CEMENT PLANT AUTOMATION IN EMERGING MARKETS

Paul Limpitlaw, Siemens AG, discusses the changing face of emerging cement markets and how automation can help plants within those fast-moving and competitive markets to get ahead.

INTRODUCTION
The global cement industry has always been a good indicator of economic activity, as industry growth patterns consistently point to the direction in which the wider economy is likely to move within the next six months. Public/private infrastructure and construction projects are also a good barometer of the mood in other industry segments. The global cement industry has undergone a period of significant change over the past decade, driven by the demands of a globalised economy and the pattern of different industry growth. This article looks at the current drivers of growth in the industry, and examines some of the special demands placed upon automation suppliers dealing with emerging markets.

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## CURRENT MARKET OVERVIEW

Global cement consumption exceeded 2.7 billion t in 2007, driven by continued economic growth, particularly in the emerging markets of Asia. Reflecting wider economic patterns, the traditional markets of Europe and the US continue to grow at healthy rates, with both regions profiting from public sector investment. By far the most significant developments are, however, to be found in Asia. Following rapid recovery from the Asian economic crisis in 1997, and the entry of China and India onto the global stage, Asia has become the most significant player in the cement market, in terms of consumption, growth and investment.

What factors have driven the Asian markets? A combination of strong economic growth, investment by the major global players and, in the case of China and Vietnam, ambitious government investment plans that are aimed at renewing the industry and improving productivity and quality levels. As a result, China and India top the league of cement consumers, with China accounting for almost 50% of global consumption.

The increasing significance of the Asian markets has spurred activity by the global players. China and India have been the centre for joint venture and acquisition activity over the past two years; recent acquisition activity in India has helped Holcim strengthen its position as the number one producer in the world. The entry of cement multinationals into China and India has also brought considerable opportunities for automation suppliers, as the companies invest heavily in improving safety and productivity levels at their newly acquired sites.

## KEY AUTOMATION INDUSTRY TRENDS

Following the entry of the major players into China and India, the playing field in the cement industry has changed. A number of macro trends are forcing the industry to modernise, with local players, as well as foreign-owned plants, investing heavily in order to remain competitive. Driven by the standards imported by the cement multinationals, three main trends are to be observed on the marketplace: productivity, safety, and environmental responsibility. This reflects a keen desire by the cement multinationals to achieve similar productivity levels in Asia as in western plants, and to take the opportunity to improve environmental standards at some emerging market sites.

For automation suppliers, local presence and long-term relationships at both headquarters and local level are key to benefiting from the investment trend. Through its unique global structure, Siemens has been able to forge these key relationships and to develop a deep understanding of the needs of its customers in this region. It has been a major player in a number of the recent cement industry projects in Asia: this article highlights key aspects of some of these initiatives.

## INCREASING PRODUCTIVITY

Productivity is a key driver behind the investments currently being made in China and India. Cement plant operators have four primary productivity goals: the reduction of downtime, the reduction of energy consumption, improvements in product quality and the intelligent use of maintenance resources.

Downtime is a significant problem at obsolete plants. This has a number of causes. A lack
of highly trained personnel, coupled with poor insight into the process, increase the likelihood of interruptions. Immediate improvements can be obtained through the implementation of modern process automation techniques. By improving the level of automation and control within the process, staff can be alerted more quickly to deviations in process parameters and take action before the situation becomes critical. Intelligent process instrumentation and gas analysis systems play an important role by increasing the quality of data coming from the process and providing higher levels of insight into key process parameters.

Another factor eroding the returns at such plants is energy consumption. Designed mainly to be fuelled by coal and oil, a number of plants in China and India are unprofitable today because of the increase in the cost of driving the kiln with fossil fuels. Diversification of the fuel supply is important, and this includes maximising the opportunity to use secondary fuels. In addition, it is vital to reduce energy consumption levels, for example, by installing intelligent drive systems, such as Sinamics from Siemens, or improving monitoring and control of clinker quality and emission levels using gas analysis systems, such as the FLK kiln probe. By taking a two-pronged approach (fuel mix diversification and energy consumption reduction), considerable improvements to plant profitability can be achieved.

Product quality is also a major issue when re-engineering plants, especially in China. Although demand for high-quality cement is increasing, and now represents a considerable chunk of domestic demand, the standard of cement production at a large number of cement plants in the region falls far short of western standards. As well as ensuring that raw materials entering the process are of the best possible quality, cement plant operators also require accurate data regarding process variables, especially during calcining processes within the kiln. The need to improve product quality represents a considerable opportunity for automation equipment suppliers, as instrumentation and control play a key role here.

The final productivity issue is the need to

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**CASE STUDY 1: PRODUCTIVITY**

Holcim Philippines Inc. was seeking to re-commission a line at its Davao plant. The company was faced with the challenge of putting the line, which had been mothballed since 2000, back into operation at minimum cost and in the shortest time possible.

As the life cycle of a cement plant is much longer than the service life of a single version of a control system, it is essential that the strategy behind the development of a control system stays innovative. The Davao cement plant had had Siemens Cemat version 3 in operation since 1996. This meant the company was able to utilise the latest process control system based on Simatic PCS7.

Fieldbus communication was preferred rather than the alternative option of connecting the MCC and field instrumentation using existing PCC junction boxes. The decision to replace the conventional MCC with the Simocode DP was a key factor in the installation. It simplified the motor control, thus saving time, while achieving uncompromising motor protection features. Simocode meets all requirements for future proof energy management and offers advantages in process management, operation management and switchboards. Simocode provides an open communication via Profibus DD, which makes it very easy to integrate it into the process control system. With innovative software, which is part of the Simatic PCS 7, a user-friendly parameterisation, diagnostic, operator control and visualisation is possible. With the predefined Cemat function blocks for the Simocode it is easy to integrate motors into the process control strategy of the cement plant.

Field instrumentation Profibus PA has a large number of diagnostic features that allow the unit to provide very detailed information about the condition of the instruments. As a result, the plant was able to go a lot further in achieving both predictive maintenance and corrective maintenance than was previously possible.

The project was completed ahead of time and the line started to produce clinker at the end of April 2006. The application of bus communication in process control was the crucial tool in beating the deadline, with easier and faster cabling decisive to the turnaround time.
improve maintenance cycles. Although staffing levels at cement plants in emerging markets are generally higher than in the West, lower levels of maintenance and control expertise, coupled with the need to reduce personnel overheads, mean that plant operators and cement multinationals are keen to improve the manner in which a plant is maintained. By reducing the amount of time needed to maintain the plant, and ensuring that maintenance cycles around the plant are optimised and reflect actual maintenance demands, plant operators can reap significant cost savings. The implementation of state-of-the-art DCS systems, such as the Simatic PCS 7 based Cemat control system, and advanced communication protocols, such as Profibus, enables field instruments to deliver enhanced maintenance data directly into the control room and provides more accurate planning of

**CASE STUDY 2: SAFETY**

**FAST AND RELIABLE SAFETY SURVEILLANCE IN COAL SILOS**

Coal silos are a common feature of cement plants, acting as storage vessels for kiln fuel. The risk of partial self-ignition of the coal within the silo is a major threat. The resultant elevated CO concentrations at the head of the silo are not only an indicator of an active fire but also pose a threat in their own right because of their highly explosive and toxic nature. As soon as out-of-range CO levels have been detected, fast counter-measures need to be applied, such as the evacuation of personnel and the application of inert gases into the silo.

**APPLICATION TASK**

Analysis of CO concentrations within the coal silo is a key monitoring task. CO is odourless, toxic and constitutes a serious explosion threat at levels above 8% volume in air. As continuous flushing of the silo with inert gases would be too expensive, inertisation only takes place in an emergency. Monitoring the CO concentration thus requires a fast, reliable and representative measurement.

**SPEED IS A VITAL FACTOR**

Knowing the exact CO level with minimal delays is not only a safety issue: the lower the measurement time, the higher the threshold value can be set. This reduces the number of false alarms, saves money and avoids costly downtime.

**THE SOLUTION**

The LDS 6 is a diode-based, laser, in situ gas analyser for the direct measurement of gas components in a process gas stream. By using an in situ measurement, no gas sampling is necessary, enabling results to be obtained far more quickly than for extractive techniques. The sensor pair is installed within the silo and connected via fibre optic cables to the central unit. Up to three sensor pairs can be attached to one unit, and, due to their intrinsically safe design, they are perfect for use in this application. In the event of a significant increase in the CO level within the silo, the LDS 6 immediately issues a warning and triggers inertisation processes. Due to the very short reaction time, false alarms are avoided and the plant operator has a constant picture of the gas concentrations within the silo.
CASE STUDY 3: ENVIRONMENTAL CONCERNS

Particulate emission filtration from the rotary kiln and raw meal preheating are key steps in cement manufacturing. It is vital for efficient cement plant operations to ensure that particle emission rates are within legal limits and to optimise preheater operation. Many older plants are modernising their operations and improving productivity levels. New exhaust air bag filter systems are installed, replacing older electrostatic precipitators.

Sitrans P DS III differential pressure transmitters are installed with measuring points upstream and downstream of the bag filter. This enables the pressure difference between the ‘clean’ and ‘dirty’ sides of the filter bag to be monitored. As the filter begins to block, the pressure difference increases. This information is used to implement an ‘intelligent’ cleaning cycle, based upon actual need rather than on a fixed time interval. At the same time, better monitoring of process conditions and early recognition of malfunctions is possible.

Raw meal preheaters consist of several cyclones that are arranged in a tall tower at the upper end of the rotary kiln. Preheaters act as a heat exchanger, using the hot exhaust gases from the kiln to preheat the raw meal as it moves through the various stages of the tower. Blockages can occur while the raw meal passes through the tower. Utilisation of pressure transmitters provides an early warning of blockages by indicating changes in the pressure conditions within the tower.

With the installation of the pressure transmitters throughout the baghouse and the preheater, the plant can significantly extend the life expectancy of the filter bags within the filtration plant. This also ensures that the preheater is operating at optimum efficiency.

The digital transmitter, Sitrans P DS III, has extensive diagnostics and simulation functions for pressure, absolute and differential pressure, flow and level.

CASE STUDIES

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**ENVIRONMENTAL CONSIDERATIONS**

In the same way that globalisation has brought about improvements in the safety levels at cement plants in emerging markets, global companies are also improving the environmental performance of plants in these markets. All the top five cement majors are investing heavily to ensure that newly acquired sites match the same emissions standard as their plants in the West. This is reflected in increased demand for CEMS systems and for *in situ* gas analysis throughout the process.

Simultaneously, the Chinese government has initiated a five-year modernisation plan for the cement industry, aimed at closing the most ineffective and environmentally damaging plants and replacing them with more effective and environmentally friendly production lines. As a part of this, the transition from wet to dry processes is also gaining momentum.

Automation suppliers can provide a great deal of assistance to plant operators looking to improve the environmental impact of their operations. Whether by state-of-the-art CEMS systems optimisation of filtration processes or *in situ* gas analysis, automation is a vital part of the environmental efforts being made by cement companies (Case study 3, see page 147).

**MARKET DEVELOPMENTS**

The Asian cement markets are going through a significant phase of development driven not just by considerable increases in cement demand, but also by the efforts of the global cement companies to implement common standards around the globe. Although growth in cement demand looks set to reach its peak towards the end of the current decade, upgrades of existing facilities are providing a number of opportunities for automation suppliers into the future. Working in partnership with local and global companies, a key task will be to examine applications and find new intelligent solutions, designed to meet the specific demands of these exciting markets.