Revival of the GMD in cement

by Matthias Neurohr, ABB Switzerland Ltd

When ABB built its first Gearless Mill Drive (GMD) for a cement plant in France, no-one would have ever imagined the road of success this technology would take over the years. Close to 90 units have been installed worldwide and mill sizes have constantly grown since then – what was thought impossible yesterday has become accepted technology. In 2011, ABB will once again make history with an installation of a 40ft, 28MW SAG mill GMD and two 28ft, 22MW ball mill GMDs at Toromocho (Minera Chinalco Peru) at the unprecedented height of 4600m above sea level.

In past years, the demand for GMD technology has been dominated by the minerals industry, but there has been a recent increase from the cement industry, where a continually growing real estate sector and increased activity in infrastructure development worldwide have fuelled a high as demand levels are way beyond installed capacity.

India's cement industry – currently the worlds second biggest after China – has witnessed tremendous growth and is experiencing a boom as well as stiff competition due to the overall growth of the Indian economy. The demand for cement depends primarily on the industrial activity, real estate business, construction activity, and government initiatives in the infrastructure sector. India is experiencing growth on all these fronts. It is therefore not surprising that due to the lucrative cement business, the world's leading cement firms and infrastructure giants like Lafarge, Holcim, Italcementi, Vicat, CRH Plc are looking to enter the Indian market, sparking off a spate of mergers and acquisitions.

According to the Centre for Monitoring Indian Economy (CMIE), total installed capacity (excluding mini plants) has increased from 165Mta in 2006-07 to 198Mta during 2008-09 and is expected to increase to 241Mta by FY2009-10 end.

At the same time, cement production also contributed to roughly eight per cent of worldwide anthropogenic CO_2 emissions in 2006, 10 per cent of which come from the electrical energy consumed. In cement production, energy cost incurred due to the need for large quantities of thermal heat for the kiln, calcinations and drying processes as well as electrical energy for operation of motors for grinding mills, fans, conveyers etc account for 50-60 per cent of the direct production cost. Reducing power consumption therefore reduces the carbon footprint of a plant.[1]

In this climate, Technocrat Mr P Subba Raju and partners established Lalitha Cement Limited (LCL) on March 5, 2004 with the aim to build a major cement plant that is environmentally sustainable.

Mr P Subba Raju, MD Lalitha Cement, and Abdellah Nahdi, senior sales manager ABB Switzerland during signing of the contract

"The population in this country is growing fast which leads to thickly populated cities. People require infrastructure, projects for food and agriculture and homes for those living below the poverty line. Cement will help provide these needs.

My dream is to harness the natural resources available in India and produce cement in an environmentally sustainable way by minimising energy consumption and CO_2 emissions – for the benefit of the people in India."

Mr P Subba Raju, chairman & managing director Lalitha Cement

To achieve this goal, LCL applied energy efficient equipment such as the horizontal roller mill (Horomill) for the raw mill and a GMD system for the cement mill to reduce operational expenditure which leads to energy savings.

The cement plant will be coupled with a 15MW co-generation thermal power plant to meet its power requirements. There are also plans for a separate waste heat recovery power plant using the low-grade waste heat from the kiln and the cooler.

In November 2009, ABB won a contract to supply a 4.8MW at 15in foot-mounted ringmotor of the new GMD design suitable for cement applications. The motor is powered by a water-cooled cyclo-converter and will operate at the centre piece of Lalitha's new 3000tpd state-of-the-art cement plant located 210km east of Hyderabad in the village of Raghunathapalem, Andhra Pradesh, India.

Delivery of the equipment is due by the end of 2010 with commissioning envisaged to be completed during 1Q11.

"We have selected the new ABB GMD for cement as it enables us to reduce operational expenditures – firstly through minimal maintenance which allows us to operate with less maintenance personnel, secondly through increased efficiency which results in energy savings and thirdly through less dependence on fossil fuel (lubrication oil) which is expensive and difficult to store."

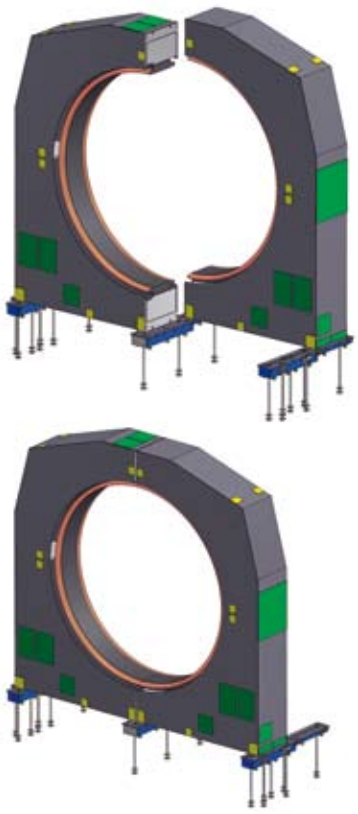

Figure 1: the new gearless mill drive for cement comes in two segments

Benefits of the new GMD for the cement industry

After the unprecedented success in the minerals industry, ABB has been investing in adapting its successful GMD design to a smaller scale that is suitable for the cement industry where mill sizes typically range between 15ft and 18ft.

The aim was to offer a low-cost, efficient and easy to assemble GMD that embodied 40 years of mill drive experience in the mining industry.

While larger mill drives come in four or even five segments that need time-consuming interconnection on site, the new cement GMD comes in just two segments: one left and one right piece (see Figure 1).

The previous pedestal mounted design has been replaced with a foot-mounted motor that requires less complex civil foundations. The inherent variable speed feature will allow cement clients to optimise the processes and adapt to the changing hardness of the clinker to achieve the most profitable cement quality. The finer the cement particles the higher the reaction rate when mixed with water, which in turn will result in faster gain of compressive strength at earlier stages – which has a direct effect on the grade OPC produced.

Figure 2: three-phase synchronous ring motor (wrap around motor)

Stepless speed control from zero to 100 per cent will ensure a smooth mill start, minimising high inrush currents that could have a detrimental effect on weak networks.

At the same time, the inherent torque control makes sure the mill is brought to a controlled stop – eliminating nuisance mill rocking.

Figure 3: fitting of rotor poles on a large SAG Mill

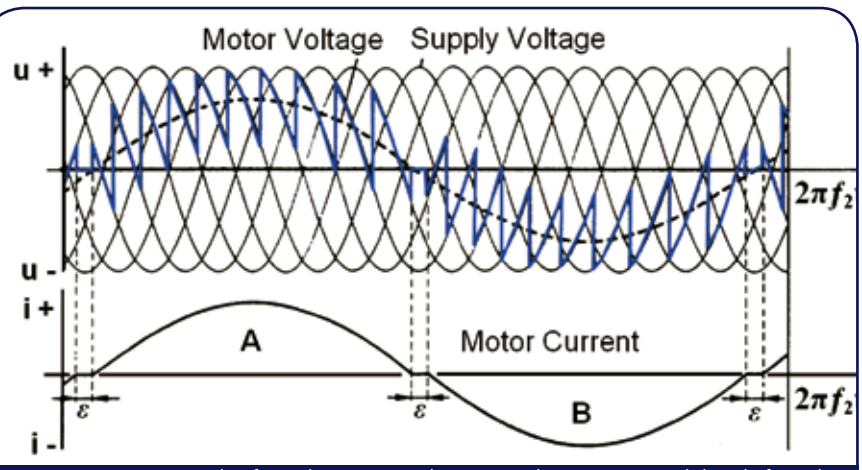

Figure 4: operating principle of a cyclo converter: the motor voltage is generated directly from the supply voltage

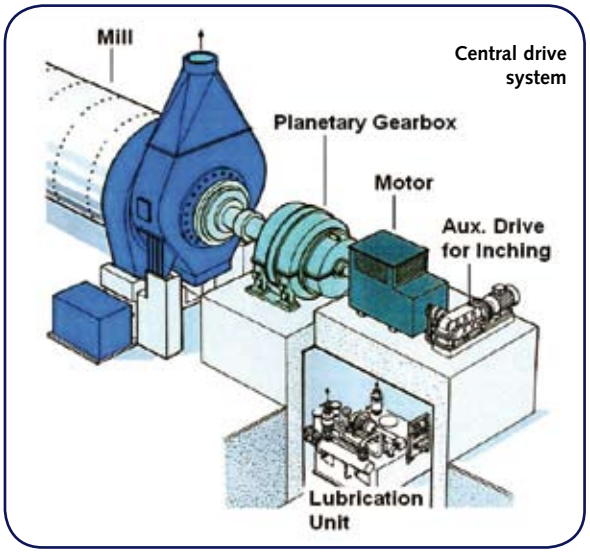

Figure 5: torque transfer happens through a planetary gearbox which inherently produces friction losses and requires regular lubrication to avoid premature failure. Auxiliary drive required for inching

ABB GMDs are synonymous with low maintenance. The ring motor has only two wearing parts – brushes for the excitation of the rotor field and dry seals – hence all maintenance can be scheduled and performed during planned downtime (ie scheduled liner replacement etc). ABB's dry sealing design uses no grease and – together with the make up fans that create an overpressure inside the motor – effectively prevents dust from entering the ring motor housing.

As a result, an ABB GMD increases the availability of your mill which will boost production and revenues.

Figure 6: torque transfer happens through the pinion which inherently produces friction losses and requires regular lubrication and alignment to avoid premature failure. To run the mill at slow speeds ie, to replace liners, either a variable spped mill drive system or an additional auxiliary drive is required

General concept

The three-phase synchronous ring motor (wrap-around motor) is installed concentrically around the mill.

The mill shell carries the rotor poles which are individually mounted to form an even air gap with the wrap around motor.

The number of poles (up to 76 poles on larger SAG mills) as well as the way the poles are mounted depends on the size of the motor. Figure 3 shows the mounting of poles on a large SAG mill.

All rotor poles are connected in series and powered from sliprings with a DC current to produce a static magnetic field. Brushes connect the slip rings to the field supply unit located in the cyclo converter control panel.

The torque transfer happens across the airgap by electro-magnetic forces – no mechanical coupling. The ring motor is driven by the cyclo converter which generates an alternating three-phase magnetic field in the motor windings.

Unlike conventional frequency converters that operate with a rectifier and inverter that generates a variable voltage, variable frequency output from a DC bus via pulse-width modulation (PWM), cyclo converters generate an alternating three phase output voltage directly from the mains supply (see Figure 4).

Tubular grinding mills typically operate at low speeds. If a conventional VSD was used for speed control, the converter would continuously run at 5-10 per cent of its nominal frequency – which will result in a lower efficiency and less accurate speed control. This is why cyclo converters are used for running mills as their nominal frequencies are less than 40 per cent of the mains frequency. Running continuously between 5 and 10Hz suits them well.

Advantages of GMDs

GMDs are an efficient way to run mills in the cement industry as they do not employ any gearing whatsoever.

They are the drive of choice where availability, reliability and operating efficiency are paramount to the success of an operation. Gear driven mill drive systems, whether they are centrally driven or side driven (ring-geared mill drive) require a gearbox that has its known disadvantages such as friction losses (on the pinion as well as in the gear reducer) and wearing parts that require constant lubrication.

Reference

1. WWF/Lafarge Conservation Partnership: A blueprint for a climate friendly cement industry.

Figure 7: torque transfer happens across the airgap by electro-magnetic forces without any wearing parts – completely touchless. No lubrication or re-occurring alignment required. To run the mill at slow speeds ie, to replace liners, the inherent variable speed feature offers stepless speed control from zero to 100 per cent