory materials. Furthermore an installation in the cold part of cooler and even in the calcining zone of the rotary kiln is possible.

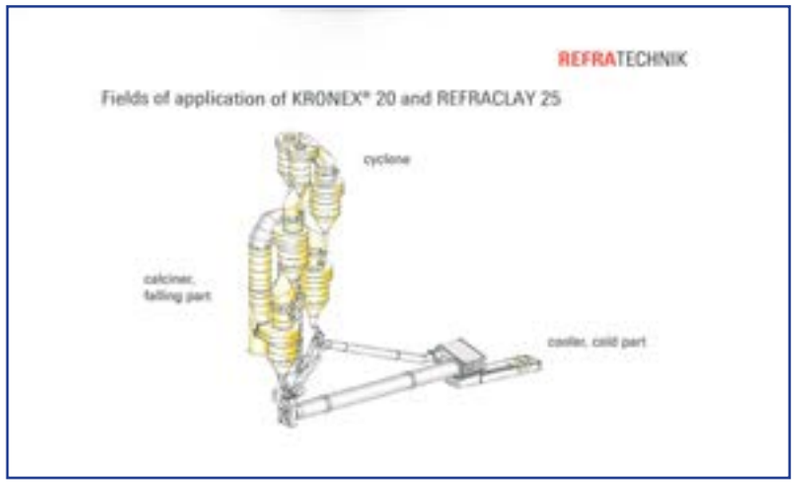


Figure 6: Fields of application

Apart from the above benefits, the application of products with considerably lower Al2O3 contents, such as KRONEX® 20 and the concretes of the REFRACLAY 25 group, offers several other interesting advantages.

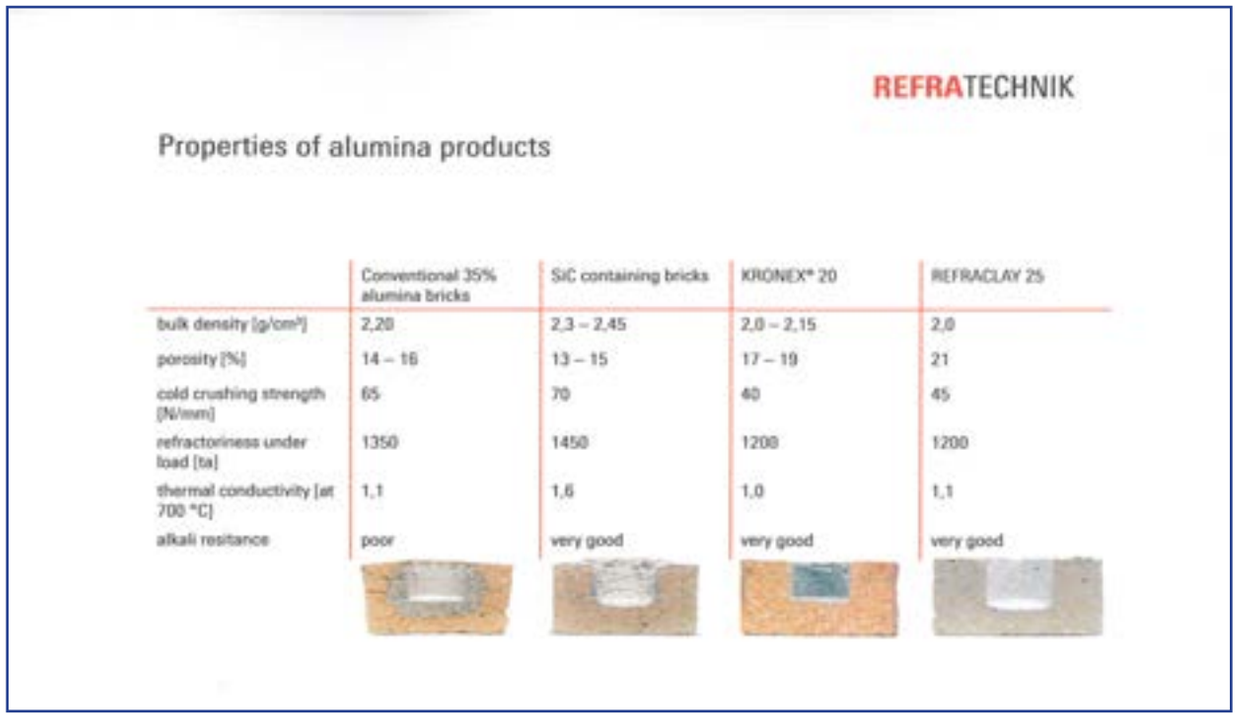


Figure 7 shows the physical and chemical properties of KRONEX® 20 and

REFRACLAY 25 compared to conventional 35% alumina containing bricks and SiC containing bricks. The bulk density as well as the thermal conductivity are considerably lower. Thanks to the significantly lower alumina content and the very favorable alumina/SiO2 ratio, the materials offer a very good alkali resistance and protection against possible after-expansion with the associated high repair and downtime costs.

Refractoriness is at about 1200°C. During normal operation (25 to 900°C), this value lies far above the temperature ranges specified by the plant manufacturers. Even short-term maximum values around 1200°C are no problem, as the application-limiting temperature of more than 1350°C for KRONEX® 20 offers adequate reserves.

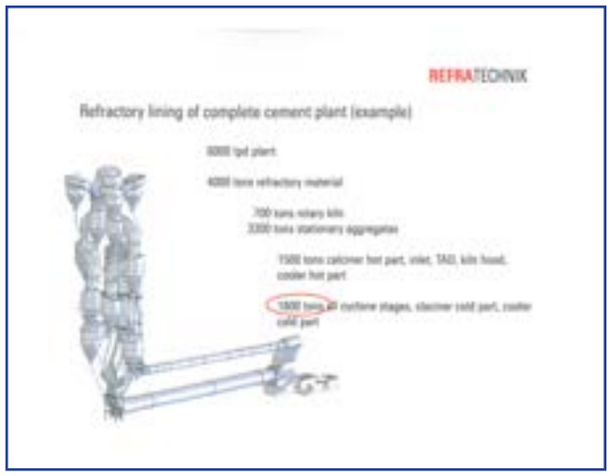


Figure 8: Amount of refractories in a complete cement plant (example).

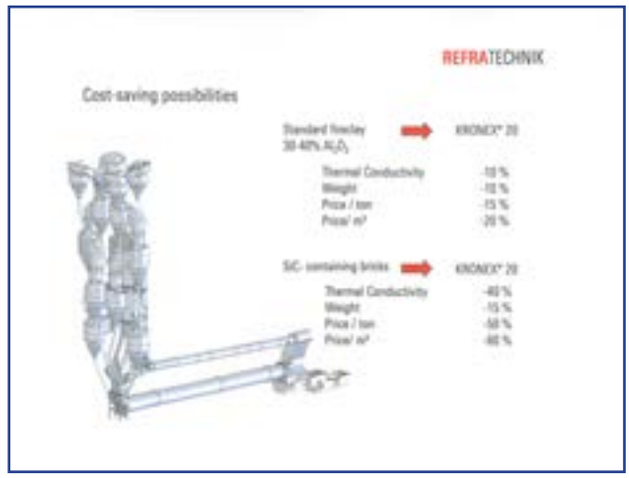


Figure 9: Cost-saving possibilities for areas where KRONEX® 20 and REFRACLAY 25 are recommended.

Within the intended operating range, the slightly lower cold crushing strength compared to that of standard fireclay is fully adequate. Normally in the intended application areas, the raw material exists in the form of extremely fine meal, so that – for temperature-related reasons – abrasive clinker minerals will not appear.

Cost saving potential

The above mentioned technical advantages of the new product generation
KRONEX® 20 and REFRACLAY 25 imply a significant cost saving potential.
For example, the initial refractory lining of a cement plant producing 6000 tons cement per day comprises roughly 4000 tons of refractories. As displayed in Figure 8, 3300 tons are installed in stationary aggregates and 1800 tons thereof in areas where KRONEX® 20 and REFRACLAY 25 are recommended. Considering this huge amount, cost saving factors like lower weight or improved insulation have a major effect.

The cost saving potential becomes particularly obvious, when comparing KRONEX® 20 and a standard 30 to 40 % Al2O3 brick which is displayed in Figure 9. The potential of weight saving comes up to 10 %, and the thermal conductivity is also approx. 10 % lower. In comparison with a silicon carbide containing brick the cost saving potential is even more convincing with 15 % lower weight and 40 % reduced thermal conductivity. In both cases the initial investment costs are reduced significantly due to an attractive price per ton and based on the comparable lower density an even lower price per volume. These commercial facts in addition to the technical advantages contribute to a perfectly elaborated and overall very economical refractory solution.

Summary

Already with the introduction of the high-grade AR products (KRONAL® series, SiC and Z AR castables), Refratechnik Cement has made pioneering developments, particularly in the highly thermochemically stressed areas of preheater, kiln hood and cooler.

In the light of several thousand tons of the new products REFRACLAY 25 and KRONEX® 20 that have been installed in more than 30 modern plant types and plant units so far, one can say for certain that the new products have firmly established themselves already and are fully accepted by cement producers and plant manufacturers today. In combination with the new easy-to-install REFRALITE® insulating concretes, a technically high-grade, but extremely economic system solution is available. This solution was so convincing that many customers decided to apply said products in their new projects. The installation in other areas such as rising section of calciner and cold section of cooler, as well as the kiln›s inlet zone, is presently subject of intensive discussions.

All known conventional refractory installation systems can be applied, i.e. castables, gunning and JETCAST® concretes of the REFRACLAY 25 range are available as well as KRONEX® 20 bricks for lining cylindrical and roof sections using Refratechnik's standard tongue and groove shapes. With its high-acid, highly alkali resistant products KRONEX® 20 and REFRACLAY 25/JC/MCG, Refratechnik Cement has created another important product range that supplements the existing and successful alkali resistant systems in an optimum manner.

Even though the technical advantages of REFRACLAY 25 and KRONEX® 20 provide already more than enough convincing arguments compared to a standard fireclay solution, one should not fail to mention that in terms of economization the increased insulation effect, the weight saving possibilities and the favorable price per ton respectively price per volume, have a crucial impact and make the complete package perfect.

References:

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High Alumina Bricks with improved Resistance to volatile alkali compounds
[Intercem Cement Technology Workshop China] Shanghai 7.-9.09.2004

[2] Johannes Södje
Refratechnik Untersuchungsbericht 41/ 08

[3] H. Freund
Handbuch der Mikroskopie in der Technik Band IV, Teil 5, Umschau Verlag, Frankfurt am Main, 1974

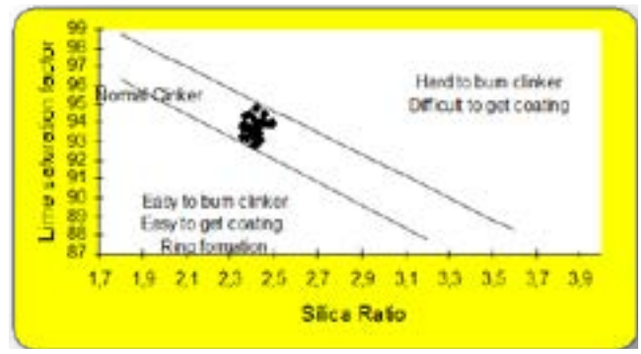
Magnesita Refractory Optimization Model™

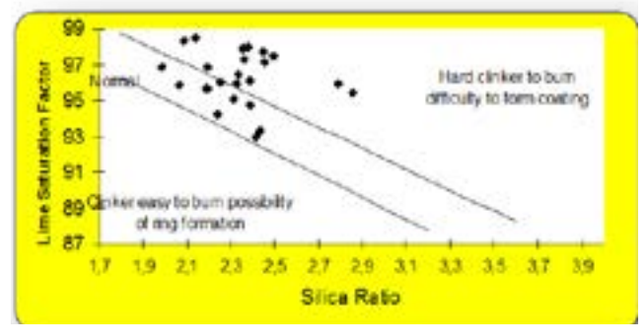
By: Magnesita, Refractories, Brazil

Through nearly 50 years of leadership in the cement industry, Magnesita has developed a proprietary service model that has proven to deliver optimal refractory performance for customers in unique operations around the world.

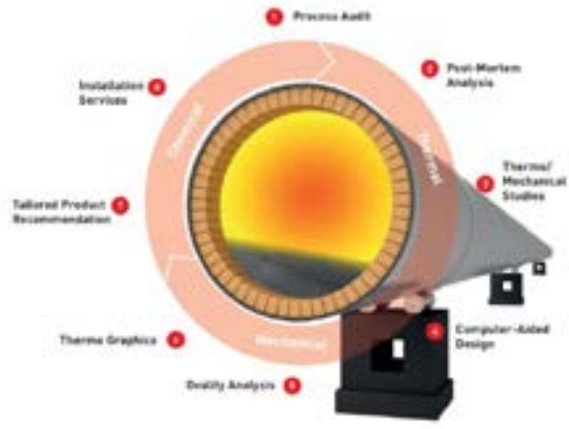
With its Refractory Optimization Model TM, Magnesita´s Team of Cement experts follow a detailed 8 steps to identify all the chemical, thermal and mechanical factors impacting each unique atmosphere. With a complete understanding of all the key variables, Magnesita recommends the optimal refractory product mix and installation procedures to deliver the greatest outcome for its customers.

This unique model implemented by Magnesita´s experts, consistently increases reliability and enhances performance while reducing the total cost of operation for our cement industry customers.
We will describe here the 8 steps.





respectively, and its propensity to be burned or not.



1) Process Audit: consists of analyzing all chemical aspects of the clinker, kiln operations conditions, visual mechanical inspections, burner and its fuels uses and thermal load.

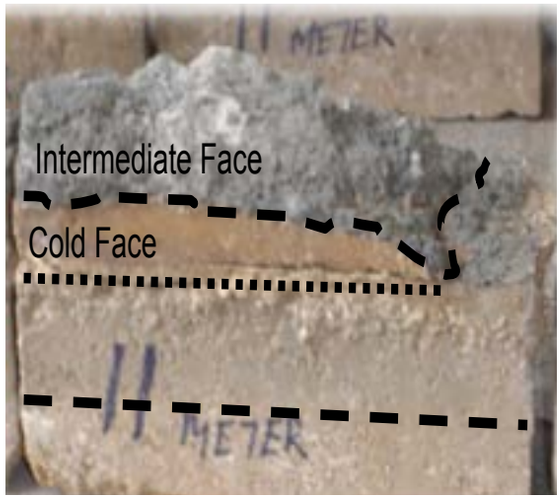
For the clinker chemical aspect, several sources of information from the process can be analyzed. When the daily data for LSF vs. SR is plotted, some important information arises: How difficult, normal or easy the clinker is to burn, and how homogeneous is the process, as a big dispersion of the points will mean a big variation in the process as a whole. As can be seen on the graphics, good versus not good homogeneity

From refractory point of view, the process is considered stable and homogeneous when the LSF (lime saturation factor) is not over the adequate limits of ± 1% (percent points) from the average monthly. The SR (silica ratio) and AR (alumina ratio) also has the same variation, but for these modulus lower than ± 0.1 average monthly, as well. Several others chemical parameters are analyzed such as:

Liquid phase at 1450°C and 1338°C;
Liquid phase viscosity;
Coating profile, thickness and its stability;
Burnability index;
Sulphate modulus; which is very important mainly due to alternative fuels and raw materials uses, etc.

Analysis of the kiln brick chart will give information about which are the critical areas. It also provides association with mechanical, chemical or thermal issues combined with the clinker analysis studies. And it identifies the potential for application of the “Multiple Campaign Performances” plan.

2) Post-Mortem Analysis: From used brick, detailed



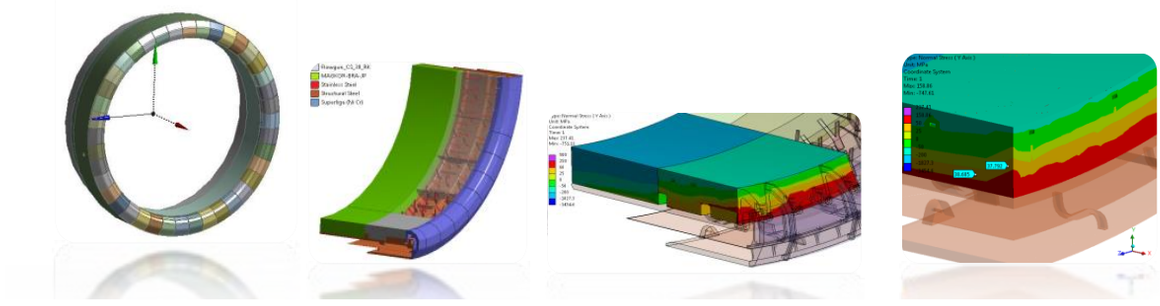
studies are developed in order to identify what kind of wear mechanism took place. Taking several brick layers, chemical, physical and mineralogical phase analyses are carried out by Magnesita's research center.

With a high level of accuracy, mechanical stress and/or kiln misalignment can be identified by elastic modulus testing. The influence of alternative fuel uses is verified by the alkalis, sulphur, flux oxides, and others gases infiltration. The new mineral phases formed during the process can demonstrate the thermal load applied by the ternary diagram phase analysis.

		Hot Face 1	Hot Face 2	Inter. Face	Cold Face	TDS
Distance from hot face	mm	180-140	140-80	80-40	40-0	
Apparent Porosity	%	11.4	13.5	12.8	11.8	13-16
Bulk Density	g/cm^3	3.03	2.97	3.00	3.01	2.96-3.06
Elasticity	GPa	15		17.5	18.5	37
Mineralogical Phases (X-Ray Diffraction)		MgO, MA, K_2SO_4, $C_{12}A_7$	MgO, MA, βC_2S	MgO, MA, $C_{12}A_7$	MgO, MA, KCl, K_2SO_4,	MgO, MA,
Chemical Analysis						
MgO	%	83.1	85.8	83.3	81.6	83-87
Al_2O_3	%	12.0	12.2	12.2	12.4	10.5-14.5
Na_2O	%	0.0	0.0	0.0	0.0	-
K_2O	%	0.16	0.04	0.09	0.28	-
SO_3	%	0.14	0.02	0.10	0.17	-
CaO	%	2.8	0.9	2.6	3.4	< 0.9

3) Thermo/Mechanical Studies: knowing the stress and strain distributions in a mechanical component is essential to make design decisions taking into account the materials resistance of an imposed set of loads. Using the Finite Element Method for thermo-structural analysis, Magnesita's Engineers evaluate and compare different design configurations in a computational environment, leading to a more complete understanding of the physical phenomena and reducing the number of necessary field tests.

This numerical simulation tool allows Magnesita's Solutions Engineering Department to reduce the thermo-



mechanical stresses in the studied component, optimizing the design process and providing the best solutions for each specific case.

4) Computer Aided Design: Design engineers working very close to the customer's needs through the input of cement engineers, focus on the full solution for the refractory and mechanical projects, mould design and numerical simulation.

From advanced software technologies, the Solutions Engineering division works to minimize the timeliness of response while maintaining reliability of results. The Engineers utilize the integrated process and methodology of 3D modeling, parametrization, thermo-structural simulations, and dynamics fluid and thermal profile analysis.

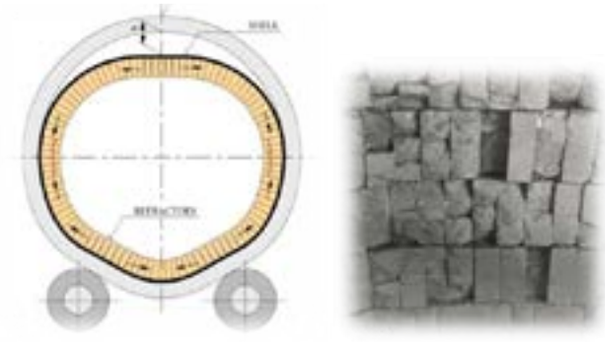
Through this technology, Magnesita obtains the highest accuracy of results related to the amount of materials for any design, special shapes development, assembly and interferences simulation, customized equipment, etc.

5) Ovality Analysis: The mechanical stability of the refractory lining is greatly affected by the mechanical condition of the rotary kiln. The refractory lining depends on the principle of a continuous arch to stay in place. Any forces acting on that arch, such as flexing of the kiln shell due to either high ovality values or misalignment, will deteriorate the mechanical stability of the lining.

Measurement of ovality is a measure of the radial deformity of the rotary kiln shell during one normal kiln revolution. The steel shell of a rotary kiln can undergo deformity during the service life caused by the kiln weight, the weight of the refractory lining, and the weight of raw materials processed in the kiln. Further deformity can be caused by the rotating movement of the kiln, which is particularly critical in the radial direction, as it will have an effect on the refractory lining of the kiln. Experience has shown that the kiln shell can almost be deformed to an elliptical shape. This results in significantly different loading on the bricks by the rotating kiln. If this is the case, it is possible that the maximum compression strength tolerated by the bricks is exceeded, which will reduce the performance life of the lining.

Radial deformities of the kiln shell are not evenly distributed along the kiln length. The maximum deformity is reached in the position of the tires, where the vertical supporting forces and radial stresses reach the highest value and this is transferred to the lining. The stresses transferred to the lining will decrease simultaneously with the distance from the tyres and reach a minimum in the middle section between two tyres and/or at the inlet or outlet end of the kiln.

Results of the mechanical stress



6) Thermo Graphics: Provides anticipation for future planning of the next shutdown, mainly on the equipment not covered by the on line system.

Recorded thermo-graphics information about the areas such as the preheater, calciner, smoke chamber, kiln, kiln hood and cooler, will give signs of the most critical areas.

Measurements are done in order to evaluate the rate of the wear and classify under the grade:

1- Critical: External temperature is between 100%-70% of the internal operation temperature.
2- Serious: External temperature is between 70%-40% of the internal operation temperature.
3- Attention: External temperature is between 40%-10% of the internal operation temperature.
4- Normal: External temperature is between 10%-0% of the internal operation temperature.

Each grade has different treatment and time response due to the inherent situation; thus refractory engineering solutions and our cement experts will work together in order to evaluate the best solution regarding the optimal design, appropriate quality material, and application methods.

7) Tailored Product Recommendation: Having in mind the most important wear mechanism – Chemical, Thermal or Mechanical - or a combination among them, physical and chemical refractory properties will be selected in order to address the optimum kiln performance. For example:

-- High brick flexibility to support mechanical stress,

-- Low permeability and or low thermal conductivity brick to protect to the gases infiltration,

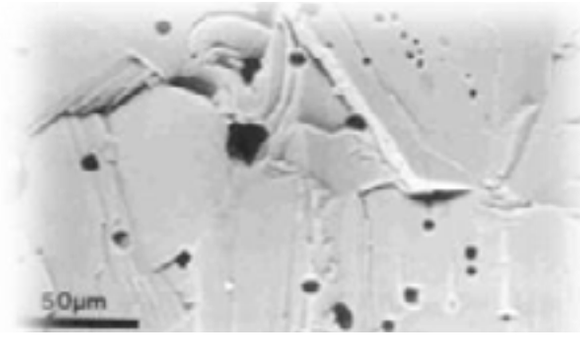
-- Suitable apparent porosity and chemical coating compatibility to ensure stable coating area,

-- Special refractory design to promote superior adherence between brick and coating by new mineralogical phases formation.

-- Under extreme thermal load kiln operation high thermal direct bonded brick will be an adequate technical solution.

All the above steps, decided in partnership between the Customer and Magnesita, have the objective to provide the most accurate and detailed information about the entire clinker process from mechanical, chemical and thermal points of view.

Magnesita demonstrates the expertise to recommend the most suitable refractory for customer processes. Our recognized brands: **MAGKOR, MAGNEFOR, DOLOMAX and SINDOFORM** for basic areas and the alumina, fireclay brick, and castable will be chosen according to the most important chemical, thermal and mechanical requirements.



8) Installation Services: One brick installed incorrectly has the potential to disrupt the integrity of the lining and the kiln will come to an unplanned shutdown.

Shaped products have a very strict dimensional tolerance control. Further, all engineering material necessary for the unshaped product designs that address application methods such as casting, vibration, gunning, pumping and shotcreting are also strictly defined and controlled.

Magnesita provides our customer Best In Class installation techniques, through our highly experienced installation supervisors, utilizing in-house training, installation monitoring, and the use of the best practices model.

All installation procedures are carefully followed with strict discipline, ensuring the next installation obtains the same level of success as the previous one.

Take the Magnesita Challenge,

At Magnesita we know refractory and we know cement. We´ve been optimizing operations and delivering value for customers for nearly 50 years. We´re so confident in our products and experts that we know there´s no kiln operation we can´t improve. Give us the opportunity to apply our optimization model, exchanging information with our experts. You will see the results. We´re up to the challenge.

Evaluation of Alumina-SiC Bricks for Alkali Resistance Applications.

Dr. Sankar Kannabiran, Gunnar Wijk, Jonas Oldin and Camil Farhat
Höganäs Bjuf AB, Box 502, SE-267 25 Bjuv, Sweden

Introduction:
The ever increasing demands for modern operating practices of cement rotary kiln have resulted in improvements of refractory lining materials significantly. The improvements, both in bricks and monolithics in cement kiln applications, aimed for improved performance in severe operating conditions such as higher productivity, usage of secondary fuel etc,. The degradation mechanisms in cement kilns are failure of refractory lining through abrasion, alkali and /or sulphur attack, corrosion of both refractory and anchors, etc,

The alkalis generated from various alternative fuels degrade the refractories through various mechanisms; The alkalies (K2O and Na2O) react with refractory matrix and form various new phases which are several times volumetric and hence generate pressure within the structure. The types and nature of the new alkali-aluminosilicate phases formation is function of chemistry of refractories; especially the matrix (i.e.,. Alumina, silica and the other elements content in the matrix) part. The phases could be orthoclase, albite, feldspar group (like kaliophillite), and beta-alumina [(1)]. As these alkali-aluminosilicate phases are several times higher in volume than original aluminosilicate phases, the refractory lining in service spalls to relieve stresses. Alkali vapours penetrate through the pores condenses in the low temperature region. This blocks the porosity, decreases the thermal shock and spalling resistance of bricks.

Existence of alkalis is unavoidable in rotary kiln environment. Robust design of refractory microstructure for better performance is the key in cement rotary kilns. There are several approaches in combating alkali attack of refractory materials; optimal alumina to silica ratio in the matrix is a commonly accepted route. The presence of higher silica content in the matrix serves in improving alkali resistance. At the same time, care must be taken while choosing alumina to silica ratio to avoid very high silica in the matrix that would lead to the formation of excessive low melting alkali-silicate formation and hence low refractoriness for refractory lining. The other approach is to add some additives/ingredients that could help in improving alkali resistance. Addition of Silicon Carbide (SiC) [(2- 3)] or combination SiC and Zircon(Zirconium silicate) is a common approach in improving alkali resistance of both bricks and monolithics. SiC addition to the refractory bricks improves the alkali resistance by forming glassy phase due to oxidation of SiC, which effectively blocks the porosity and thus the permeability to alkali vapour or melts. Also, the glassy phase covers the grains and protects from alkali attack.

Oxidation of pure SiC is a function of several variables such as temperature, particle size distribution,(PSD) purity, atmospheric conditions etc,. The SiC passive oxidation is controlled by the diffusion of oxygen molecules (or oxygen ions) through the oxide film. At temperatures above 600°C in air, SiC will react with air to form a silica-rich surface layer. Numerous studies have shown that the oxidation of SiC above 1000°C follows a parabolic rate law, which indicates that the oxidation process is controlled by diffusion. The oxidation process is dominated by the transport of molecular oxygen at lower temperatures (<1300°C) with a substantial contribution from diffusion of ionic oxygen at higher temperatures. The oxidation behaviour of SiC is also influenced by factors such as moisture in the environment, particle size and the purity[(4- 8)].

In refractories, it also depends on the porosity, and the other phases present in the microstructure. However, there is a strong relationship between particle size and the oxidation behaviour of SiC. As the particle size decreases the oxide formation is favoured [(4,6)]. The selection of quality and the PSD of the SiC is the key in development of SiC containing products, especially for bricks manufactured for alkali resistance applications with low level of SiC. However, the SiC selection process must take cost into consideration, while keeping optimal end properties for which SiC addition is intended for.

The effect of SiC addition level and PSD can be evaluated through simple alkali test in laboratory. The physical properties such as apparent porosity , chemistry and the microstructural analysis can support to explain alkali test results but cannot always confirm the reasons for changes in the performance. An another important evaluation technique, that could well explain the influence of SiC addition and the alkali test result is the permeability measurements on the bricks fired with SiC to form glassy phase through oxidation or the

used brick in application. This could reveal the fact that how the oxidation of SiC has changed the pore size and the permeability to gases, which has a direct connection to alkali penetration. Most of the times, bricks with same porosity and chemistry not necessarily with same alkali resistance due to the difference in pore configuration and distribution.

Modern permeability measurements well explain the resistance of refractory material to alkali attacks. The conventional permeability measures in refractory bricks, which takes only Darcian permeability into consideration. In reality, the porous materials like refractory bricks, the non-Darcian effects such as the higher permeability in low pressure due to the slippage effect (Klinkenberg effect), and inertial effect at high pressure must be taken into consideration through Forchheimer's equation to understand better the permeability and correlate the effect of SiC oxidation on alkali attack [9- 11].

In this paper, two different alumina-SiC refractory bricks with different particle size distribution of SiC developed in laboratory have been analysed for physical properties, alkali tests, and microscopic analysis. Permeability analysis is under progress.

EXPERIMENTAL

Alumina-SiC bricks with 10% SiC carbide addition were made with 2 different particle size distribution of SiC. The samples are named as 1 and 2. The processing conditions of bricks are not provided in this paper due to confidentiality reasons. Apparent porosity and bulk density were determined using an immersion technique (Archimedes principle, based on ASTM C20,"Standard Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water").

The alkali resistance was tested in a brick with 50 mm diameter and 40mm depth hole, filled with 50 grams of K2CO3, fired at 1100°C for 5 hrs. The optical microscopy on samples before and after alkali test was conducted using Axiolab –transmitted light microscope. The scanning electron microscopic (SEM) study was conducted on fired samples. Permeability studies are on-going with an internally fabricated permeability analyser and the results are not presented here. The physical and chemical properties of alumina-SiC samples are presented in Table 1.

Table 1 Physical and Chemical Properties of Alumina-SiC Bricks

Characteristics	1	2
Fired bulk density , g/cc	2,41	2,40
Apparent porosity , %	16,7	16,2
Chemical Analysis, %		
Al2O3	50	
SiO2	37	
Fe2O3	1.3	
MgO+CaO	0.3	
Na2O+K2O	1	
SiC*	10	

* The PSD of Sic are different for 1 and 2

RESULTS

The chemical analysis for samples 1 and 2 are similar except the fact that they are with SiC addition of different particle size but at the same level. The apparent porosity and bulk density of fired bricks are almost the same.

ALKALI TEST

The alkali test results of sample 1 and 2 are presented in Fig.1 and compared with an alumina brick with 50% Al2O3 without SiC. The optical microscope pictures of samples before after alkali test is presented for sample 2 in Fig.2. The alkali attacked area measured in cm2 is presented in Table 2. The SEM and EDS spectroscopy of fired sample 2 is presented in Fig.3.

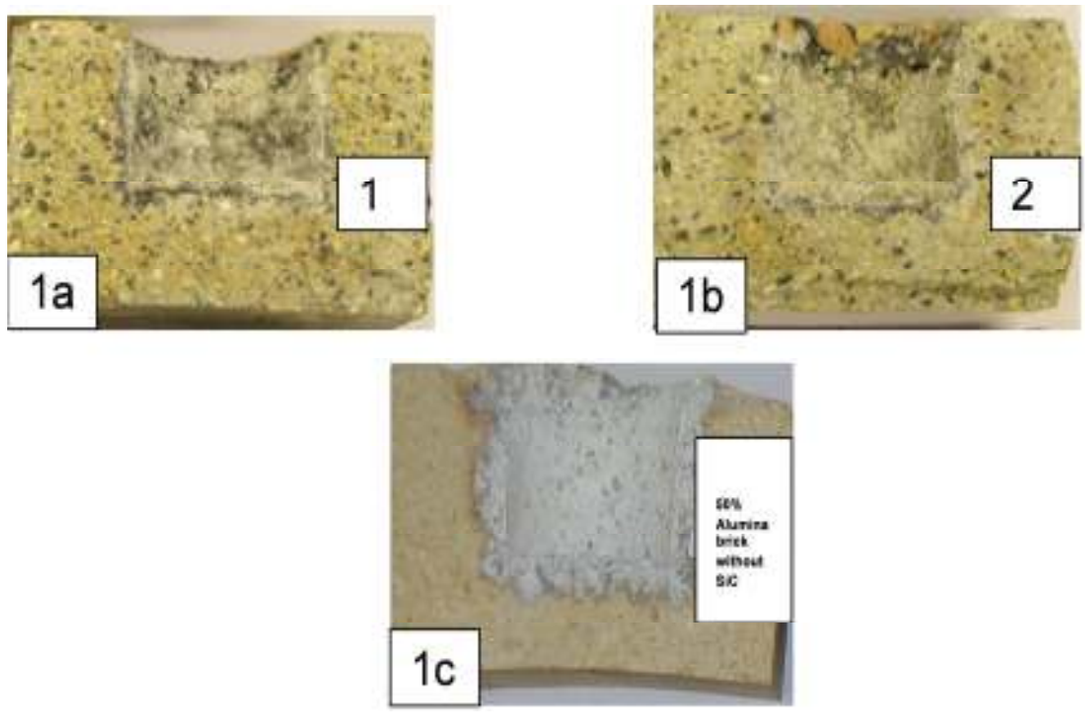


Fig.1 Comparison of alkali tested samples; 1a- sample 1, 1b- sample 2 and 1csample with 50% alumina content.

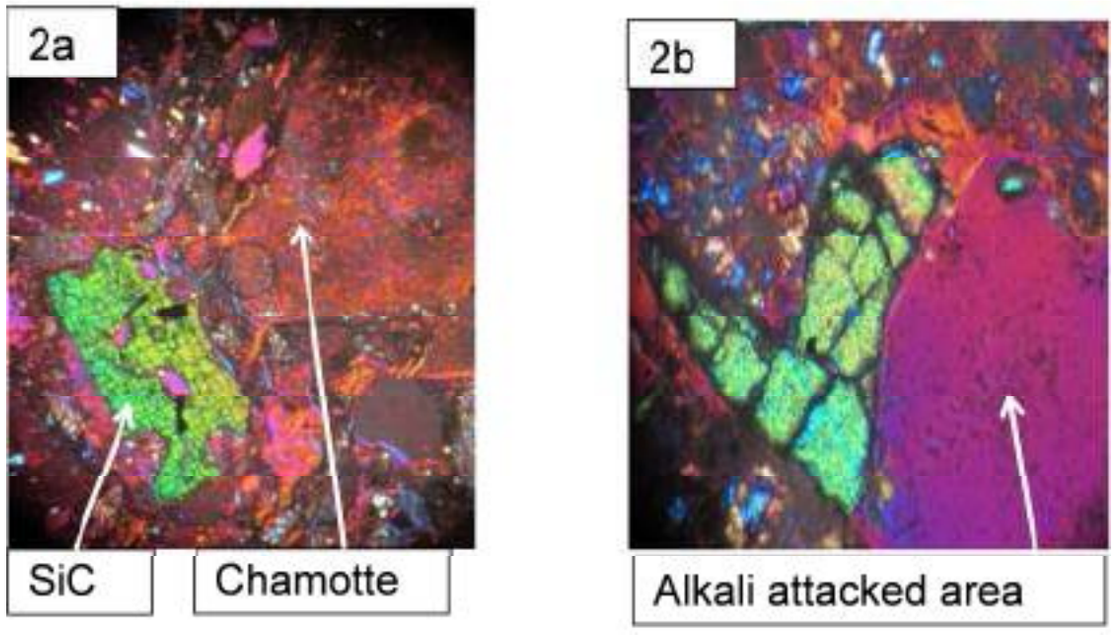


Fig 2. Optical microscopic pictures of sample 2a) sample 2 before and 2b) sample 2 after alkali test

Table 2. Alkali attack measurements

Sample	Alkali attack in cm^2
50% alumina Brick	13
1	3.6
2	1.2

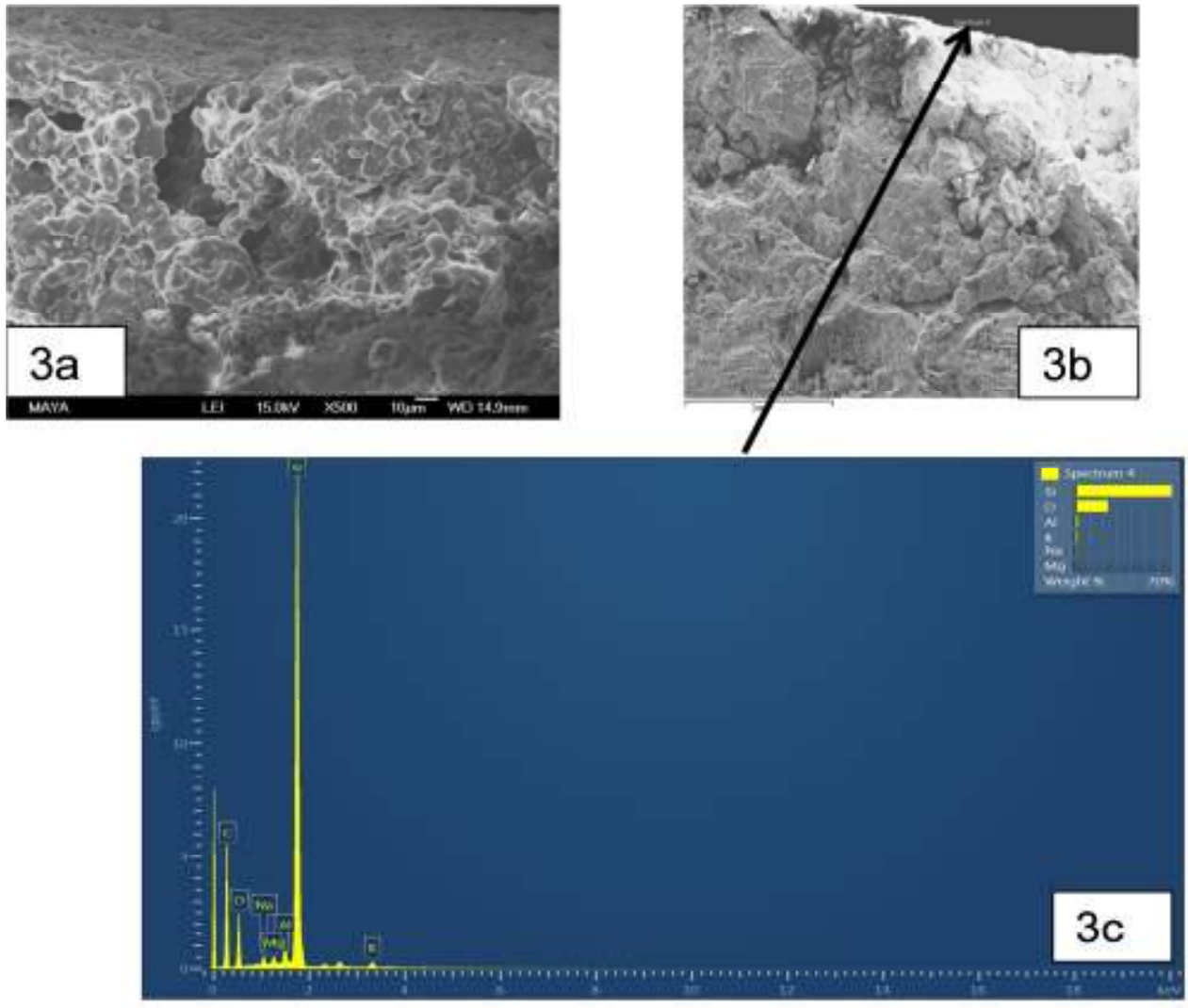


Fig.3. SEM analysis of sample 2.

DISCUSSIONS

The physical and chemical properties of sample 1 and 2 presented in Table 1 confirm the similarity in chemistry and other physical properties though the particle size distribution of SiC present in the bricks are different. The alkali test result of 50 % alumina brick has resulted with 13 cm^2 corroded area. The addition of SiC (brick 1) has reduced the alkali corrosion from 13 to 3.6 cm2 . This confirms the role of SiC in combating alkali attack in refractories. SiC involves oxidation reaction in various possible ways, depending on the temperature and atmospheric conditions and the presence of other phases in the microstructure. Silicon carbide reacts with oxygen and forms an oxide film on the surface of SiC particles, and if the volume of oxide produced is greater than the volume of SiC (and this is true of silicon carbide), the oxide film may be protective and cause the rate to diminish with time. Often the rate equation is that of a parabola, in which case the oxidation is said to follow the parabolic law. There are greater complexities in the case of silicon carbide, for one reason because it is a compound and each of its elements can form two oxides. Probably when plenty of oxygen is reaching the silicon carbide surface, the final oxidation products are SiO2 and CO2. But in many practical situations oxidation occurs in a limited supply of oxygen; this applies to all products with a ceramic bond, in which case several other reactions may occur. The possible reactions of silicon carbide with oxygen are presented below (all are with negative free energies, which means that all are possible thermodynamically). These reaction products can react further, and there are at least twenty more possible reactions.

$$SiC + 2O_2 \blacktriangleright SiO_2 + CO_2$$

$$SiC + \frac{3}{2}O_2 \blacktriangleright SiO_2 + CO$$

$$SiC + O_2 \blacktriangleright SiO_2 + C$$

SiC oxidation is surface process. The major variable that could accelerate the formation of SiO2 through oxidation process is specific surface area (SSA) of SiC powder. Modification of grain size distribution of SiC (increasing SSA) further reduced the corroded area from 3.6 to 1.2 cm2 , table 2. EDS spectrum on brick surface confirmed the SiO2 rich as shown in Fig 3b and C.

FURTHER RESEARCH;

As noticed in Table 2, the physical properties of Brick sample 1 and 2 remains almost at same level. However, marked improvement in alkali resistance has been noticed by changing the PSD of SiC from brick 1 to 2. This poses several questions on the microstructural changes of bricks and the change of pore size distribution and blockage effect of pores by modifying PSD of SiC. These changes can be quantified by permeability measures considering Darcian (viscous flow) and non Darcian (inertial) effect in permeability measures. Internal fabrication of permeability apparatus and research is on-going in Bjuf laboratory.

CONCLUSIONS:

The alkali resistance of brick has been improved by addition of SiC and firing them at an optimal temperature. As the reaction mechanism of SiO2 formation from SiC is surface area based, modification of SiC's PSD (SSA) from brick 1 to 2 has enhanced the alkali resistance of brick. Further research is on-going to understand the pore size distribution and their role in alkali resistance through permeability measurements.

INDUSTRIAL TRIALS:

The Alumina- SiC brick already existing with Höganäs Bjuf refractories known as AlSiC 500 has already been industrially tried and the trials were well explained in the publication (12). Further trials are on-going.

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CHARACTERISTICS OF A HIGH MOMENTUM KILN BURNER

By:*ATEC GRECO Combustion Systems Europe*

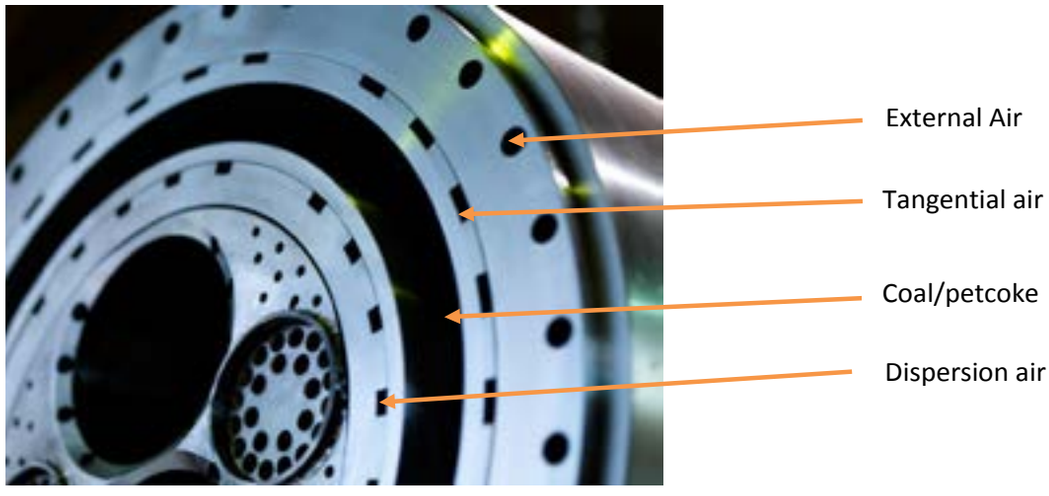
ABSTRACT
Today's burner suppliers are offering different technologies for their main burner to produce the final clinker quality in the kiln. Some burner supplier's changed their designs to lower momentum burner, while ATEC GRECO constantly improved the high momentum burners to follow the increased requirements as multi-fuel combustion, enhanced flame control, controlling of sulfur circles, increased usage of alternative fuels and harder to achieve environmental emission limits. The experience, comparison and newer installations have shown that burners with higher flame impulse are more flexible to reach the described process targets of cement production.

HISTORICAL REVIEW
The main technological principles of high momentum kiln burners by ATEC GRECO are based on calculations and studies undertaken by Prof. Clemente GRECO (1937- 2003), who lectured in Brazil at the Institute of Thermodynamics.
In the 1990s, practically the entire Brazilian cement industry was converted to petroleum coke firing in order to save on fuel costs. ATEC GRECO was one of the leading providers of burners for petcoke, as this initially difficult to handle fuel placed special demands on the burner concept. Today, this basic concept of rotary kiln firing is still in use. ATEC GRECO burners were developed further and optimized for combined firing with alternative fuels. Current rotary kiln burner design developments aiming at a 100 % alternative fuel usage rate are already well advanced.

With beginning 1990s, ATEC GRECO constructed rotary kiln burners for the local cement manufacturing industry and was among the first suppliers to provide the burners needed for changing over the numerous heavy oil and coal firing systems to the cheaper petcoke fuel. From today's viewpoint the company's petcoke burner design was advanced technology. The burner's axially symmetric design and high momentum enabled the effective use of petcoke, which significantly reduced fuel costs. Up to now, ATEC GRECO has supplied more than 300 such burners for successful use in cement plants all around the world.

Since its beginnings, ATEC GRECO has maintained its good corporate philosophy of customized burner geometry precisely tailored to the customer's particular requirements. Today, the company's main development activities are located in Austria, where ATEC GRECO has built up and operated its technical center since 2010 with the participation of pyroprocessing specialist A TEC. The R&D division's comprehensive testing facilities support the company's further developments in burner design.
Picture 1: Burner tip

CHARACTERISTICS OF DESIGN OF THE FLEXIFLAME™ HIGH MOMENTUM BURNER
The FLEXIFLAME™ burner operates with an outer, high momentum flow of primary air (external air), whose



high momentum and therefore high exit velocity is decisively responsible for the slim, firm shape. That produces

a shorter and high radiant flame compared to low momentum burners. The high momentum is equivalent to the mixing zone length of the flame which follows the ability to control the flame from the ignition point to the remaining flame length. A low momentum (low NOx) burner design means a longer mixing zone and a longer flame inside the kiln. Not always good when trying to control the clinker sintering zone length and cooling zone length for crystal grow formation. A shorter flame length and the ability to control the flame are favorable for sulfur cycles at the kiln inlet as well.

The arrangement of the primary air outflow as individual air jets has a very favorable effect on the combustion, as it assures rapid mixing of the hot secondary air into the flame. The form of the flame is adjusted by means of the primary air momentum. To the outside and inside of the burner's coal/petcoke channel, there are two inlets for swirling airflows (tangential air & dispersion air) that intensively mix the pulverized coal. This so-called double-swirl effect gives the flame a high stability (providing superior flame control) and results in rapid flame formation (flame ignition point close to the burner). Compared to other burners, the flame geometry in the kiln is easy to control, a fact that is evidenced by the thermal profile of the kiln shell.

The central elements of the burner, such as the oil lances, solid fuel pipes, igniter, etc. are guided and cooled via a burner tip plate. If the mixture of fuels and the arrangement of the channels permit, an axially symmetric design is used, as this ensures better flame control than an asymmetric design. The very safe construction enables extremely precise setting of the burner. As all burner channels are separately adjustable, their functioning can be clearly followed, without influencing other airflows.

The important mixing momentum of the burner is selected on a customer-specific basis, depending on the kiln application, the system configuration, the fuel composition and the clinker analysis. This customer-specific burner design with a sophisticated nozzle geometry has achieved excellent operating results and thus reduced the

fuel costs even in the case of very sensitive kilns, such as a white cement kiln with planetary cooler (low secondary air temperature) operated with a fuel mixture of petcoke and solid alternative fuels (sawdust & fluff).
A further basic concept of the ATEC GRECO burner is minimization of wear. This is achieved by means of the

Table 1:

Typical specific burner design criteria are:	
Primary air pressures:	200–350 mbar
Primary air rate:	4–12 % (without transport air)
Axial burner momentum:	6–14 N/MW
Fuel/air ratio:	nom. 5 kg/kg air
RDF/air ratio:	2.5–4 kg/kg air

Table 2:

The specific axial burner momentum I_a [N/MW] can be calculated according the equation below:

$$I_a = m_a \cdot v_a / P_{th} \quad (1)$$

m_a = the mass flow of axial primary air [kg/s]

v_a = as the speed of axial primary air flow [m/s]

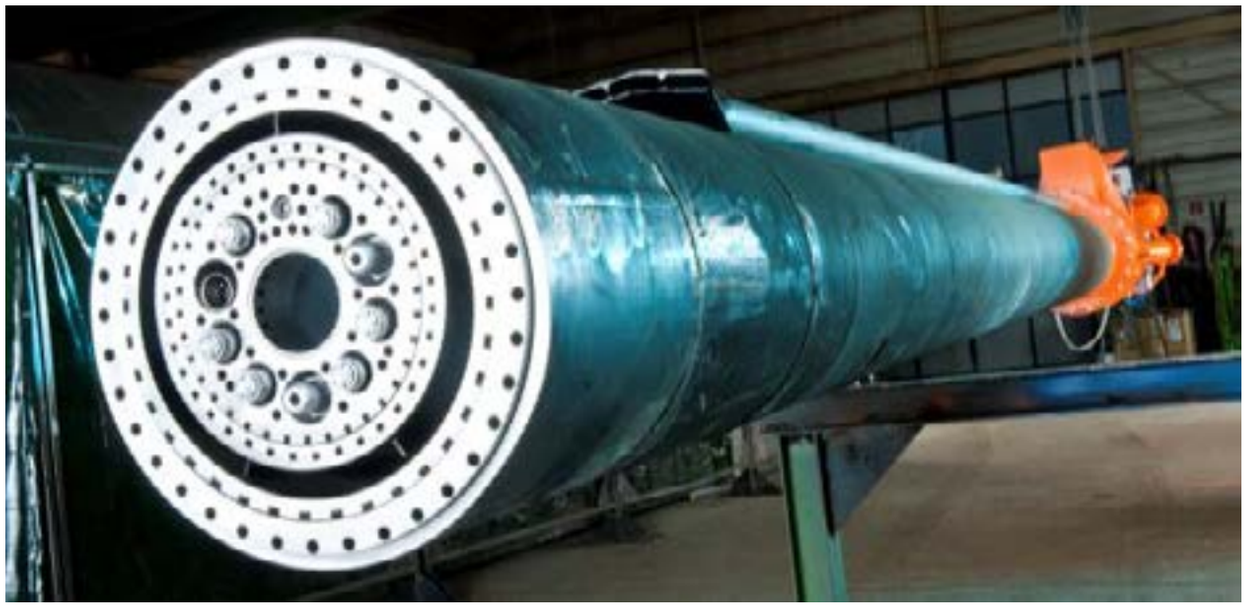
P_{th} = the thermal burner power in sintering zone [MW]

following design features:

- The coal channel has no cone or geometric deflection (it is possible to use supply air for adjusting the coal injection velocity)
- The alternative fuel pipe inlets are wear-protected with composite material
- Mixing nozzles for alternative fuels (RDF) are located for wear reasons at the outside of the burner tip plate
- Components for coal feeding into the burner are flow optimized and protected by ceramic elements
- Good burner cooling (longer refractory service life) due to the higher flow velocity in the outer "external air" channel.

Picture 2: A FLEXIFLAME Burner at ATEC GRECO workshop in Austria

PULVERIZED FUEL



It is well known that petcoke has particular characteristics as regards complete burnout in the flame and transmission of heat to the material to be burnt. It has to be taken into consideration that petcoke has a low content of volatiles and that this results in late ignition of the fuel, which lengthens the black ignition zone of the flame. As soon as the fuel has ignited, carbon combustion commences. This can last longer than it does in the case of normal hard coal and can therefore produce a longer flame.

Particularly in the case of burner designs that work with lower mixing energies (mixing momentum $I = m \cdot v$), i.e. with low primary air pressures and primary air rate, the lengthening of the flame is measurable and results in a longer sintering zone. This longer sintering zone can cause undesirably excessive growth of the clinker crystals, which in turn results in larger clinker granules. Shortening of the flame by the use of higher swirl air rates, which is often assumed to be an effective countermeasure, actually only partially compensates this process because the insufficient primary air momentum restricts the swirl to the periphery of the flame and prevents it from penetrating into the flame core. As a fundamental principle, the burner should not induce a high degree of flame swirl, as this leads to the so-called diabolo effect, i.e. an initial constriction of the flame followed by a trumpet-shaped wide flame expansion with a high rate of flame swirl, which is counterproductive for the burning process.

SOLID ALTERNATIVE FUELS

The last optimization measures performed for the FLEXIFLAME™ burner resulted from a study of the injection and combustion of solid alternative fuels through pipes located at the center of the burner. An injection velocity that can be set independently of the conveying air (typically between 35 and 45 m/s, depending on the type of kiln) proved advantageous. It is fundamentally important to mention that the selected design of a burner for solid alternative fuels ensures that oxygen is available close to the alternative fuel injection point in order to promote quicker ignition of the alternative fuels. In this zone, there is a local deficiency of oxygen, as this usually has a higher affinity for the carbon combustion. In other words, unless special design measures are taken, the alternative fuel is initially injected into a zone of the flame that has low oxygen content until the carbon combustion has taken place and sufficient oxygen is then available to ignite and burn the alternative fuel in the flame.

One often observed problem is that alternative fuel particles prematurely fall out of the flame and land in the bed of clinker. The greater proportion of the alternative fuels burn on in the flame and cause a displacement of the flame in the direction of the kiln inlet. Depending on the alternative fuel composition and ignitability, this problem occurs at alternative fuel usage rates of 10–60 % of the thermal power at the main burner. It is not possible to increase the usage rate of solid alternative fuels with today's conventional technology without causing further problems in kiln operation.

CONTROL OF EMISSIONS

Kiln process studies combined with burner optimization measures have shown that the fundamental combination of lower primary air rate and higher momentum has the beneficial effect of reducing the NOx generation. The setting of the swirl air channel (dispersion air) that is located to the inside of the coal channel has a significant influence on the NOx emission. The burner observably reacts to a reduction of the internal recirculation zone with a decrease in NOx generation. This effect of the burner is certainly of advantage in particular kiln systems and with particular fuels. Alternative fuels with their water content may decrease the flame peak temperature due to the necessary demand of evaporation energy which follows in a decrease in NO2 emission.

THE FUTURE OF MAIN BURNERS TECHNOLOGY

Due to the market situation in Europe, further development of pyroprocessing technology is being directed at achieving an alternative fuel usage rate of 100 %. Both 2-dimensional and 3-dimensional alternative fuels will be employed (RDF, fluff, plastics, pre-treated domestic refuse etc.), which will be specially prepared and will permit substitution rates of up to 100 % in the planned new burner series. The solid alternative fuel will be additionally conditioned to permit controlled ignition, flame formation and burnout similar to the characteristics of a coal flame. The known disadvantages of the current main burner technology, such as flame displacement (double flame formation), reduced combustion, high inlet temperatures and lower clinker quality should then be a thing of the past. The cost of classical fuels contains a high savings potential that is of great interest to all clinker producers. This new technology, in which ATEC GRECO is again a prime mover as in past developments, will soon be presented to the market.

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World Geosynthetics Demand to Surpass 5 Billion Square Meters in 2017

Global demand for geosynthetics is expected to rise 8.9 percent per year to 5.2 billion square meters in 2017. Gains will result from a much improved environment for the construction of structures and roads. Additional growth will be driven by increased market penetration, stimulated by growing concerns regarding environmental protection and greater awareness of the performance advantages of these products in a variety of applications. The construction market accounted for approximately one-third of global geosynthetics sales in 2012. In addition to being the largest, this market is projected to register the fastest gains through 2017. These and other trends are presented in **World Geosynthetics,** a new study from **The Freedonia Group, Inc.,** a Cleveland-based industry market research firm.

Freedonia analyst Pam Safarak notes, "in 2012, the Asia/Pacific region surpassed North America to become the largest regional market for geosynthetics, with 35 percent of the global total." Advances in the region will be propelled by the rapidly developing Chinese market, which will account for roughly three-quarters of the regional sales in 2017 and over half of additional global volume demand through 2017. India is also expected to post double-digit annual growth through 2017, although from a much smaller base. In many of the least developed countries, however, growth for geosynthetics will be more limited due to inadequate government funding, a lack of regulations that require their use, and the presence of lower-cost alternatives such as natural fiber geotextiles and aggregates.

WORLD GEOSYNTHETICS DEMAND
(million square meters)

				% Annual Growth	
Item	2007	2012	2017	2007-2012	2012-2017
Geosynthetics Demand	2801	3400	5200	4.0	8.9
North America	923	965	1300	0.9	6.1
Western Europe	668	615	725	-1.6	3.3
Asia/Pacific	723	1200	2330	10.7	14.2
Central & South America	124	160	220	5.2	6.6
Eastern Europe	248	305	405	4.2	5.8
Africa/Mideast	115	155	220	6.2	7.3

In 2012, North America was the second largest regional geosynthetics market, accounting for 28 percent of global sales. The US is the world's largest national market, alone accounting for 23 percent of global demand in 2012. The position of the US market reflects the immense size and advanced nature of the country's economy. In addition to its huge construction sector and extensive transportation infrastructure, the US has relatively strict environmental control regulations regarding containment of waste and chemicals; all of these will continue to provide significant opportunities for geosynthetics through 2017.

World Geosynthetics (published 12/ 2013, 462 pages) is available for $6100 from The Freedonia Group, Inc. For further details or to arrange an interview with the analyst, please contact Corinne Gangloff by **phone 440.684.9600** or **e-mail pr@freedoniagroup.com**. Information may also be obtained through **www.freedoniagroup.com.**

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LOESCHE Symposium 2014
Date : 25 - 26 September 2014
Venue: Hyatt Regency Hotel Düsseldorf, Germany
For more information please contact:
LOESCHE GmbH
Hansaallee 243,
40549 Düsseldorf, Germany
Tel.: +49 211 53 53 775
Fax: +49 211 53 535775
Email: Symposium2014@loesche.de

14th Global Gypsum Conference
Global wallboard and plaster production and trends
Date : 29 - 30 September 2014
Venue: Berlin, Germany
For more information please visit:
www.GlobalGypsum.com

10th «CCC» Central European Congress on Concrete Engineering "CONCRETE OFFERS FOR THE PERIOD OF ECONOMIC RECOVERY"
Date : 01 - 02 October 2014
Venue: Liberec, Czech Republic
For more information please contact:
Congress secretariat:
10th CCC Congress LIBEREC 2014
Czech Concrete Society
Tel.: +420 222 316 173, +420 222 316 195
Fax: +420 222 311 261
Email: ccc2014@cbsbeton.eu
http:// www.cbsbeton.eu/ccc2014

Global Insulation Conference and Exhibition
Global insulation production and trends
Date : 30 - 31 October 2014
Venue: Copenhagen, Denmark

December 2–3, Moscow, Expocentre

CemEnergy-2014

III GLOBAL CONFERENCE

REDUCING ENERGY CONSUMPTION AND CO_2 EMISSIONS IN THE CEMENT INDUSTRY OF FAST DEVELOPING ECONOMIES

Maria van der Hoeven, Executive Director of International Energy Agency: The IEA will take part in the Conference "CemEnergy", organized by the International Analytical Review "ALITinform: Cement. Concrete. Dry Mixtures". It will present highlights of its most recent analysis "Energy Technology Perspectives 2014".

KEY SPEAKERS:

Philippe Fonta,
Managing Director,
Cement Sustainability Initiative (CSI) and Energy Efficiency in Buildings (EEB)

José OtavioCarvalho,
President, National Sindicat of Cement Industry, Brazil

Egmont Ottermann,
Group Energy Manager, PPC Ltd

Sui Tongbo,
Vice President of China Sinoma International Engineering Co. Ltd.
China

And More…

MAIN QUESTIONS:

- Is there a potential for substantial excess of production over consumption of cement?
- What measures should be taken to reduce the risks of destabilization of the cement market by the cement community?
- How to get more investments and profits by reducing emissions and improving energy efficiency?

CONFERENCE THEMES:

- Current status and the forecast of the global and regional cement markets development;
- A new industrial revolution in cement production and consumption;
- Cement consumption in different regions of the world;
- State and inter-state regulation of cement production and the consumption;
- Energy-saving technologies in the cement production;
- New types of binders with low values of energy consumption and emissions;
- Monitoring, economic and legal regulation of energy consumption and emissions in different countries.

PLAN YOUR PARTICIPATION RIGHT NOW!

Organizer: ALITinform Международное аналитическое обозрение Цемент. Бетон. Сухие смеси International Analytical Review Cement. Concrete. Dry Mixtures

Supported by: Государственная Дума; Министерство регионального развития Российской Федерации; СОЮЗЦЕМЕНТ; Российский Союз Строителей

CEMENT

For more information please visit:
www.Globalinsulation.com

BusinessCem Almaty 2014
Date : 20 - 22 October 2014
Venue: Almaty, Kazakhstan
For more information please contact:
Ms. Irina Valyukova, Deputy Director
BusinessCem
Tel.: +7 499 977 4495
Fax: +7 499 977 4968
Email: irina@businesscem.msk.ru
http://businesscem.ru

3rd Global Landfill Mining Conference & Exhibition
Global landfill mining for profit
Date : 17 - 18 November 2014
Venue: London, UK
For more information please visit:
www.landfill-mining-co.uk

"Cement. Concrete. Dry Mixtures 2014" Conference and Exhibition
Date : 02 - 04 December 2014
Venue: Expocentre, Moscow, Russia
For more information please contact:
Organizer: LLC «AlitInform»
Phone/Fax: +7 (812) 380- 65- 72, (495) 580- 54- 36
E-mail: mail@con-tech.ru

10th Global Slag Conference & Exhibition
Global slag production, applications and trends
Date : 08 - 09 December 2014
Venue: Aachen, Germany
For more information please visit:
www.GlobalSlag.com

2nd Global Well Cem Conference & Exhibition
Global oil well cement production and well cementing
Date : 22 - 23 January 2015
Venue: Houston, Texas, USA
For more information please visit:
www.Well-Cem.com

3rd Global Cement India Conference & Exhibition
Cement production technology and market trends in India
Date : early 2015
Venue: Mumbai, India
For more information please visit:
www.Cement-India.com

8th Global CemFuels Conference & Exhibition
Alternative fuels for cement and lime
Date : early 2015
Venue: Dubai, UAE
For more information please visit:
www.CemFuels.com

1st Global SynGyp Conference & Exhibition
Global synthetic gypsum production and applications
Date : April 2015
Venue: Chicago, USA

For more information please visit:
www.GlobalSynGyp.com

3rd Global CemPower Conference & Exhibition
Waste heat recovery and energy efficiency for cement and lime
Date : May 2015
Venue: London, UK
For more information please visit:
www.CemPower.com

Concrete 2015
Date : 30th August - 2nd September 2015
Venue: Pullman Albert Park, Melbourne, Australia
For more information please visit:
www.concrete2015.com.au

For more information please contact:
Organizer: LLC «AlitInform»
Phone/Fax: +7 (812) 38036-54-580 (495) ,72-65-
E-mail: mail@con-tech.ru

DIARY DATES

CERAMIC

International Conference on Calcium Aluminates
Date: 18 - 21 May 2014
Venue: Avignon, France
For more information please visit:
www.cacements.com

1st Joint Meeting of DGG – ACerS GOMD
Date: 25 - 30 May 2014
Venue: Aachen, Germany
For more information please visit:
http://www.dgg-gomd.org/

CIMTEC 2014: 13th International Ceramics Congress
Date: 08 - 13 June 2014
Venue: Montecatini Terme, Italy
For more information please contact:
Tel.: +39 0546 22461 / +39 0546 664143
Fax: +39 0546 664138
E-mail: congress@technagroup.it
Web site: http://www.cimtec-congress.org

HIP 2014 - 11th International HIP Conference Call for Papers
Date: 09 - 13 June 2014
Venue: Stockholm, Sweden
For more information please contact:
Conference Secretariat:
Tel.: +46 8 54 65 15 00
Email: confirmation@mci-group.com
Or visit the link: http://www.ipmd.net/news/002130.html#sthash.X8dJmA0a.dpuf

CIMTEC 2014: 6th Forum on New Materials
Date: 15 - 20 June 2014
Venue: Montecatini Terme, Italy
For more information please contact:
Tel.: +39 0546 22461 / +39 0546 664143
Fax: +39 0546 664138
Email: congress@technagroup.it
Website: http://www.cimtec-congress.org
Tecnargilla
Date: 22 - 26 September 2014
Venue: Rimini, Italy
For more information please visit:
http://www.tecnargilla.it

MS&T14 – Materials Science & Technology Conference and Exhibition, combined with ACerS 116th Annual Meeting
Date: 12 - 16 October 2014
Venue: Pittsburgh, USA
For more information please visit:
http://ceramics.org/meetings/acers-meetings

GLASSTEC
Date: 21 - 24 October 2014
Venue: Dusseldorf, Germany
For more information please visit:
http://www.glasstec.de/

CERAMITEC 2015
Date: 20 - 23 October 2015
Venue: Munich, Germany
For more information please visit:
http://www.ceramitec.de

GENERAL

7th World Congress on Particle Technology (WCPT-7)
Date : 19 - 22 May 2014
Venue: Beijing, China
For more information please visit:
www.wcpt7.org

3rd Process Engineering Expo and Conference – 2014
Date : 04 - 06 September 2014
Venue: HITEX Exhibition Center, Hyderabad, A P., India
For more information please visit:
http://www.processengineeringexpo.co.in

Minerals Metals Metallurgy & Materials
10th International Exhibition and Conference
Date : 04 - 07 September 2014
Venue: Pragati Maiden, New Delhi, India
For more information please contact:
International Trade and Exhibitions India Pvt. Ltd.
110611 ,1107-th Floor, Kailash Building,
Kasturba Gandhi Marg New Delhi - 110001 India
Tel.: +91- 11- 40828282
Fax: +91- 11- 40828283
Web: www.itei.in / www.ite-exhibitions.com

The Key Support Exhibition
by the Ministry of Commerce
of P.R.CHINA

CEMENTTECH 2014

The 15th China International Cement Industry Exhibition
2014'China International Cement Conference

April 28-30, 2014

China International Exhibition Center (Old Venue)

Organizer

China Building Materials Federation

China Cement Association

CCPIT Building Materials Sub Council

Sponsor

Beijing Building Materials Expo Science & Technology Development Co., Ltd.

Tel: +8610-57811677/76 Fax: +8610-57811680 Email: jinx@ccpitbm.org

Please visit **www.cementtech.org** for more information

Nineteenth Arab International Cement Conference & Exhibition (AICCE19)

Le Centre International de Conférences de la Palmeraie,
Marrakech - Morocco

11 - 13th November 2014

For more information, please visit our website :
www.aucbm.org or contact us at
email: aicce19@gmail.com

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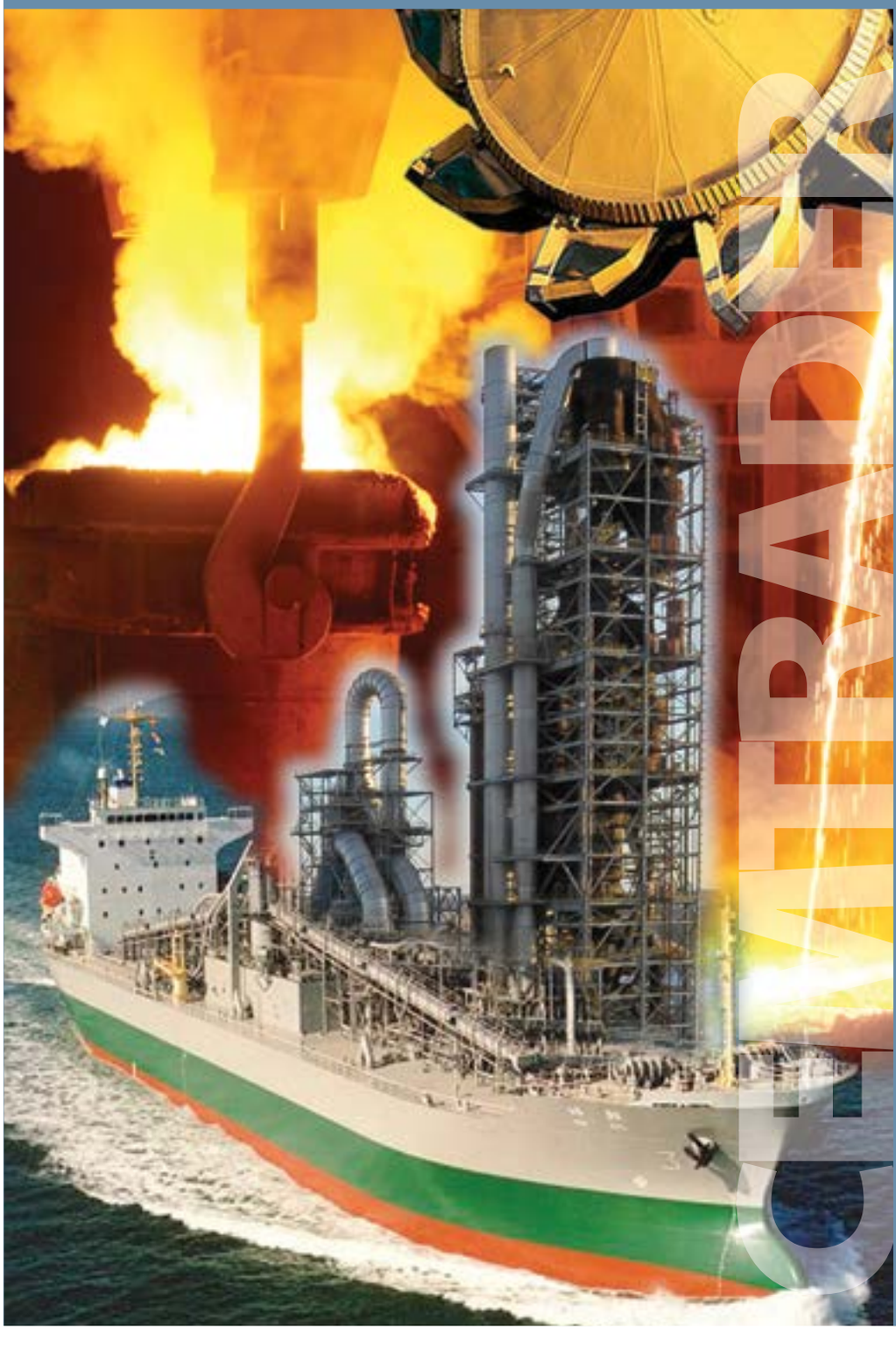
Markets
Shipping
Prices
Trends



Who should attend?

Suppliers, shippers, traders and buyers of cement and clinker

Suppliers, shippers, traders and buyers of fly ash, slag-based products (GBFS, GG-BFS), silica fume, mill-scale, natural pozzolans, FGD/DSG and other gypsum, other supplementary cementitious materials (SCM)

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Suppliers, shippers and traders of coal and petcoke for the cement industry

Analysts, researchers

Financiers, brokers

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