

APC and analytic abilities

Advanced Process Control (APC) techniques can be applied to the problem of kiln feed variability and the optimisation of cement qualities, while data analytics allows for the ongoing tracking of APC controllers. ABB's suite of APC solutions has enabled producers such as Votorantim Cimentos and Bursa Cimento to achieve efficiency and productivity gains, as well as reductions in energy consumption.

■ *by Ryan Koorts, ABB, Switzerland*

Process and energy industries are increasingly taking advantage of rapid advancements in big data, and digital technologies such as the internet of things, the cloud, data analytics, visualisation and advanced modelling algorithms, to overcome the perennial challenge of delivering high-quality products while keeping production costs low, plant efficiency high and minimising downtime.

Cement producers worldwide are employing advanced process control (APC) techniques such as those developed by Swiss-based multinational ABB to maximise production and the use of alternative fuels, which are difficult to control manually due to variations in heating values and numerous lines in the plant.

APC can also be applied to the problem of feed variability and the optimisation of cement qualities, while data analytics such as ABB KPI monitoring allow for the ongoing tracking of APC controllers to ensure they perform at an optimum level, long after commissioning. These KPIs are now available remotely in the cloud, enabling managers to continually access the digital performance of their plants.

Digital solutions also streamline complex and multivariable cement plant processes that often force manual human operators to operate a safe distance away due to process constraints, at the expense of increased profitability.

ABB's Ability Minerals Process Control Library

The ABB Ability System 800xA Minerals Process Control Library is a ready-to-use, tailor-made automation solution for the mining and cement industries comprising of software modules. It is designed to achieve the highest plant productivity, availability and safety, as well as the best operator efficiency.



Advanced process control and analytics technology for cement producers

Employed in more than 400 cement and mining sites around the world, the Process Control Library increases standardisation, functionality and quality of process control software over the lifecycle of a production facility, reducing downtime, and maximising production process and asset efficiency.

The library forms part of the ABB Ability System 800xA Extended Automation Platform which manages more than 10,000 industrial plants worldwide using parameterised process control.

Visualisation is an important factor in process control, providing the main interface between humans and the production site. The Process Library's graphic interface is designed to offer operators a high level of situational awareness.

"In the past we focused on creating, and later optimising, a performant data interface between the control library blocks and the software parts of the APC," explains ABB minerals/control library lead, Gregor Schuetz. "Lately, we have focused

our development effort on new graphic elements to reinvent process control human machine interfaces (HMIs) and how the plant operator interacts with the system. The HMI is no longer a point-to-point interface, but rather an information hub that gives operators a holistic view of their whole plant. At ABB, our challenge is to keep those various and often very different viewpoints optimised," he adds.

Averting downtime and fostering collaborative working

The ABB Ability System 800xA Minerals Process Control Library also alerts operators to abnormal scenarios that have the potential to negatively impact plant production. Advanced alarm handling functionality enables the operator to identify the root causes of production problems, and drill down from all process levels to detect, understand and resolve them, thus averting costly downtime periods.

"The graphic of the Minerals Process Control Library natively supports

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Used in conjunction with APC, ABB's Ability Minerals Process Control Library can help cement manufacturers improve operations in four key areas: kiln optimisation, alternative fuel management, mill optimisation and material blending

information layers for operation, maintenance and process optimisation," says Mr Schuetz. "This is the interaction point with the new, emerging digital technologies used in process optimisation, which add a whole lot of new requirements to HMIs."

"There was a lot of effort needed to add all the required functionality to the HMI of the process control library in order that it is now able to aggregate and renders the impressive amount of data of these technologies into meaningful representations that humans can understand. Importantly, the process control and process optimisation system is able to communicate information such that human operators and the digital technologies for process optimisation work together in harmony," says Mr Schuetz.

Kiln optimisation and alternative fuel management

Used in conjunction with APC, ABB's Ability Minerals Process Control Library can help cement manufacturers improve operations in four key areas:

- kiln optimisation
- alternative fuel management
- mill optimisation
- material blending.

The kiln process is intrinsically unstable, and influenced by long time delays and large perturbations. ABB's Ability™ Expert Optimiser (EO) enhances control of the process using distinct APC techniques including fuzzy logic, soft sensors and model predictive control (MPC), enabling a higher level of automation and optimisation of cement kilns and mills, as well as alternative fuel management.

The ABB Ability EO stabilises the kiln process, before driving the manipulated variables to process constraints – effectively controlling the machinery at its optimum performance level 24/7.

Burning alternative fuels can lead to instability in the clinker manufacturing process. EO controls, mixes and monitors rates of alternative fuels to ensure consistent burning, whilst ensuring the kiln does not become unstable due to changes in fuel calorific value.

ABB Ability™ Expert Optimizer supports operators in standardising optimisation strategies to minimise shift-to-shift variations



Case studies

Votorantim Cimentos, Brazil

In 2014 Votorantim Cimentos, the largest cement company in Brazil, commissioned ABB to tackle the complexity of cement processes and minimise the effect of variability in feed and fuel on a new production line at its plant in Rio Branco do Sul in Paraná using ABB Ability EO.

The control problem consisted of maintaining a given temperature profile during the unstable kiln process and obtaining good burning conditions, all at the lowest energy consumption possible.

With EO taking over control from human operators, the system was able to minimise variability in the process and then drive it to constraints set by operations. By pushing the process to constraints previously unreachable due to the larger variation in process variability, ABB was able to reduce the standard deviation of raw mill power and bed depth, reduce the standard deviation of free lime, kiln motor load, litre weight and burning zone temperature, and reduce the consumption of grinding media in the ball mill.

The EO installation topology is such that the technology at the plant at Rio Branco do Sul was able to be successfully integrated with the existing third-party control system. Votorantim Cimentos reported that the resulting productivity gain led to a reduction in energy consumption of 1.15kWh/t.

Bursa Cimento, Turkey

The tangible benefits of ABB's MPC-based optimisation system for advanced kiln

control are also in evidence at Bursa Cimento's cement plant near the city of Bursa, Turkey, where the system improved both average kiln feed and thermal energy consumption by 2-3 per cent.

The ABB Ability EO was applied to a 2250tpd rotary kiln (50m long), with a five-stage preheater and in-line calciner, and a waste heat recovery plant using exhaust gases to generate electricity.

ABB was able to minimise calciner temperature variation whilst maximising feed. Efficiency was seen in a reduced variation and total value for preheater oxygen, which helped contribute to overall reduced specific energy.

Mill optimisation and material blending

Grinding makes up a large portion of the electrical energy consumed at the plant, thus the efficiency of grinding operations has a major influence on cement producers' energy bills. The ABB Ability EO optimises the grinding circuit to increase throughput

and secure consistent output quality, while lowering energy consumption.

Stable and correctly proportioned raw meal is essential for energy-efficient clinker production, just as cement blended at the right proportions is critical to allow producers to meet specifications and deliver a quality product to end-customers. ABB Ability EO provides solutions for both raw material and cement blending.

Advanced Process Control and Analytics (APCA)

Disruptive digital technologies are transforming the process and energy industries. ABB's suite of solutions also includes Advanced Process Control and Analytics (APCA) technology, which offer analytics and optimisation services for monitoring, predictive analytics and closed-loop control.

ABB scientists and engineers are also exploring the potential of artificial intelligence (AI) with the use of reinforcement learning neural networks. Innovations such as this promise to take the software-as-service business model to an entirely new level, as well as increasing the situational awareness of plant operators, and maximising productivity at the device, edge and cloud to ensure real-time operational efficiencies. ■



The next step for ABB scientists and engineers is exploring the use of artificial intelligence to take the software-as-service model to a new level