

Suspended reality

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Refractory castable linings and CaSi board-based insulation are commonly used in cement plants. However, in some applications such as cyclones, kiln hoods and post combustion chambers, other options exist. Fireclay bricks are a suitable alternative in the construction of suspended roofs and are easier to install and repair.

Until recently, refractory linings in cement plants were mainly designed with refractory castables, primarily from low cement castable types containing SiC. This ensured high quality, sufficient resistance against wear and chemical corrosion. Chemical degradation is primarily caused by sulphates and alkalis that form following the ignition of alternative fuels.

To insulate the steel kiln shell, kiln lining was made with CaSi boards, particularly when the customer required low heat losses and reduced thermal temperatures. While the CaSi boards offer good insulation, the anchors between the castable and insulation layers often become brittle when the burning temperature reaches 800°C. This causes corrosion and a loss of strength in the anchors even though the castable blocks remained in good condition.

The repair of such blocks is complex and dangerous due to the risk of their collapse. Moreover, LLC castables are difficult to break when they are positioned and installed overhead.

Alternative solutions

To solve these issues, two alternative options are available:

- cyclones (mostly C4 and C5) and kiln hood (with straight roof)
- post combustion chamber and bullnose (with arched roof).

Cyclones and kiln hood

In cyclones and the kiln hood, the hot face is lined with brick-shaped fireclay, suspended on a T-shaped stainless steel anchor. In addition, the bricks have a tongue-and-groove construction on two or four sides to promote better fixation to the hot shell as well as offering improved stability and compactness.

The insulating layer of lightweight bricks or CaSi boards is freely placed between the

carbon steel shell and bricks, providing a 10mm air gap. This helps to cool the steel hangers. Experience shows that even after eight years of operation in the C4 and C5 cyclones, the stainless steel hanger shows no signs of corrosion or damage.

Thermal expansion issues relating to the fireclay bricks are solved by the inclusion

of an expansion joint, made from ceramic paper (it is 3mm thick and placed in a longitudinal direction, every third or fourth brick) and a ceramic blanket (transverse direction).

Post combustion chamber

Post combustion chamber roofs usually



The roof of the kiln hood at LSR Cement, Slantsy, Russia



The suspended roof in the post combustion chamber at Lafarge Cement a.s., Cizkovic, Czech Republic

Table 1: brick materials used in suspended roof construction

Indicator	Standard fireclay	Special fireclay		LCC castable 1400SiC10RA
		Brick A	Brick B	
Bulk density (kg/m ³)	2250	2200	2250	2250
Cold crushing strength (MPa)	40	60	60	80 (at 110°C), 100 (at 800°C) 75 (at 1400°C)
Al ₂ O ₃ (%)	41	25	37	39
SiO ₂ (%)	-	68	57	44
Fe ₂ O ₃ (%)	1.8	1.3	-	1.0
Fe ₂ O ₃ + K ₂ O + Na ₂ O (%)	-	-	4.5	-
Refractoriness under load (°C)	1450	1450	1350	1400

The suspended roof of kiln hood at LSR Cement, Slantsy, Russia



have an arched shape and therefore a refractory lining that consists of a suspended roof is preferred. As a result, the bricks have a wedge-shaped profile with a tongue-and-groove construction and two holes on each side. Lightweight bricks or CaSi boards form an insulation layer.

The suspension of two bricks can be carried out in one of two ways:

- from an anchor head made from a high-temperature alloy and a hook made from stainless steel
- anchor head from stainless steel bar which is hooked onto a longitudinal bar. The bar is loosely fitted into a steel loop

welded onto the carbon steel shell. The advantage of the suspended-roof solution is that the bricks are not firmly fixed by the suspended structure, which allows for some brick movement.

At Holcim's Slovakian cement works, this solution has been in operation for the

past six years and no signs of damage have been observed. Hot face bricks can also be made from LCC castables. The selection of suitable material depends on the working conditions and other factors in the cement plant.

Benefits

Despite the production of brick shapes being more time-consuming, this approach offers several benefits:

- The bricks are easier to install when compared with casting.
- There is no formwork required.
- The drying process is quicker and easier
- Possible repairs are easier, and therefore safer, to carry out.

When it comes to cost, there is little difference between a suspended roof made from fireclay bricks and one constructed from LCC castables. In the case of the brick shapes being made from castable, the price is then higher than the casted roof counterpart. _____

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