Building an intelligent cement plant

Max Tschurtschenthaler, cement lead, and Gregor Schuetz, product manager, ABB Process Industries, explain the company's vision for a digital future in the cement industry and the solutions it offers to get there.

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Automation and advanced process control (APC) – once just buzzwords in the pages of trade journals and on conferences slides – have become increasingly influential forces within the modern cement industry. Underpinning the development of intelligent plants, these digital solutions support the cement industry achieve peak plant operating conditions. Where once the industry may have relied on engineer's experience and data from previous production runs, these can now be replaced by extensive real-time data, historical data sets and advanced digital models to help predict and manage outcomes.

The scope for optimising plant operations using today's digital toolbox is considerable. The impacts also go far wider than an improvement to the plant's bottom line. Intelligent plants also have less impact on the environment, a key factor in a world struggling to come to terms with and limit the impact of climate change. With the cement industry contributing to global carbon dioxide emissions, ensuring plants operate in the most efficient way possible is the first step to meeting sustainability targets. The EU has committed itself to reaching carbon neutrality by 2050. Sweden is pushing to

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ABB recently launched a new version of its automation software Minerals Process Control Library with a new visual control graphic interface

achieve this by 2030. Digital technology will be a central factor in realising these goals.

ABB is at the centre of the digital transformation with its APC system, ABB Ability™ ExpertOptimizer, part of its dedicated digital portfolio of solutions for the cement industry. Other systems include ABB Ability™ CementOptimize (see box story), as well as its ready-to-use tailor-made automation solution for mining and cement, ABB Ability™ System 800xA Minerals Process Control Library.

Advanced process control

ABB Ability ExpertOptimizer opens up the benefits offered by Big Data, data analytics, advanced process modelling algorithms and artificial intelligence (AI) to maximise a plant's potential. Whether optimising alternative fuel (AF) use, reducing feed variability and raising cement quality, or balancing kiln performance, it streamlines complex and multivariable cement plant processes, boosting productivity and averting unnecessary downtime.

Specifically, ABB Ability ExpertOptimizer assists cement plants in four key areas: kiln optimisation, AF management, mill optimisation and material blending.

In the kiln ABB Ability ExpertOptimizer first helps stabilise the process before automatically running the variables to the limits of process constraints, ensuring optimal performance. When AFs are added to the equation, it can control, mix and monitor rates of AF substitution to ensure consistent burning, while avoiding instability due to changes in the fuel's calorific value.

In the grinding circuit, ABB Ability ExpertOptimizer optimises the grinding circuit to increase throughput and ensure consistent output, while lowering energy consumption. It also ensures that the

ABB Ability™ CementOptimize

ABB Ability™ CementOptimize offers cement projects and operations a full portfolio of solutions to optimise capital and operating expenditure. It comprises four basic pillars: optimised engineering, optimised solutions, digital applications and collaborative services.

Optimised engineering starts when a cement plant or plant expansion is being designed. ABB helps the plant owner ensure that the new plant is digital ready from the start, with all necessary tools and equipment.

Optimised solutions are the smart electrified equipment that enables digitalisation: the drives, motors, actuators, instruments and sensors that push data to the control system, making it available for analysis and optimisation.

Digital applications are the software solutions that allow plants to use the data they collect to optimise plant performance. In addition to ABB Ability™ ExpertOptimizer and the Minerals Process Control Library, these applications include:

• ABB Ability™ Optimax aggregates and optimises decentralised energy resources to help reduce energy costs and emissions.

• ABB Ability™ AssetVista asset management pulls together previously-disparate data on the condition of equipment to provide a complete picture of asset health, increasing process efficiency and avoiding unnecessary maintenance.

• ABB Ability™ Knowledge Manager information management system provides analytical insight to identify best practice and improve overall operations at plant and corporate level.

Finally, collaborative services link ABB experts with the plant on an ongoing basis to provide remote assistance, predictive maintenance and continuous performance optimisation.

blending of both raw materials and final product is optimised, essential for energy-efficient clinker production, as well as the delivery of on-spec cement to customers.

Minerals Process Control Library and the human-machine interface

Underpinning the advanced process control offered by ABB Ability ExpertOptimizer is the ABB Ability System 800xA Minerals Process Control Library. Based on standardised control modules and function blocks, the Minerals Process Control Library provides parameterised control of plant equipment and systems. This approach offers a framework into which subsystems and electrical devices can be quickly integrated, ensuring a continuous flow of information from the device in the field to the control room's human machine interface (HMI).

The latest update of the library sees the launch of a completely new HMI which reinvents the way the operator interacts with the system.

The aim is to help address some of the implications of growing digitalisation in the cement industry. Operators are being asked to manage much larger plant areas than previously, adding complexity to daily plant operation and increasing the demands on control room personnel. These operators are at the cutting edge of digital change and must cope with the pressures and stresses that any change brings, while still responding to plant conditions to ensure plant efficiency and reliability.

The importance of the HMI becomes apparent when considering the issue of unscheduled downtime. Globally, process industries lose US$10bn – or five per cent of annual production – due to unscheduled downtime. Of this, 80 per cent is preventable and 42 per cent of this preventable unscheduled downtime is down to human error.

A revolution in HMI

By enhancing the interaction between human operators and the control system, the new graphical interface reduces that potential for human error to bring production to a stop. The most noticeable change is in fact its visual simplicity: the

user interface has been stripped of most colours and animation in favour of a modern, almost minimalistic look, that is designed for operator comfort. The simplicity removes distraction and ensures that key information is immediately visible.

The new graphical interface for process displays, faceplates and workplace layout is clear and intuitive, providing operators with the process information they need in its situational context. This improves operator awareness of any given situation, supporting him or her to make the right decision at the right time. It also comes with a wide range of options for adapting presentation, allowing the focus to be tailored according to need, so that users can navigate to the information they require much more quickly.

The unique alarm system is one example of how the new visual control graphics make the process of accessing and responding to information more intuitive and therefore more efficient, saving potential unscheduled downtime. Critical elements of the production process are highlighted through a combination of context-based information and consistent alarm colours and shapes. This enables plant operators to immediately detect, understand and resolve issues and disturbances, and ensures attention is always drawn to those requiring an immediate response.

Case study: CRH Hoghiz cement plant, Romania

Located in the Brasov region of central Romania, the CRH Hoghiz cement plant has been producing cement for 45 years. The current plant has a capacity of 1Mta from a single 4000tpd dry-process clinker line. Process control at the plant was recently upgraded to the latest version of the ABB Ability System 800xA Minerals Process Control Library, including the new-generation HMI.

"Following the upgrade of the automation system to the latest version of ABB Ability System 800xA, which has been in operation since early July, process displays are much clearer," said Razvan Cocea, who leads Electrical and Automation at the Hoghiz plant. "With the new visual control graphics, it is now immediately obvious which equipment requires attention. The new process alarms instantly alert operators when something is wrong. They can then easily navigate to the detailed displays to find the root cause of the issue and

ABB's new HMI provides operators with more information and can be tailored so users can navigate to needed information much faster
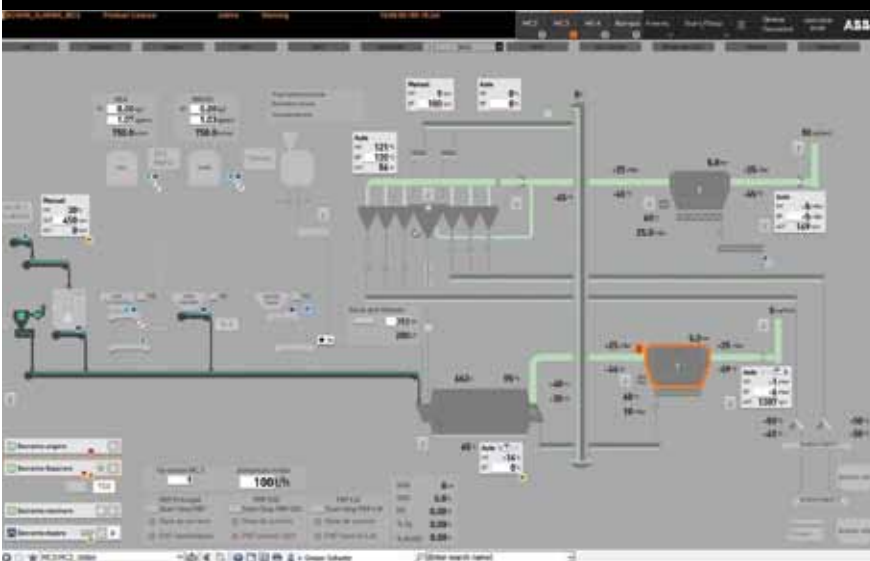
take appropriate measures to bring the process up and running again."

The switch to the new HMI was assisted by immediate buy-in by the Hoghiz operators, who were embedded in the commissioning project to optimise training. Despite being a significant change from the previous system, it has proved easy to master with only limited training required.

"It all comes together in a very nice package that makes the operator's life easier, makes fault tracing easier and tells the operator who to send where in the field, before anything wrong happens with the process," said Mr Cocea.

The new system was originally installed on Cement Mill 3 (CM3), a 100tph ball mill that is used for the production of high-quality and special cements using a hybrid third-generation separator. Following the successful roll-out on CM3, the system has now been installed on the plant's two additional cement mills (CM2 and CM4), as well as the raw materials mill with commissioning scheduled in late February. Engineering for installation of the system on the kiln will begin later this year.

Conclusion

While there is little doubt that APC and automation systems such as those offered by ABB offer huge advantages to the cement industry, the process of digitalisation is also an inherently disruptive one. Despite its focus on technology, its success or failure at any particular plant will rest on the ability of the human operators to adapt and accept the change. Therefore, the HMI is at the crux of the issue: the unique features of the new graphics make success more likely, as its intuitive approach supports co-operation between control room personnel and their digital tools, ensuring the plant runs consistently at peak performance. ■

The CRH Hoghiz cement plant in Romania where a state-of-the-art process control system is in operation