Göllheim manufactures its own luck

ABB's Expert Optimizer has proved itself worthy

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Figure 1. Dyckerhoff's Göllheim plant in Germany.

ABB's Expert Optimizer has proved itself worthy to Dyckerhoff AG. Michelle Kiener and Dr Eduardo Gallestey, ABB Switzerland Ltd, explain how the software works.

Introduction

For many people, October means witches, wizards and spells. But Göllheim is not risking its success on Halloween cauldrons and magic. With world energy prices soaring and competition between cement manufacturers remaining strong, Dyckerhoff's Göllheim plant is taking decisive steps to ensure advantageous operating conditions. The company is installing the new version of ABB's Expert Optimizer across 12 areas of its processes. Version 6.0 of the software introduces the new model-based state estimation technology to ensure that Göllheim's kilns and mills can be optimised to the highest level. The new edition will also hone Göllheim's entire process, including raw mill, driers and material blending, to ensure that nothing is left to chance.

The story so far

Dyckerhoff AG, a member of the Italian Buzzi Unicem Group, is already using this piece of equipment at its Deuna plant in Germany, where positive experiences encouraged the company to install the machinery at Göllheim. The order was placed in March 2008 meaning that the latest version (version 6.0) would be installed at Göllheim - its first commercial installation in the world.

In February 2008, Expert Optimizer was awarded the Global Fuels Award for 'most innovative technology for electrical energy efficiency'. Built on the excellence of its predecessor, LINKman, the software achieves stable and optimal process operation at a level that even the best operators are not able to match, 24 hours a day, 7 days a week.

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Measuring mid-kiln temperature

Part of ABB's Collaborative Production Management suite, Expert Optimizer comprises rule-based control with other modern tools like neural networks and fuzzy control, Model Predictive Control (MPC) and Mixed Logical Dynamic (MLD) frameworks, which optimise the process while complying with the process constraints.

In its newest version, model-based state estimation is introduced in the moving horizon approach. This means the history of process inputs (fuel, rate, feed, air rates) and of measurements (back end temperature, burning zone temperature, oxygen level) together with the plant model, are processed in a mathematical algorithm in order to estimate magnitudes that cannot be observed directly, like the mid-kiln temperature. Expert Optimizer adapts the model continuously, and by sending frequent but small set point changes to the controller, stabilises the process.

Version 6.0 is being installed on two raw mills, two raw material dryers, the raw meal proportioning, two kilns and coolers, and three cement mills at Göllheim. The installation includes the ground-breaking application of model-based state estimation MPC technology.

MPC is a multivariable control technique. It is based on the 'receding horizon' principle where the controller uses a process model to predict process responses to actuator moves and is thus in a position to calculate the best moves for the process evolution over a relevant period. The MPC controller then sends this set of independent variable moves to the corresponding regulatory (PID) controller, to be implemented in the process as setpoints.

It is important to note that a sequence of optimum actions can be calculated while incorporating the dynamics of the system. MPC technology can, unlike many other controller strategies, explicitly take account of lag and delay times directly in the model. Moreover, it can optimally handle process and actuator constraints.

Further, the models in Expert Optimizer are not black boxes like in 'standard MPC tools', but are instead constructed in a graphical model building toolkit. They are a clear representation of the real system with components that have clear interpretation for versed process engineers. This increases understanding and facilitates maintenance. The mathematical complexity is hidden, and only relevant process knowledge is presented.

Model-based state estimation MPC technology builds on existing MPC methods and experience, but improves on the model by being able to interpret information that would not otherwise exist. In other words, it can recreate, through modelling, a process input value that cannot otherwise be measured. In this context, the estimation of mid-kiln temperature has already been mentioned, but another important example is estimation of the mill load. Here, Expert Optimizer uses a mill mathematical model, together with the history of fresh feed rate, elevator power consumption and return rates, in order to produce a reliable estimate of the amount of material inside the mill at a given point in time. This additional information means that improvements in process stability can reach levels that were previously unattainable. Running such a stable process allows Göllheim to operate closer to its operating constraints than has previously been possible. Running such a tight process means more stable clinker and cement quality and a need for less fuel and electrical energy, which of course means an improvement in operating costs.

Figure 2. Screen view of drivers and mills.

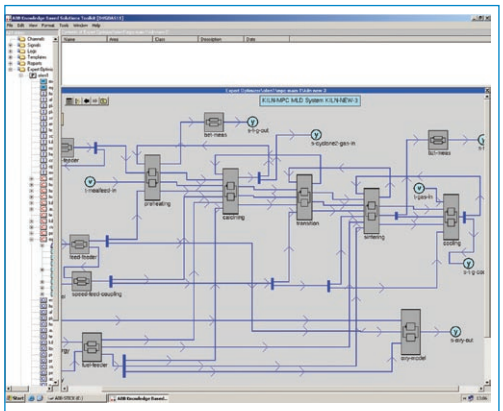

Figure 3. Screen view of MPC kiln model.

Figure 4. Andrew Wilson, Sales Engineer, ABB.

Up and running

ABB Switzerland Ltd is carrying out this installation in partnership with ABB Germany Ltd and, at the time of writing, it is already installed, commissioned and online on two raw mills, two raw material driers and three cement mills. The installations are already achieving high run times and good results. Currently, ABB's team of process experts are installing Expert Optimizer on the two kilns, expected to be commissioned and online by next month. The raw meal proportioning installation is scheduled for spring 2009.

Andrew Wilson, Sales Engineer for the project, pointed out that this is a very large installation and that there are some unique aspects to the project; for example, the configuration of the raw mills and raw material driers is unusual. However, he is confident that the equipment and engineers will be able to get the best out of the process.

Göllheim in control

Ruediger Matheis, Production Manager at Göllheim, who is responsible for this project, expressed Dyckerhoff's and ABB's satisfaction with the results at the Deuna plant, and is pleased with the progress at Göllheim. The plant may be taking control of its own luck, but this does not involve spells, potions or unicorn hair. Expert Optimizer 6.0 is an open solution that Göllheim can control according to market, operating and process demands, to assure their continuing good fortune.

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