



## The project

Holcim (Costa Rica) S.A. operates a cement plant in the centre of Cartago. Converted from wet process to dry process in 1974, its kiln was producing 1450 tpd at the turn of the century. In order to meet the rising demand for cement in the country and in Nicaragua, Holcim launched a modernisation project aimed at increasing production capacity, and including up-to-date environmental issues such as lowering emissions, energy efficiency, and the use of alternative fuels.

In 2002, Fives FCB (formerly FCB Cement) received an order for a new production line and an additional cement grinding unit. Other parts of the plant, such as the raw materials preparation and grinding sections, and main process filters, received partial upgrades.

The production capacity of the new line is 3000 tpd, but with the upgrading project not yet complete, it can only operate at 2400 tpd. The capacity limitation is determined by the reuse of old components, the

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# Lowering Emissions



Figure 1. The Cartago plant.

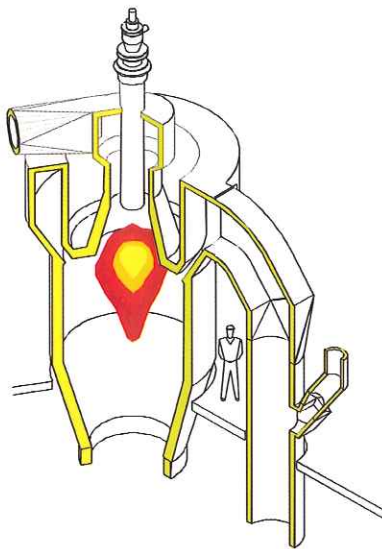


Figure 2. General design of the FCB Low-NOx precalciner.

Table 1. Equipment of the new production units

Equipment	Manufacturer
Rotary kiln, 3-piers (4.5 m dia. x 70 m, 3000 tpd)	Fives FCB
Preheater (5-stage) and Low-NOx precalciner	Fives FCB
Burners (kiln, precalciner)	Fives Pillard
Cement HOROMILL® (110 tph)	Fives FCB
TSV classifier (4.5 m dia.)	Fives FCB
Process filters for mills	Fives Solios
Clinker cooler (compact swing support HE6-1029-1029)	Claudius Peters
Pozzolana mill (45 tph, dry)	Gebr. Pfeiffer AG
Hot gas generator (17 MW, coal)	Fives Pillard
Preheater ID fan	Howden
Spray cooling of kiln fumes	Envirocare
Raw materials PGNAA analyser	Scantech

existing raw material handling and grinding sections, as well as the main kiln dedusting systems. The FCB 5-stage preheater kiln system is equipped with a downstream Low-NOx precalciner, designed for burning high sulfur petcoke and alternative fuels (AFR). A HOROMILL® 3800 was chosen for the new cement grinding unit, as it is energy efficient and produces high quality cement. Its 110 tph capacity adds to the production of two existing ball mills. In addition, a pozzolana mill has been installed to complete the supply of additives to all mills. The new production line was commissioned in September 2004 (see also *World Cement*, October 2005).

### The FCB Low-NOx precalciner

The FCB Low-NOx precalciner system (hot spot type) consists of a precombustion chamber and a calciner string vessel. It operates with a parallel direct current flow of the central combustion gas and the covering meal curtain, in comparison with the designs of competitors that use a tangential swirl. To ensure an equal and stable meal curtain, the meal is mixed into the rising part of the tertiary air duct. This suspension is then fed into the precombustion chamber around the flame through a ring-shaped opening. This design ensures the control of a stable, hot-centred burning zone in the core of the pre-combustion chamber, which is equipped with a multichannel, Low-NOx burner, providing flexible control of the flame shape.

The calciner has been designed to fire a wide selection of fuels, and the high performance burner ensures efficient fuel ignition. A good burnout can be obtained without the installation of excessive gas residence times at the calciner vessels. In the Hoang Mai plant (Vietnam), which began operation in 2002 with a capacity of 4000 tpd, a stable operation with very low reactive anthracite coal and a total gas residence time of 4.5 s can be achieved. No fuel oil is required to support the combustion.

At the Cartago plant, the kiln line was designed for the combustion of 100% petcoke. The total gas residence time of the calciner was designed for 4.5 s, and is capable of firing low grade alternative fuels. The precalciner is fitted with an 80 MW multichannel ROTAFLAM® burner supplied by Fives Pillard, for the combustion of petcoke and alternative fuels.

### Precalciner operation

The burning line performance tests were carried out shortly after the start-up, firing Colombian coal. With a production rate of 2660 tpd, the level of heat consumption reached 3093 kJ/kg. Since February 2005, the kiln line has been operating with 100% petcoke, maintaining low NOx emissions.

In order to further reduce NOx emissions, Holcim and Fives FCB conducted common research to assess the NOx formation mechanism of the precombustion chamber. The three objectives were:

- Investigate flame-shaping in the calcination chamber, combustion and NOx formation.
- Clarify the influence of operating parameters on the NOx generation, in order to define correct adjustment strategies according to the fuel qualities used.
- Anticipate the use of alternative fuels.

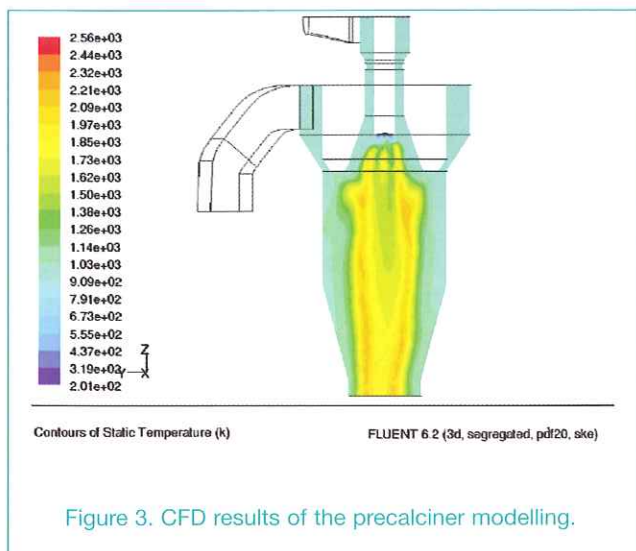


Figure 3. CFD results of the precalciner modelling.

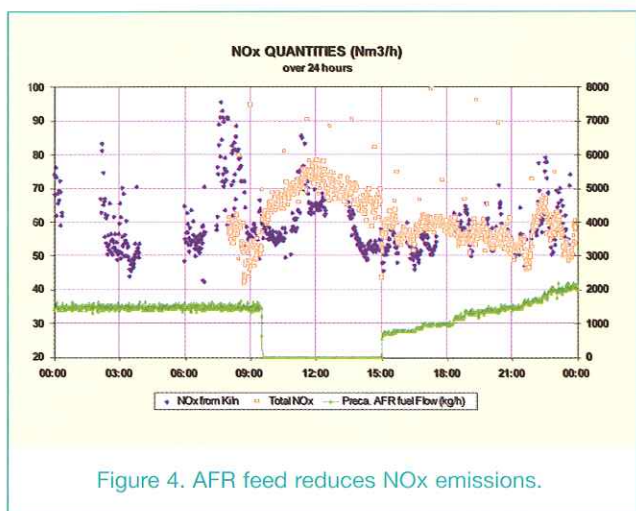


Figure 4. AFR feed reduces NOx emissions.



Figure 5. The preheater with coarse AFR feed conveyor.

Figure 3 displays the results of a CFD calculation realised in the Research Department at Fives FCB; the development of the flame can be seen right in the middle of the chamber.

The geometry of the real flame corresponds with that of the calculations. Measurements performed onsite at the precombustion chamber confirmed the symmetry of the flow and of the temperature gradients. With combustion parameters fixed at optimum levels, flame stability is high, allowing the burning of large amounts of alternative fuels, ignited by petcoke flame, while keeping NOx emissions as low as possible.

A stable and efficient ignition in the hot spot zone of the precombustion chamber favours a quick use of oxygen with a low air ratio and low NOx generation levels in the combustion zone, even when using petcoke and alternative fuels. During tests, NOx levels below 500 mg/m<sup>3</sup> could be achieved without using SNCR.

Alternative fuels are fed to the burning line, take advantage of the high temperatures in the kiln and precalciner, and burn efficiently without forming noxious compounds. Waste liquids are fed to the kiln burner, while shredded material is fed to the precalciner. In addition, small amounts of miscellaneous materials can be introduced at the kiln inlet. The FCB precalciner system ensures a high level of flexibility when firing coarse AFR with high flame stability. A gas residence time of 4.5 s is sufficient to ensure complete combustion. All gas components measured continuously at the stack (CO, NOx, SO<sub>2</sub>, NH<sub>3</sub>, HCl, VOC) are significantly below the legal limits.

The use of AFR in the precombustion chamber contributes to a reduction of NOx emissions by 10 - 15% (see Figure 4).

### The HOROMILL® grinding workshop

The new HOROMILL® cement grinding unit completes the capacity of the two existing ball mills. It has been designed for a production capacity of 110 tph of MC cement (composite cement with ca. 20% pozzolana meal and 11% limestone, and a 30 MPa resistance).

As already mentioned, the main components of the grinding plant are the HOROMILL® 3800 and the TSV 4500. This energy-efficient equipment is well-suited to the Costa Rica plant, where a shortage of energy can cause large machinery to shut down. The plant is also very flexible and easy to drive, with a full automation system that includes starting and stopping, and the ability to become stable within 10 minutes. The average net availability of the mill over the last year has been 86%.

The grinding plant began operations in February 2005, and performance tests were completed two months later. The results showed energy consumption to be 22.2 kWh/t of cement for the workshop, including handling systems from clinker transportation to cement silo feeding.

The plant is capable of producing other types of cement to an equally high standard. For example, with CPC 40 (a cement with 4000 cm<sup>2</sup>/g, produced from 4% rough pozzolana and 12% limestone), production was 91 tph, and mill consumption was only 19.6 kWh/t.

**Low-NOx precalciner  
your cement requires  
safe emissions**



Increase your production and cut the NOx emissions with the Fives FCB Low-NOx precalciner:

- Hot Spot – Downdraft design
- Multi-channel burner
- Staged combustion
- No swirl – No segregation
- Adaptable residence time
- Zero NOx emission

At Holcim Costa Rica burning 100% petcoke & AFR, the NOx emissions at stack are below 500 mg/Nm<sup>3</sup> at 10% O<sub>2</sub> without SNCR system.

Thanks to the Low-NOx Precalciner and to other innovative solutions, Fives FCB designs today the cement plants of the future: more efficient, more environmentally friendly and more economical.

