Introduction
The Cam Pha Cement project was initiated in 2003 by Vinaconex, Vietnam, aiming for a production capacity of 1.8 million tpa of cement. The project included the construction of two new plants: the main plant for the production of clinker, located in Cam Pha, Quang Ninh province, north Vietnam, and a cement grinding plant, installed in My Xuan, Ba Ria Vung Tau province, in southern Vietnam. The first step of the project was the erection of this second plant, with a capacity of 240 tph of PCB40.

In 2004, Fives FCB was awarded the order as the main supplier and coordinator for design and supplies. The handling and storing portion was awarded to FAM, while the electrical and automation portion was awarded to Siemens.
An innovative solution

Vinaconex selected the Fives FCB HOROMILL® for the grinding plant.

With more than 15 years of experience and 40 mills running throughout the world, these grinders have accumulated more than 1 million hours of operation. The HOROMILL® workshops with the valued TSV™ classifier have proven to be advantageous and valuable towards sustainable development.

**HOROMILL®**

The HOROMILL® provides 40% energy savings compared to the ball mill, and 20% compared to a vertical roller mill. It is a compact machine installed in a compact grinding plant. The small quantity of materials present in the milling circuit minimises the duration of the transition periods when changing cement qualities, which avoids the production of out-standard cement.

Industrial tests made with cement produced with a HOROMILL® show that the fineness of the cement (expressed as Blaine) can be reduced compared to other systems, for a given target of concrete characteristics (water demand, resistance); additional power savings can therefore be achieved.

The HOROMILL® is a stable machine that does not need any water injection in cement grinding, be it to control the machine or to control cement temperature. This leads to a better cement quality and avoids water consumption. The production capacity does not decrease when the lining becomes worn, and a HOROMILL® plant is a fully automatic system.

**TSV™ dynamic separator**

The set-up involves a patented turbine with blades leaving room for a separation zone that is 5 - 10 times longer than in other classifiers. This leads to a high separation efficiency, with a very low bypass value and no oversized particles. A patented anti-vortex device is in place, allowing very low pressure drop and power consumption.

The TSV™ dynamic separator can be fed through both the top and the bottom, offering a wide range of installation possibilities.

For the Cam Pha cement grinding plant, Fives FCB proposed an innovative concept: the twin HOROMILL®, which consists of two identical grinders using a common gas and selection circuit, with only one TSV™ classifier and one filter, and also only one feeding system.

This particular arrangement allows a more compact building structure, which leads to a
reduction in investment costs. A high production flexibility is also achieved - periods of low production (>50 %) can be achieved with normal operation of the mills. Additional benefits include: a more flexible maintenance programme, less disturbance on the power network at start-up and optimised spare parts management and minimum spare parts investment cost.

Vinaconex was the first company in the world to install this innovative solution.

The mill plant

The process arrangement of the plant is displayed in Figure 2.

The main equipment used at the grinding plant comprises 2 x HOROMILL® 3800s. They each process half of the materials and use one common gas circuit. The mills are not ventilated, (only dedusted) and their outputs directly feed two bucket elevators. These feed one common 6500 mm dia. dynamic classifier TSV™.

The finished product is collected through the bag filter and transported to the cement silo by airslides. The classifier rejects fall into the intermediate reject bin, the two outlets of which feed two belt conveyors transporting the materials back to the mill. These return belt conveyors are equipped with two belt scales and have a variable speed drive to control the flow of materials recycled to each mill.

A split gate at the fresh feed inlet is used to balance material feed between the two mills. One of the mills is fed with the fresh feed directly after the split gate, whereas the feeding of the second one takes place via a belt conveyor. This simple system is sufficient because there is no need to precisely control the split of fresh feed between the two mills, the mill load being controlled through the reject flow.

Some of the gas is recirculated from the outlet of the bag filter to the classifier. The remainder is sent directly to the chimney stack. Fresh air can be introduced into the gas circuit to control the finished product temperature, while a hot gas generator has been added to the workshop for the use of high-moisture additives (pozzolana). Cement temperature is thus precisely controlled to produce consistent quality cement.

The main equipment of the grinding plant is listed in Table 1.

Commissioning

The contract was effective from October 2004. The main equipment was delivered within just 16 months - notable when a steady demand for steel and
equipment worldwide was inducing high delays for large equipment parts.

The first HOROMILL® became operational on 27 December 2006, and the second one on 6 January 2007.

From 11 January, fully-automatic twin-mill operation was effective and successful.

As with the classical single HOROMILL® plant, the twin-mill operation is fully automatic. The complete start-up of the plant is ensured from the CCR by the operator according to the production needs with only three mouse clicks:

- Selection of the operating mode: single or twin.
- Selection of the product recipe, including all the grinding plant settings to ensure the final cement production and quality, from the cement composition to the target silo.
- Auto-start.

The main steps of the automatic start-up sequence (mentioned above) can be described as follows:

- Start of the hydraulic pressure unit and the lubrication system.
- Start of the cement transport.
- Start of the gas circuit and setting to its nominal operation.
- Start-up of one mill (the fresh feed split gate is set to feed 100% material to this mill). After the lift-up of the roller and starting of the mill main motor, the roller goes down and the mill is fed with material.

Three minutes later, the circuit is stabilised and the other mill can start without disturbing the first mill. At the material feed, the set points are modified. This involves doubling the nominal fresh feed flow and the speed of the main feed belt, quick positioning of the split gate to its intermediate position, and start-up of the reject feed to the second mill.

The stability of the system is ensured by regulation loops and automatic procedures. The quantity of material through each mill is adjusted with the reject belts, the total fresh feed flow is controlled according to the material level in the intermediate hopper, and the stability of the final product quality is ensured by the constant air flow through the TSV™ classifier and its rotor speed.

Stoppages are also managed in a fully-automatic manner. Should one of the mills stop for any reason, the split gate is quickly moved to feed the only running HOROMILL® and the nominal fresh feed flow is cut by half. The stoppage of one mill has no influence on the operation of the second, nor on the finished product quality.

Automation is one of the most important parts of the commissioning period. All the sequences are previously tested without material, and at the Cam Pha plant, they were successfully validated during the on-load commissioning.

Performance

As the main plant at Cam Pha was not yet in operation at the time of commissioning, imported clinker was used for the performance tests. In spite of this and the variations of the clinker quality, the plant fulfilled the guaranteed figures in terms of production rate, cement quality, and energy consumption.

The results for PCB40 with 4% gypsum and 16% pozzolana are shown in Table 2.

The performances of the TSV™ classifier are also very good, with a cumulative fines efficiency over 83%.

Conclusion

The HOROMILL® and the TSV™ have proven themselves to be efficient, thereby facilitating the cement production process.

With the installation of the twin HOROMILL® at the Cam Pha grinding plant, stable operation was obtained very quickly during commissioning, and the new concept has proved its flexibility. The grinding workshop produces more than 240 tph of cement with a total electrical consumption below 24 kWh/t.

This success in Vietnam opens the way to other new innovative plant projects. Fives FCB is involved with more twin units to be erected next year: two for the Rizhao Jinghua (P. R. China) plant, and a third at the Vinacon Thanh Nguyen (Vietnam) plant.

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**Table 2. Performance results**

<table>
<thead>
<tr>
<th>Workshop (kWh/t)</th>
<th>Production (tph)</th>
<th>Compressive strength 28 days (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guarantee figures</td>
<td>24.0</td>
<td>240</td>
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<tr>
<td>Period A</td>
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<td>249</td>
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<tr>
<td>Period B</td>
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