Reprint from International Cement Review, September 2011

Jura Cement's optimization drive
ABB expert solutions for cement plants

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Jura's optimisation drive

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Jura Cement has a long and well-established partnership with ABB Switzerland, optimising production methods through state-of-the-art control equipment to help develop the cement producer's use of alternative fuels to their full potential.

Jura Cement was launched as Zurlinden & Co in 1882 in Aarau with a cement plant comprising five shaft kilns. Increasing market demands led to the construction of a second plant, Wildegg, which was eventually joined with the Aarau plant to form Jura Cement Fabriken. Today, the company is owned by Irish building materials company CRH, but continues to operate as Jura Cement.

The company's partnership with ABB Switzerland began early on when Jura Cement hired ABB to supply its entire electrical equipment and plant control system. With this state-of-the-art technology Jura Cement could realise new and alternative cement and fuel materials to improve the efficiency, quality and sustainability of its plants. By putting a pilot plant into operation, where the combustion chamber burns complete tyres, the use of alternative fuel materials was raised.

Over the following years, the company continuously increased its investment in alternative fuels. Materials range from dry sludge, waste oil, bone meal and chemical waste to plastics. Therefore, the ABB Expert Optimizer became a natural choice and highly critical for Jura Cement's operations as it enables the usage of such fuels to their full extent.

Jura Cement, Switzerland, optimises production with new ABB equipment

New installations from ABB

The latest control system, Industrial^{IT} System 800xA, which is based on a server-client-architecture with redundant servers, was installed by ABB in 2006. The entire plant is operated from the central control room (CCR) where over 12,000 signals are constantly controlled. In addition, the raw mill, kiln/cooler as well as all the cement mills were optimised by the ABB Expert Optimizer. The average running time of the expert system reaches up to 98 per cent of the overall plant running time. All process data are collected continuously by the ABB Knowledge Manager and made available according to Jura Cement's needs.

Automation

Control room installation

Special attention was given to the design of the new CCR. The environmentally-friendly plan was well received by the operators and is frequently presented to visitors from Jura Cement and ABB.

With only one operator on duty, Wildegg chose to install a relatively high number of operator stations (11 in total), which allows for the observation of almost all plant sections at the same time (see Figure 1).

The installation of an ABB extended operator workplace (EOW) with three-beamer technology enables a detailed

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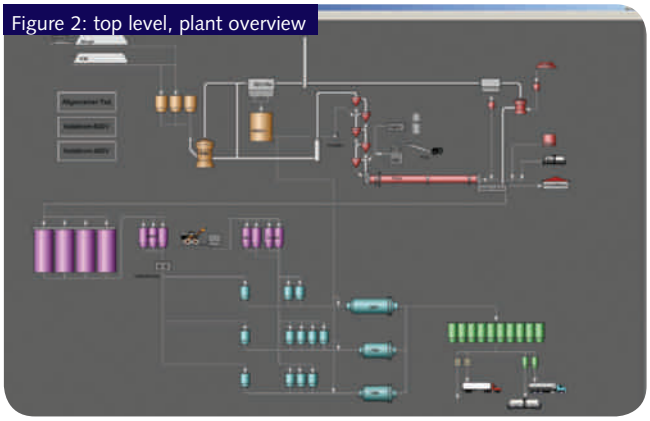
Figure 2: top level, plant overview

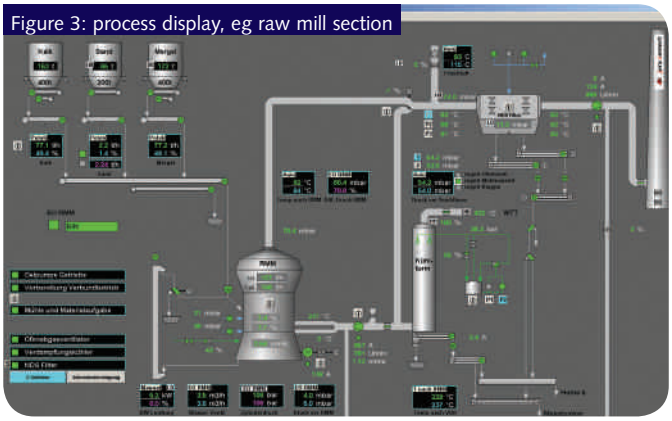
Figure 3: process display, eg raw mill section

display of the actual plant status on screen, which is useful in critical situations, such as during the kiln start-up when process experts need to see detailed process data simultaneously.

To ensure good working conditions for the operator (ie, in terms of heat and noise) all PCs were placed in a separate server room, situated directly under the CCR.

ABB installed a professional matrox graphic card to avoid any potential quality losses on the PC screens. This consists of a receiver box and an optical transmitting PCI card installed in the PC. The receiver box has ports with four USB connections, keyboard, mouse, audio and four DVI monitors enabling up to four monitor connections at one PC operator station. ABB also supplied motor driven, height-adjustable desks, which provide an ergonomical work station for the operators.

Field installation

During renewals, Jura Cement also replaced the complete control system, including the IO boards. Since the old Brown Boveri & Cie (BBC) IO cabinets were still in excellent condition they remained in place.

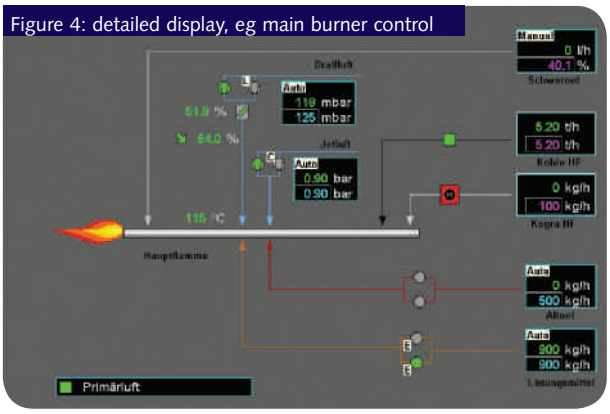

Figure 4: detailed display, eg main burner control

Installing the new S800 IO boards on pre-manufactured aluminium frames, based on the Lütze system helped to ensure a work- and time-efficient IO board exchange. The field signal cables were disconnected from the old Procontic boards and put aside. After dismantling the Procontic boards the aluminium frame could also be removed. The new Lütze frame was then mounted with the pre-installed S800 IO boards and the field cables were reconnected. All new IO boards were equipped with cage clamps instead of terminal screws, which ensure a quick and reliable connection. Signals from the IO cabinets and other Profibus consumers were connected to the central server room by fibre optic Profibus transmission. In addition Jura Cement opted to install new variable speed drives and other sub-controlled systems, such as weighfeeders with serial Profibus interfaces. This provides access to even more detailed information from important devices.

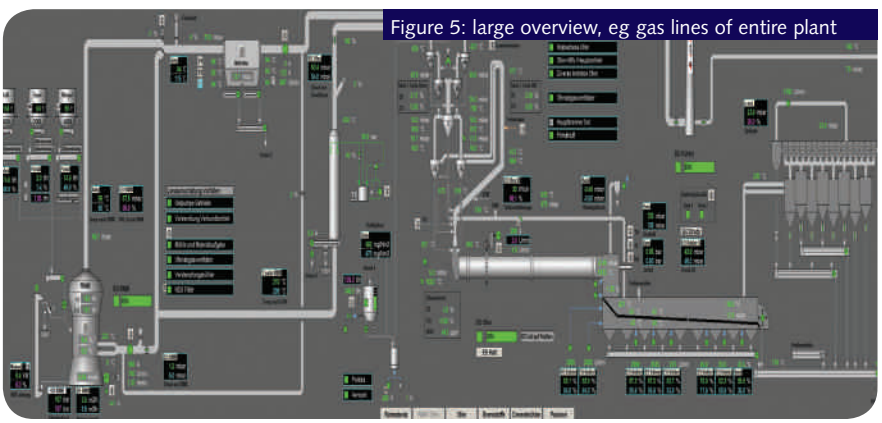
Figure 5: large overview, eg gas lines of entire plant

Reprogramming of Procontic code

Since the Procontic PLCs were also replaced by the new AC800M controller (type PM861 and PM864) the entire programming code had to be replaced. After documenting all IO signals in Excel, the data was fed into the minerals bulk data handling tool PDA 5.0. This tool helps group all consumer objects efficiently, making the data available for download into the controllers, providing an IO signal list as well as electrical diagrams. The base of this structure is the Minerals Library 5.0 which proved to be very flexible and capable of fulfilling the customer's demanding needs in this project. A total of 12,000 IOs in 15 AC800M controllers were installed at Wildegg. For maintenance purposes it is crucial for Jura to know all the programme code specifics. In addition to providing a successful installation, ABB also benefitted from all the process know-how during the set up over the course of a year.

Ergonomic and efficient displays

A key feature of ABB installations is efficient and clear process displays, which supports the operator in keeping his process running smoothly. Displays are structured in only three levels.

The plant overview (shown in Figure 2) shows links to any of the 20 individual process displays. These displays are usually on the operator's screen.

To see more individual details, eg for large motor drives, detailed overlap displays are very helpful to the operator (see Figures 3 and 4).

A last challenge was the large overview screen (EOW) which needed special displays due to its high resolution. Standard features like trend displays, operator notes, event lists and an alarm list provide additional support to the operator and maintenance engineers. All plant sections have different alarm sounds (four in total) so the operator is made aware immediately, based on type of alarm noise and where it originated, and can then respond accordingly.

Commissioning during maintenance stops

To avoid production losses, commissioning of the complete plant was scheduled during the two annual maintenance stops in January.

The first phase was implemented in January 2007 over the course of approximately three weeks. This included raw material transport, raw mill, dust transport, homogenisation of the silo and the gas lines. It was a challenging assignment as the homogenisation silo was completely emptied prior to the kiln stop due to replacement works on the homo-silo aeration. Consequently, the kiln had to be restarted with a newly-programmed raw mill and no raw meal in storage.

Phase two of commissioning took place in January 2008 with the preheater, kiln, cooler and clinker transport as well as the roller crusher and additive transport. This phase was also finalised in approximately three weeks.

ABB faced the challenge of commissioning the new CCR while the system needed to continue running for cement mill operation. ABB managed this by maintaining a provisional CCR, which enabled uninterrupted and smooth plant operation. Again, the pressure to restart the kiln was immense: the 60,000t clinker capacity was emptied to about 5000t, which amounts to not even two days of cement production at Wildegg. In 2007 all other plant sections that could operate independently (three cement mills, the steam house, main station and the system upgrade of all alternative fuel sections), were commissioned after each other. ABB met every project milestone on schedule. Jura Cement and ABB were also able to carry out the project without any production losses, thanks to excellent scheduling which allowed for all the work to be completed during the annual maintenance stops.

Integration of Siemens Cemat into ABB's System 800xA

The Wildegg packing plant section was automated by a local Swiss automaton company in 2005 using Siemens S7 with Siemens Cemat library. However, for the main plant the customer chose the state-of-the-art ABB System 800xA and requested Cemat to be integrated into the System 800xA SCADA. System 800xA enables this integration by accessing data via Siemens OPC servers and a special 'ABB Cemat Connect' library.

Energy saving with modern and reliable drive technology

The first medium-voltage drive, ACS 2000, was installed at Jura Cement Switzerland in February 2009 as part of a pilot project. It has proven its value by reaching a reduction in energy costs of the specific drive by approximately 20 per cent. It is the fifth and youngest member of the ABB medium-voltage frequency converter line, with an output of 550kW and the clinker cooler exhaust fan.

The ACS 2000 replaced a 25 year-old sub-synchronous converter cascade installed by BBC. In the past, maintenance of the converter cascade or the relevant slip-ring motor led to various production interruptions each year, which could now be avoided.

Figure 6: the ACS 2000

The ACS 2000 is the world's first direct-voltage source inverter without transformer for standard drives up to 6.9kV. It is designed to operate with a transformer or a direct connection to the network. Since the costs for a transformer can amount to 40 per cent of the total investment for a drive system, the customer can benefit significantly with this solution. In addition, the drive system is much lighter and smaller, which is positively reflected in transportation costs and footprint.

Collaborative Production Management solutions (CPM solutions)

Jura Cement has been using ABB's Expert Optimizer to improve operational performance since 2001. The initial focus was to facilitate the use of various alternative fuels in the calciner and kiln. Once fully integrated into the existing Jura Cement operational infrastructure, the Expert Optimizer quickly helped to substitute 60 per cent of regular fuel material with alternative options.

In 2005, Jura Cement partnered with ABB Switzerland again for a new technical development. Model Predictive Control (MPC) technology was integrated into the new Expert Optimizer 5.0 and extended to include Mixed Logical Dynamic (MLD). MPC together with MLD was able to predict future process conditions while also presenting the data in Expert Optimizer's graphical model building toolkit with a clear representation of the real system relationships. Thus increasing the user's strategy understanding and making maintenance easier. After the Expert Optimizer upgrade to 5.0, the system was extended to all of Jura Cement's mills, including a vertical raw mill and a unique three chamber, central discharge cement mill. The graphical modelling capability of Expert Optimizer helped to make this a smooth and quick implementation.

Jura Cement has controlled the materials proportioning to the raw mill using a software package provided by their automated laboratory supplier for a number of years. While operating satisfactorily during stable operation of the plant, the aforementioned software package did not adapt well to typical day-to-day conditions which cause upset. With the upgrade to

Expert Optimizer 6.0, ABB was once again able to help Jura Cement enhance plant performance. The raw mix proportioning module was implemented to specifically deal with such 'upset' process conditions, changes in raw material piles and sudden non-availability of one or more feeders to the mill. The strategy was quickly deployed using MPC/MLD and the results to-date have been more than impressive.

ABB's Knowledge Manager and its predecessor CIMS have been the backbone of production and more recently laboratory reporting in Wildegg for many years. The current installation, including data not only from Jura Cement's Wildegg plant, but also Wildegg's sister plant at Cornaux, was upgraded to version 6.1 in 2010. The connection between the Knowledge Manager server in Wildegg and Cornaux is effected via Jura Cement's office network with a data collector node (DCN) collecting process data locally in Cornaux. The DCN buffers all data if, for any reason, the network is unavailable and transfers the data when the network is available again.

Some process samples taken at Cornaux are sent to Wildegg for lab analysis, thus minimising replication of expensive laboratory equipment at both plants. Knowledge Manager's LIMS module helps to simplify this process. Samples taken and registered in the LIMS at Cornaux are automatically registered for analysis on the specific instrument at Wildegg as well. Once the physical sample arrives at Wildegg and the analysis is completed, the results are transferred to the LIMS at Wildegg. The results are then also immediately accessible to authorised personnel at Cornaux for further analysis.

Figure 7: ABB Spectraflow analyser, powered by SOLBAS™ for raw material analysis

ABB Spectraflow analyser, powered by SOLBAS™ for raw material analysis

The basic concept for raw material preparation at Jura Cement uses two raw material storages. One is used for limestone with an average chemical composition already close to the target value. The second is for marl, which is primarily used as silica source. This particular storage receives varying raw material in addition to the marl. Controlled feeding of the raw mill from both storages achieves the target composition of the raw meal, which then enters the further cement-making processes. Since a broad range of materials go into the marl storage, ABB's SpectraFlow analyser was installed at the entry of the marl storage (see Figure 2). It analyses the material coming from the crusher at the quarry using near infra red (NIR) and permits Jura Cement to achieve average target silica modules in the marl storage. This analyser has been successfully installed and is currently in the optimisation and calibration phase.

Operational experience and improvements achieved

Automation

According to Mr Hitz, Jura Cement's production manager, the ABB control systems have significantly reduced the number of kiln stops per year to a maximum of one or two, which means a total of about 6-10 hours per year. The time of each production stop has been reduced thanks to the highly-detailed failure information received from the control system.

Optimisation

Implementing ABB's Expert Optimizer enabled Jura Cement to use seven individual alternative fuels in parallel. The system is constantly controlling and optimising the use in terms of energy consumption, availability and lowest production cost. The actual recording has shown the online operation of the system by 98 per cent of the cement production time. The raw mix proportioning module further enhances the raw material proportioning to the mill. This module allows for better dosage and more efficient production.

Reliable motor control

With the installation of the new ACS 2000 drive system Jura Cement chose a reliable motor control. Maintenance could be significantly reduced and electrical energy saving at the clinker fan drive is approximately 20 per cent. Since its installation no production stops have occurred because of drive system malfunctions. The plant operates 24 hours a day throughout the entire production year. According to Jura Cement, this project has seen a return on investment within the shortest possible time.

New challenges

Jura Cement strives to continuously improve energy and production efficiency. Changes in raw materials and availability of new alternative fuel materials may require further updates, optimisation or even new plants altogether. The long-lasting partnership with ABB allows quick and efficient development of solutions that fit Jura Cement's needs and meet the new challenges.

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