

Peter F. Parkes Process Improvement Manager, *Castle Cement Ltd*

Sourcing refractories from a cement-manufacturer's point of view

Many companies in the refractory industry may have the impression that cement manufacturers only look at price when deciding which refractories to use, and which refractory supplier to choose. While price is an important factor, there are many other important influences on who gets the job, and what gets installed in the cement factory at the end of the day.

Castle Cement is part of HeidelbergCement, the world's third largest cement producer, and sells more than three million tonnes of cement a year, satisfying over 24% of the UK's needs and providing employment for 1000 people.

The company was originally formed in 1982 as RTZ Cement through the acquisition of Tunnel Cement, Ketton Cement and Ribblesdale Cement. The new, combined company was renamed Castle Cement in 1986 and in 1988 was purchased by Scancem, a joint venture between two Scandinavian public companies - Aker of Norway and Euroc AB of Sweden. In 1995 Euroc merged with Aker's cement and building materials division to form Scancem AB. In 1999, Scancem AB was bought by HeidelbergCement.

Castle's operations in the UK are based at three works - Ketton in Rutland, Ribblesdale in Lancashire and Padeswood in Flintshire. There are also two import terminals at Avonmouth near Bristol and Goole on the river Humber in Yorkshire.

Castle Cement's Kilns:

The Ketton works operates two kilns; kiln 7 is a preheater kiln producing 1050t/day and kiln 8 is a precalciner kiln producing 2600t/day. The Padeswood works operates a single preheater kiln with a capacity of 2650t/day, which was commissioned in 2005 and is the most modern kiln in the UK. The Ribblesdale works operates a single preheater kiln with a capacity of 2250t/day.

What do we want?

What is a cement company looking for when purchasing refractories and refractory services? Probably the first thing that everyone thinks of these days is price! This has certainly become very important over the years and many refractory suppliers must feel that this has become the cement industry's biggest concern. Internationalisation of formerly domestically-owned cement industries is now common. Over the last seven or eight years the British cement industry has become part of the global cement industry, and the three largest players in the UK are now Lafarge, HeidelbergCement and Cemex. This has led to group purchasing initiatives and the large companies using their combined spending power as a means to secure discounts from all their suppliers, not just in the refractory industry.

There is no denying that price is very important but there are a number of other factors that are also very important, which will be discussed under the following sections:

1. Refractory bricks
2. Monolithics
3. Wrecking & installation

Refractory bricks.

Basic bricks are the most important type of brick in the cement industry, as it is in the kiln burning zone where most of the brick consumption takes place. In many kilns the decision is taken to replace the burning zone every year. As more and more alternative fuels are being burned, in particular secondary liquid fuels, the choice of bricks has become more critical and more variable from one kiln to another. Increased chemical attack has led to brick failure and a drop in the life-span of basic bricks in critical areas, particularly the upper transition zone. Chemical ingress spreads down through a brick over time, from the hot-face, which can lead to premature failure.

Below: Castle Cement's Padeswood works.





The types of alternative fuels used and the switching from one fuel to another also have a marked effect upon the burning zone. Fuels with more ash tend to build more coating. The flame may change from a very sharp profile to a longer 'lazy' flame, which has the effect of shortening or lengthening the burning zone, with resultant changes in coating.

It is desirable to have a good coating in the burning zone as this not only protects the brickwork, but also helps reduce heat loss through the kiln shell. Cement makers like to see a decent coating, as it is generally a sign that the kiln is in a stable condition and producing well. Loss of coating causes thermal shock on the brickwork and the coating can sometimes remove part of the hot face of the brick, all of which contributes to reduced lifetime of the lining.

The main refractory brick manufacturers now have a range of products available using different base materials such as magnesia spinel, magnesia fused spinel, magnesia hercynite, magnesia fused hercynite, magnesia galaxite, and magnesia zirconium. This wide choice can be seen as either a good or bad thing to cement engineers. For the more experienced engineers a choice of bricks that perform better in certain areas may be just what they are looking for, but for the less experienced people it can be confusing.

So, once more, what is the cement industry looking for from a brick supplier?

We are looking for more special products to deal with individual problems, but fewer types of bricks to make the choice easier: a fine conundrum! Similarly, new products are welcomed, particularly when offered at trial prices! The cement industry is looking for help and guidance from suppliers to decide on which brick to install in the specific areas in the kiln.

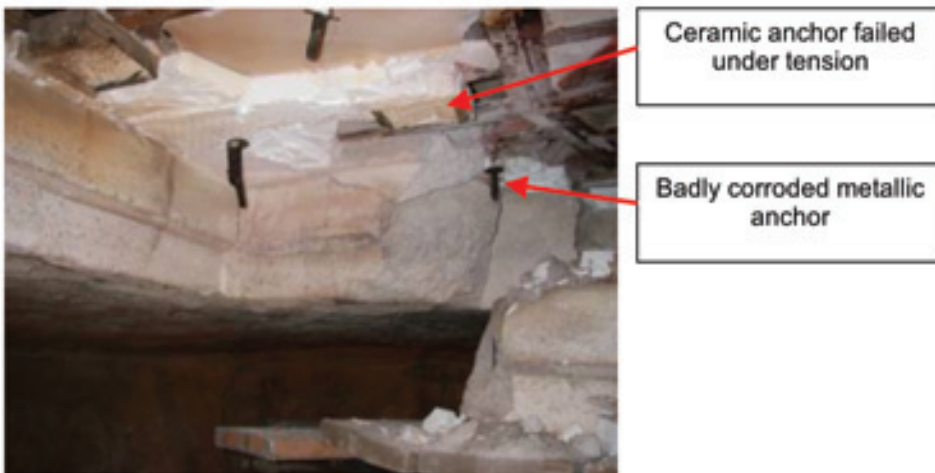
A lifetime of two years for bricks in the burning

zone would be a big benefit to many in the cement industry. Some plants may achieve this and many would say they can get over a year's life but less than two years. Most kiln operators either want one year or two years life and anything in between is not worthwhile. Traditionally kiln shutdowns are taken early in the year (in the UK and in northern hemisphere countries), as this is the quietest time for sales and the time when many clinker stocks are at their highest level. Sales of cement in the UK are seasonally driven: the summer months are always the busiest which puts pressure on production and on clinker stocks. It is always difficult to guarantee a mid-year shutdown. Quite often if this second shutdown is taken there is huge pressure to get the kiln back up and producing as quickly as possible. Therefore cement producers would like to see the bricking done in the winter shutdown and if this happened every two years rather than annually then the savings are obvious.

From brick suppliers the industry is looking for a number of different things: performance in the kiln at the correct price, consistency in the quality of the bricks, from materials to the shape, and the extra after sales service. This service can be supervision during the installation, reports on testing of refractories in the case of poor performance and a good, close customer/supplier working relationship. This would normally consist of regular visits from suppliers to discuss the performance of their materials and any new products or innovations they may have. These visits are always welcomed.

Stock holding and quick delivery are also important factors. In the case of any premature failures, it is important that refractory companies hold a stock of bricks and can deliver them quickly for any unplanned shutdowns.

Below: Figure 1: Anchor failure in a cyclone roof: note that the refractory thickness is still as it was when it was installed.



Monolithics

There are a number of areas of interest in refractory concretes: materials and solutions, types and pattern of retaining anchors, speed of installation and speed of dry out.

Many of the factors affecting the life of bricks discussed above also apply to refractory concrete and from a material point of view cement producers are looking for the same things; special products for specific areas and fewer types of materials. This is particularly useful for holding emergency stocks on site, particularly if the material can be used in a number of areas in the kiln.

Holding smaller quantities on stock reduces the risk of losing money on materials that may 'go off' if stored for long periods on site.

Refractory concretes is an area that has seen much change in the last few years, with new products and new installation techniques and again the cement industry is looking for help from suppliers in the selection of materials and the means of installation.

Anchoring of monolithics is an area where improvements could be made. Castle Cement has not been alone in experiencing problems with corrosion of metallic anchors in preheater tower cyclone roofs; there have been similar problems in Turkey and the United States. There have also been failures of ceramic anchors which are known not to be strong in tension. The temperature profile through the refractory provides the perfect conditions for this corrosion to take place. There are safety implications in these roof failures and this is currently a big concern for the cement industry. It is very difficult to see this type of anchor failure if the refractory is still full-thickness and the roof is being keyed together as a number of self supporting blocks. The collapse of the roof invariably takes place after the kiln has cooled down and often some days after the flame was turned off. Roofs have been inspected one day and have appeared to be in very good condition only for them to fall out a day or so later. Further work is required in this area to guarantee the safety of anyone entering a cyclone during a shutdown. The possibility of pre-casting hanging roof sections that could be removed externally, avoiding the risk of anyone having to enter the vessel with an unsafe roof, is currently being investigated.

Speed of installation is probably more important with monolithics than refractory bricks. Quite often the bricking can be fitted in easily with other maintenance work, since there is normally not a lot of mechanical work on the rotating part of the kiln. It is a different matter in the preheater tower and cooler

however, as the refractory work tends to run alongside the mechanical work and careful planning is required to minimise the impact of one upon the other to ensure that the repairs are completed as swiftly as possible. This often means that casting cannot be done due to time constraints and shotcreting or gunning has to be employed. If time permits, casting is always the best solution but it is often not done due to time constraints.

Returning a kiln to production as quickly as possible is one of the most important issues for plant managers. After every shutdown there is always the debate about how long should be taken to dry out the refractory and warm the kiln up. The refractory company would like to see a long period of heat up and the plant manager would like it sometime this afternoon!

So, once again, what is the cement industry looking for from a monolithic supplier? The answer is very similar to that of what is expected of a brick supplier. More special products to deal with individual problems, but fewer types of materials to make the choice easier! The cement industry would like to see materials with the strength and durability of a castable, but with a rapid installation followed by the minimum heating up time. Cyclone roofs that do not put people at risk due to premature failure is currently a prime concern; could a prefabricated block design of roof be installed and removed externally? And finally, when designing installations, suppliers should take into account the heat profile through the refractory, avoid crossing the dew point and watch out for the potential corrosion of anchors.

Wrecking and installation

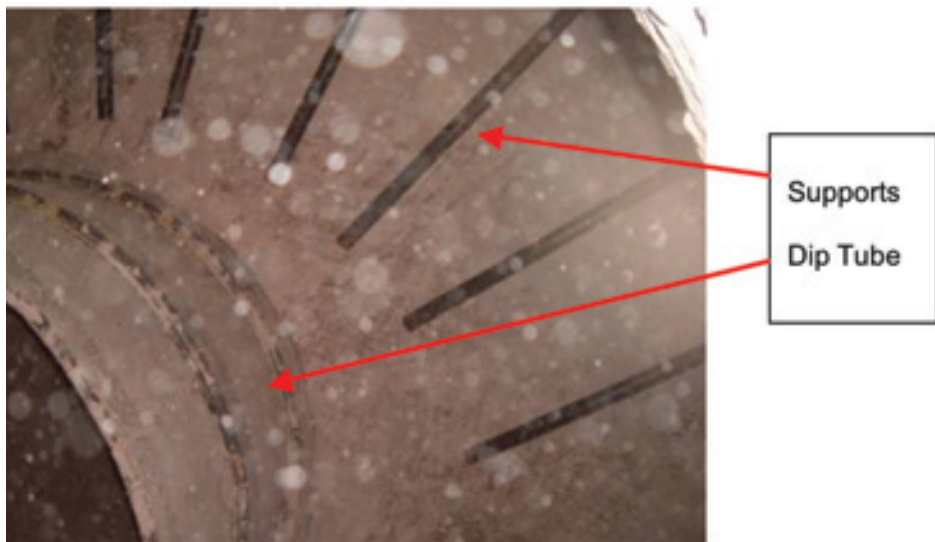
Safety and environmental performance has become an important issue in the cement industry over the last ten years and many old practices have changed to reduce impact in these areas. Removal of coating both in the kiln tube and the preheater cyclones is now normal practice.

Risk assessments and method statements are the norm now on all activities in a works, but how can cement companies be sure that these safety rules are being followed, particularly out of normal working hours? Refractory removal and installation is a tough job: it can be hard manual labour in restricted and confined spaces and could certainly be described as 'a young man's game'. It is just such people that may feel they are immortal and they feel that for them to cut corners on safety is an acceptable practice. Safety performance has become better in the refractory industry but there is still some room for improvement.

Consider the case of wrecking and replacing refractory in a preheater cyclone. This requires careful planning to assess the risks. The cyclone must be made safe before access scaffolding can be installed, any build up on

Below: Figure 2: Tubes on the outside of the cyclone through which the supports are placed.





Above: Figure 3: A view inside the cyclone, with supports in place.

the roof or walls must be removed and the roof must be tested to ensure that it is sound and not liable to collapse when people are working inside the vessel. Next scaffolding has to be erected for access to remove refractory and this must be strong enough to take the weight of the material that is being removed. Once knocked off the roof or walls, old refractory must not be allowed to build up and overload the scaffold. There must be a safe method of removing the waste from the cyclone. The safety of and impact upon anyone working below or in adjacent vessels must be considered. Removal of old anchors, replacement with new and then the installation of refractory can then follow. Finally, there is cleaning out the cyclone and removing the scaffolding. All of these jobs add time onto the repair, so it is essential that they are done as quickly as possible but without compromising safety.

At the Ribblesdale works they have used a system of tubes that are slid through the top of the cyclone walls underneath the roof across to the dip tube, to provide

some support in case of an unforeseen failure of a roof pane. The first impression of the people wrecking the roof was that these supports made it slightly more difficult to remove the refractory with jackhammers, but they admitted that they did feel safer with these in place. Figure 2 shows the tubes on the outside of the cyclone through which the supports are placed, while Figure 3 is a view inside the cyclone with supports in place.

Environmental aspects

Environmental impact is also a cause for concern during major repairs. When bricks are removed from the kiln through a manhole, which can be ten metres or more up in the air, there is the problem of dust generated which could be blown around or worse still off site.

Similarly in preheater towers, removal of refractory from cyclones generates dust, again at a high level with the potential of causing problems for neighbours, so this must be carefully controlled.

Site supervision is a critical factor on all refractory installations. The quality of the job, the safe working of the people and the speed of the installation invariably depends upon the quality of supervision

Proper planning prior to a kiln shutdown is the key to creating good safety and environmental practices. Meetings should be held with the cement engineering team and all contractors prior to shutdowns, so that every contractor is aware of what is expected of them and how their work will impact upon others. These meetings should lead to better performance, not only in safety and the environment but also to time-saving and coordination in all aspects of the repair.

So, finally, what is the cement industry looking for from a refractory installer?

Meetings should be held prior to shutdown to plan the proper execution of the jobs and they should include site engineers and all the major contractors. This then allows for open discussions and can provide an early indication of the potential impact of one job with other work that has to be done in the area or on adjacent equipment. Cement companies expect strict adherence to the site safety rules and proper documentation for risk assessments, method statements and environmental impact.

Vitaly, the repair needs to be done as quickly as possible, without compromising safety. The installation must be of the highest quality; there is no point in using high cost specialist refractories if they are not installed correctly. As mentioned earlier the key to a good, safe and speedy installation is the quality of the supervisor. 