Teresa plant, the Philippines: cement grinding plant.
Loïc Pottier, Fives FCB, discusses options for the reduction of electrical demand in the cement manufacturing process.

Introduction
Competitiveness is contemplated through cost reduction aspects, which, in the field of cement manufacturing, is synonymous with energy consumption savings. This has led, during the last two decades, to the emergence of innovative technologies in the field of grinding, aiming at reducing its electrical demand. The FCB Horomill® was developed and came to the market in the 1990s with this target, which it has fulfilled.
However competitiveness is also in accordance with the ability of the company and products to quickly adapt to a changing market with minimised capital expense. In the cement industry, this means either offering new cement types to the market for higher differentiation or being able to process a wide range of material and additives, upon availability.

The latest evolutions of the FCB Horomill plant fit with this requirement: from coarse to very fine product, from dry to highly moist material, and from soft to very abrasive compound, the FCB Horomill is suitable for multiple applications.

**Raw meal grinding**

The conventional FCB Horomill grinding plant is composed of a mill operated in closed circuit with a third generation separator, the FCB TSV™ classifier, filter and fan. It has from the early stages, demonstrated its ability to drastically reduce power demand for cement grinding in comparison with other technologies on the market, with figures ranging from 40 – 50% compared to conventional ball mill or 20 – 25% compared to vertical mill. The evolution of the FCB Horomill plant has seen increased capabilities, particularly within the raw meal grinding application through the incorporation of a flash dryer in the gas circuit, thanks to the unique system concept with the grinding and classifying functions being dissociated. The recent commissioning of three different raw grinding plants has provided a representative picture of its ability in raw meal grinding applications including low energy consumption, a high drying capacity, zero water injection, and high resistance to wear.

**LafargeHolcim case study**

The first reported example is the LafargeHolcim plant of Barroso, Brazil, where a FCB Horomill 4400 has been installed to feed the 4500 tpd clinker production line. Raw materials are known to be hard and abrasive, with total moisture reaching up to 5%. The raw meal department has been sized for a 17 hour/day operation in provision for a periodic roller refurbishment on a 420 tph production basis (dry) at R90 µm <12%, and is fitted with a FCB Aerodecanter – Flash dryer.

The performance guarantee test was successfully achieved, with a 438 tph production rate at R90 µm = 11.2, an electric specific consumption of 5.4 kWh/t for the...
mill only, and 10.8 kWh/t for the mill department at power meter (including mill, bucket elevators, classifier, main fan, dedusting fans, feed and rejects belt conveyors, metal detector, and vibrating feeder).

In addition, the FCB Horomill in Barroso benefits from an automatic welding system, allowing for an in-situ refurbishment of the grinding roller and the grinding track.

**Cementos Fortaleza case study**
The second reported case is the Cementos Fortaleza plant of Tula, Mexico, wherein three identical FCB Horomill 3800 have been installed, one for raw grinding and two for cement grinding, as part of the new 3300 tpd production line.

The raw grinding plant is similarly fitted with the FCB Aerodecanter – Flash dryer within the FCB TSV™ classifier gas circuit, as the total feed moisture can reach up to 6%. Performances of the grinding plant were successfully met, with a production in excess of 300 tph of raw meal at R90 µm = 11.8%, an electric power consumption of 6.9 kWh/t for the mill only, and 11.2 kWh/t for the whole workshop, inclusive of weigh feeders, belt conveyors, bucket elevator, and transport to homo-silo.

The Tula plant mills installed by FCB Horomill offer the unique opportunity of having identical mills for raw and cement grinding plant, allowing for only one single set of spare parts for these two distinct sections.

**Lone Star Industries Inc. case study**
The third reported case study refers to the Buzzi Unicem US plant in Texas, hosting another FCB Horomill 3800 for raw meal grinding. The plant design is also inclusive of an aerodecanter flash dryer. The average electrical performance of the milling plant is, for R90µm=12% raw meal fineness, 11.5 kWh/t only for the hole grinding plant main consumers.

Through these figures, the FCB Horomill plant consistently demonstrates its ability to grind raw meal with the lowest energy consumption, while ensuring an efficient drying of the mix. While the previously mentioned max total moisture is 6%, another plant operating in Mexico is effectively dealing with a total moisture content reaching 9% during the wet season.

Recently, to confirm the performances of the FCB Horomill grinding plant worldwide, Fives FCB gained two new raw grinding plants for La Cooperativa Cruz Azul, Mexico, for their plants expansion of Hidalgo and Lagunas.

**Cement grinding: moist additives and fine products**
As the FCB Horomill is not air-swept, drying is achieved in the gas circuit of the classifier, dissociated from the mill, in the rising duct below the separator. The drying consists of the direct feeding of the moist material into the riser. The arrangement design and chosen equipment of the grinding plants are selected according to the type of material to be dried, grain size, and moisture content. Since dried and hot after flashing and classification, the external material circulation, including the rejects, act as a dilution for moisture when mixed with the fresh feed. This facilitates material handling in case of raw mix, but also allows control of the moisture content into the mill.

Such an arrangement allows for an easy and effective incorporation of large amounts of wet additives in the cement mill circuit with no drawback on the mill operation. As a significant example, the FCB Horomill plant in operation in The Philippines at Republic Cement’s Teresa and Norzagaray plants are producing 1P cement type with a C/K ratio of 1.8. The main additive is a natural Pozzolana having a moisture content of up to 25%.

A heat source is provided either by the clinker cooler exhaust gases or by a hot gas generator and with drying being achieved on a flash mode, the required heat quantity is optimised. In addition, the mill stability is controlled by an active material flow control system, which makes water injection in the mill irrelevent, ensuring the optimal thermal balance of the FCB Horomill grinding plant. This has a significant impact when considering stand-alone cement grinding installations, as the hot gas generator is the only heat source and the corresponding fuel consumption is a critical operational cost.

Moreover the absence of water injection in the mill has another two very sensitive impacts on the cement grinding process. The first is that it drastically reduces the potential of cement pre-hydration. Known drawbacks of cement pre-hydration are the risk of silo blockage and a decrease in cement performance. Known remedies to this loss of performance are either an increase of the cement fineness and corresponding specific energy consumption, the addition of costly grinding aids, or the reduction of the additives percentage in the recipe. The second is that it prevents heavy wear of the mill, limiting abrasion between wear parts and reducing maintenance costs. The ‘zero water injection’ working principle is achieved by specific control of the material bed together with an accurate measurement of the circulating load, which ensures mill stability.

The C/K ratio increase goes hand in hand with an increase of the cement fineness in order to compensate the decrease of reactivity. For example, a 5% increase of clinker substitution at constant cement performance, corresponds to a 10% fineness rise (Blaine), as per in house tests conducted on Pozzolanic cements. As a consequence, finer grinding leads to an increase in electrical consumption, but the inherent savings on material cost overwhelm the additional electrical consumption. In the above simulation, based on US$0.10/kWh and US$22/t material cost difference
between clinker and additives, the net saving is around US$1/t.

Such strong arguments illustrate why market trend has turned toward fine or very fine cement, generally in the range of 4000 – 5000 Blaine, which the FCB Horomill plant achieves efficiently with no need for water injection or variable speed control of the mill.

**Supporting quick penetration into new markets**

Standalone grinding stations currently represent another strong growth trend, particularly in emerging and booming markets. A significant number of cement producers have recently chosen modular grinding plants in their last investments. Modular grinding plants provide the advantage of a fast installation deployment, minimise the work to be performed onsite, and reduce capex exposure and risks compared to conventional grinding plants.

But on the other hand, standalone grinding plants are strongly dependent on locally sourced raw materials, as well as clinker, which is subject to extensive transport and multiple trans-shipments. This may result in variable quality, seasonal moisture content, and more dusty and fine clinker.

Based on the FCB Horomill plant concept and the multiple feed-point opportunity offered by the FCB Aerodecanter, Fives is now addressing this quick-access market with the FCB FLAG Station, a combination of the FCB technologies within a modular-based grinding system aimed at covering the widest range of cement and slag grinding applications.

The FCB FLAG Station allows for the collecting of a very fine fraction of material generated by multiple haulages and trans-shipments, before entering into the mill, thus ensuring a comfortable mill stability margin. It also offers a competitive, simple, and proven solution to cement producers willing to capture new and potentially changing markets in the fastest way.

**Conclusion**

Whether considering raw meal grinding, cement grinding, or slag grinding, the FCB Horomill plant demonstrates the ability to operate at the lowest operating costs, while also maximising production. It offers the possibility to install one single type of mill in a complete plant with raw meal and cement being ground in identical mills, leading to minimised capital expenditure for spares, common training requirements, and simplified maintenance organisation.

**About the author**

Loïc Pottier has a masters degree from ICAM Lille-France’s School of Engineering. He has experiences in the automotive industry and the oil and gas sector. Since 2006, he has been the Area Sales Manager for Fives FCB, and has been in charge of the Middle East and North Africa from 2006 to 2013, and for Africa independently since 2014.