Preheater cyclone protection

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The preheater system of a cement plant is often characterised by aggressive and high-temperature operating conditions. Moreover, the increasing use of alternative fuels adds further demands to an already-complex operating environment. The use of high-quality, specially-developed refractory bricks can help protect key equipment such as cyclones from issues including alkali attack, chloride and build-up.

The preheater system is a major part of efficient cement production. Temperatures in this area can vary between 350-950˚C and local refractory solutions are based on the prevailing temperature and aggressive conditions.

Along with the development of high-efficiency cement plants, the requirements placed upon refractory manufacturers have become even more complex. The rising use of alternative fuels such as tyres, plastics or household wastes dramatically increases the occurrence of alkali attack, chloride and build-up problems on the preheater lining. The refractory lining suffers from infiltration and the corresponding destruction of the refractory microstructure, and a change in the physical properties of the materials can be observed.

Generally, refractory maintenance of preheater cyclones is undertaken after several years. Therefore, a suitable, tailor-made design combined with a superior alkali-resistant brick quality will prove to be an economical solution and prolong the service life of cyclones.

Cyclone protection against alkali and abrasion

Höganäs Bjuf's Viking 330, a dry-pressed version of Bjuf SX, withstands alkali and abrasion issues in cyclones. Based on fireclay, its main physical properties combine a low density (2.31g/cm^3) with optimal porosity (18 per cent). The refractoriness under load, T_{05} equals 1330˚C and T_5 equals 1430˚C. Thermal conductivity at 500˚C is 1.8W/mK, remaining 1.8W/mK at 1250˚C.

In terms of chemical composition, the new brick comprises Al_2O_3 (35 per cent), TiO_2 (1.8 per cent), SiO_2 (59 per cent), Fe_2O_3 (1.7 per cent) and CaO (0.4 per cent).

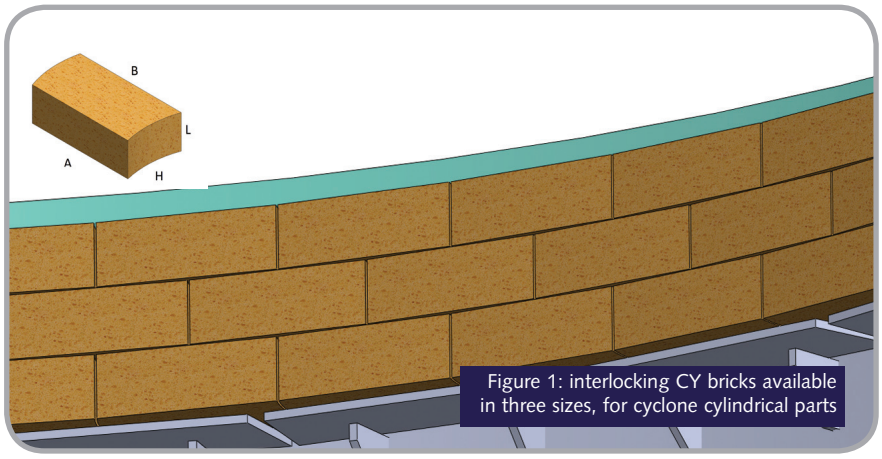


Figure 1: interlocking CY bricks available in three sizes, for cyclone cylindrical parts

It is well known that a brick matrix structure of 30-35 per cent alumina consists of 30-35 per cent mullite and 60-65 per cent silica. As the alkalis come into contact with the brick, they first only attack free silica and then mullite. The reaction of silica and alkali creates a viscous glassy phase that covers the surface and stops the alkali attack. In comparison, the reaction of mullite and alkali leads to volumetric alkali aluminosilicate phases and cracks on the bricks, instead of creating the protective glassy phase. Under these conditions, the chemical composition of Viking 330 provides protection in cyclones that need resistance against alkali attack.

Additionally, during an alkali cup test Viking 330 showed a good alkali resistance of <4cm^2.

Securing stability

The alkali performance of Viking 330 has been further optimised with a specially-tailored design. Due to the large diameters of a cyclone, it is often difficult to keep bricks in place. Therefore, CY interlocking bricks have been developed to secure the line stability of the cyclone's cylindrical parts (see Figure 1).

CY bricks come in three different sizes: CY2, CY4 and CY6. They are installed in ring formation, whereby the combination of two CY bricks per ring is accurately calculated using specific software. Their lining thickness is 115mm, bonded together with mortar. An insulation layer of 65mm calcium silicate boards or

Tried and tested

Various tests have been conducted to prove the physical and chemical properties of Viking 330, including:

- **bulk density/apparent porosity tests, according to EN 993-1:1995**
- **cold crushing strength (EN 993-5:1998)**
- **thermal shock resistance (ENV 993-11:2007)**
- **water quenching method**
- **refractoriness under load (EN ISO 1893:2008)**
- **thermal conductivity (EN 993-15:2005).**

Figure 2: conical parts of cyclones, lined with the combination of side-arched 11 series and end-arched 12 series bricks in various sizes

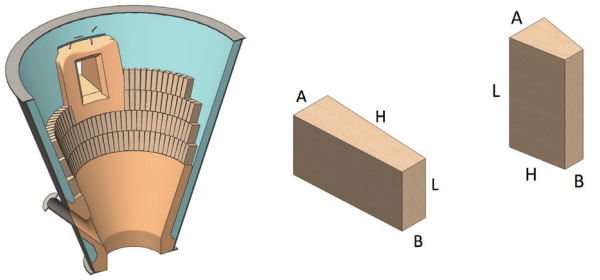
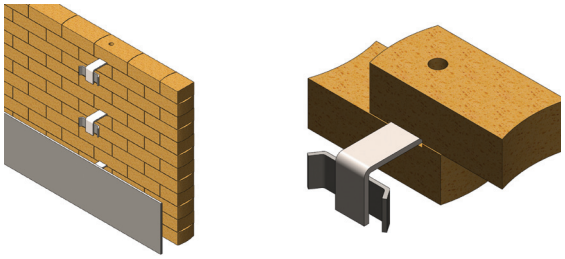


Figure 3: vertical plane walls, line with CY bricks in combination with anchor bricks



insulation bricks creates a stable and long-life lining.

The conical part of cyclones (see Figure 2), is lined with the combination of side-arched 11 series bricks and end-arched 12 series bricks. The lining thickness of these bricks is 114mm and can be installed together with mortar and back-up insulation of 65mm calcium silicate boards or insulation bricks. Vertical plane walls are lined with CY bricks (see Figure 3), in combination with anchor bricks. For the cyclone roof, a brick shape 6620:10 of 200mm thickness hangs on IPE steel beams centre to centre 200mm (Figure 4). An optional insulation layer of 65mm calcium silicate boards is installed above the brick lining and ceramic fibre insulation blankets are placed within the lining for thermal expansion protection.

Conclusion

Höganäs Bjuf's Viking 330 brick's tested chemical and physical properties combined with its design deliver an improved protection against alkali attack in the aggressive operating conditions of a cement plant's preheater system.

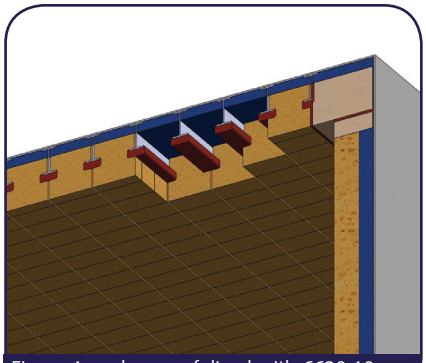


Figure 4: cyclone roof, lined with 6620:10 brick shape, hanging on IPE steel beams centre to centre 200mm