Reducing environmental impact with digital solutions

Like so many other process industries, the global cement sector is embracing the digital revolution and employing Industry 4.0 innovations in an effort to optimise operational efficiency, deliver high-quality end products at high volumes and minimise production costs and downtime. However, digital solutions such as those developed by ABB can also help to reduce a plant’s environmental footprint and ensure regulatory compliance by controlling SO$_2$ emissions and associated hydrate consumption.

by Max Tschurtschenthaler and Ryan Koorts, ABB Process Industries, Switzerland

Imagine cement producers worrying less about emissions control and limit violations. One of ABB’s customers in Germany is already living this reality thanks to ABB Ability™ Expert Optimizer, part of the ABB Ability™ portfolio of digitally-connected solutions and services for cement.

An advanced process control solution for controlling, stabilising and optimising industrial processes, ABB Ability Expert Optimizer allows cement producers to increase production, minimise their CO$_2$ footprint and reduce fuel consumption to meet energy usage goals.

The platform utilises a range of advanced process control technologies to manage critical cement plant components including the kiln, alternative fuels, mills and blending. ABB Ability Expert Optimizer identifies the optimum operating conditions to maximise productivity and reduce costs.

This capability is backed by the option of leveraging the remote ABB Ability™ Collaborative Operations Center, from where experts continually monitor the system and help retune it remotely for new process conditions.

SO$_2$ emissions management

Why is the control system such a critical component of any modern cement production plant? It is directly responsible for regulating the plant’s stability and the quality of product delivered. The ubiquitous proportional integral derivative (PID) control forms the base level for automation and is adequate for simple processes. However, cement and mining processes are anything but simple.

Variability in feed and fuel sources as well as complex dynamics, mean that manual operators with PID control tend to remain at ‘safe distances’ from process constraints, at the cost of plant profitability.

ABB Ability Expert Optimizer tackles the complexity of cement and mining processes by minimising the effect of variability in feed and fuel sources, driving production for maximum cost effectiveness.

In addition, the installation topology allows it to be deployed both in the ABB Ability™ System 800xA and in third-party control architecture, making it applicable to any type of control system set-up.

Cemex case study, Germany

One of the Cemex’s plants located in Rüdersdorf, Germany, already utilising ABB Ability Expert Optimizer on its raw material preparation (RMP), mills and kiln, approached ABB to improve their emissions control system. The ultimate
The challenge was to reduce deviation around the operating target for daily SO\textsubscript{2} emissions. This was achieved with ABB Ability Expert Optimizer, utilising established advanced process control techniques to reduce emission variability. This allowed the plant to run closer to targets and constraints, ensuring zero emission violations while decreasing unnecessary hydrate overdosing and consumption.

The controller reduced operator workload by automatically optimising the short-term exhaust SO\textsubscript{2} target based on the current daily average. There are two optimisation modes that allow the operator to select either normal or aggressive optimisation, based on whether to target the daily average below the limit at the end of the day or within the next 30 mins. ABB Ability Expert Optimizer automatically adjusts the multiple feeder points of lime hydrate to ensure the SO\textsubscript{2} and hydrochloric acid (HCl) targets are stringently met.

After one year of operation, the ABB Ability Expert Optimizer not only minimised standard deviation but significantly reduced the deviation around the operating target for daily SO\textsubscript{2} emissions (see Table 1 and Figure 1).

Overall, ABB Ability Expert Optimizer has helped reduce overall hydrate consumption in the plant by 11 per cent.

In addition, operator confidence and utilisation of the emissions controller was rated as high. The advanced process control solution removes the manual process of balancing hydrate injection points with other pressing plant activities. It is playing a major role in the digitalisation journey.

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**Table 1: daily SO\textsubscript{2} target, Cemex Rüdersdorf plant**

<table>
<thead>
<tr>
<th></th>
<th>Δ target</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator control</td>
<td>-27</td>
<td>21</td>
</tr>
<tr>
<td>ABB Ability™ Expert Optimizer</td>
<td>-6</td>
<td>14</td>
</tr>
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**Smart move: data utilisation and condition monitoring**

Automation and advanced process control (APC) have become increasingly influential forces within the cement industry. Defining a ‘smart’ or ‘intelligent’ plant is not easy – every operation has both different and overlapping challenges – but a common theme is that data is collected from multiple plant systems and used to mitigate issues that may impact production or result in costly downtime.

The process starts with production planning using digital tools that analyse the failure of a particular piece of equipment, or unplanned maintenance, and adjust the daily production plan automatically. Historically, this would be carried out by an engineer and not always optimally.

Instead, data collected from cement plants around the world can now be used to implement advanced condition monitoring and preventative maintenance. For example, ABB Ability™ Asset Vista Condition Monitoring for cement, a tool integrated into the control system, allows the operator to monitor the condition of equipment, compare it with normal

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operations and assess if a failure is imminent. Maintenance staff can then carry out predictive maintenance to avert a potential plant shutdown.

The impacts also go far wider than simply improving a cement manufacturing plant’s bottom line. Intelligent facilities also have less impact on the environment. APC can be used to optimise energy usage, increasing the use of alternative fuels and reducing the overall CO₂ footprint of the remote operation, allowing cement operators to comply with strict carbon reduction goals in the EU and worldwide.

Forward thinking: using data to predict cement strength

Looking to the future, the question is not if new digital technologies can bring significant advantages to cement operations but how they are able to achieve ongoing process optimisation in practice.

The use of artificial intelligence (AI) and machine learning to analyse data from cement operations is set to increase. Many operators already collect such data from their plants to benchmark productivity, but they are not yet using it to address challenges that have not yet been tackled in process optimisation.

To this end, ABB is working on utilising data collected through its information management system, ABB Ability™ Knowledge Manager, to carry out cement strength predictions. Based on the collected data, ABB then employs an algorithm to predict the actual quality of the end product in the operation, and plant processes can then be adjusted accordingly to meet expected product quality. While this research is at a very early stage, ABB can already envisage the potential benefits to customers.

integrated with the ABB Ability System 800xA DCS and its extensive ABB Ability™ System 800xA Minerals Process Control Library, the ABB Ability Knowledge Manager provides visualisation of large volumes of complex plant data via web and mobile interfaces. The latest iteration, ABB Ability Knowledge Manager 9.1, offers new chart technologies based on html5, for better interactive functionality and performance.

It supports engineering based on standard ISA-95 equipment models and can be easily integrated with other ABB solutions, such as ABB Ability Asset Vista Condition Monitoring.

Without a doubt, more and better-quality data – gathered directly from connected equipment and processes or from soft sensor models – lies at the heart of the cement industry digital revolution. Digital and automated technologies are connecting equipment and processes to plant operators and company management to an unprecedented degree. Advanced data analytics and artificial intelligence can be applied to enhance process control and, ultimately, bring the concept of an autonomous plant – whereby optimisation and asset management mostly take place without human interaction – within reach.