Optimising **Adana** >>

MAHMUT SELEKOGLU, ADANA CEMENT INC. (PART OF THE OYAK GROUP), TURKEY, DESCRIBES THE APPLICATION OF AN OPTIMISATION SYSTEM FOR PROCESS CONTROL OF THE ROTARY KILN LINE, RAW MILL AND COAL MILL AT THE ADANA PLANT.

Introductıon

Adana Cement Industry Inc. operates four separate clinker production lines, two coal mills and five cement mills at its Adana plant.

Expert Optimizer (EO), which is an ABB product, is a computer based system for controlling, stabilising and optimising industrial processes. It achieves this through a technology that enables the operating rules of the best operator to be applied accurately, tirelessly and consistently at all times. The principle concept is that EO mimics the actions of the operator and implements them in the manner of an autopilot. The potential

benefit expected from the product is that performance will improve from that of an "average operator" to that of the "best operator" for 24 hours a day, 365 days a year.

The following measurable targets are expected from the program in terms of the performance values.

Rotary kiln line 4

- Minimum 2.0% energy saving.
- Minimum 1.5% production increase.
- Minimum 10% longer refractory life.

Raw mill line 4

- Minimum 1.8% energy saving.
- Minimum 1.8% production increase.

Coal mill line 2

- Minimum 2.0% energy saving.

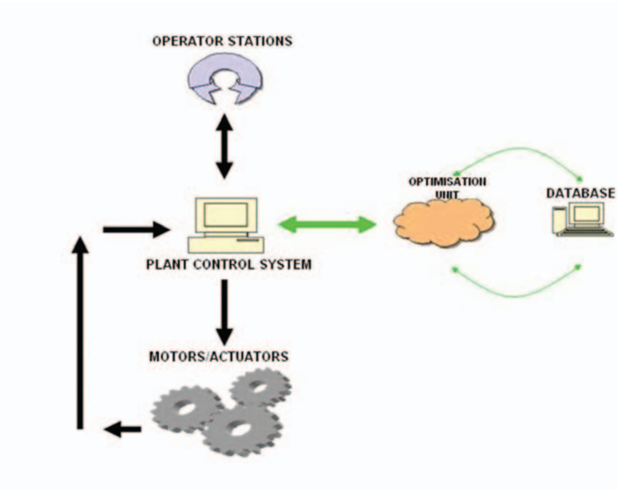
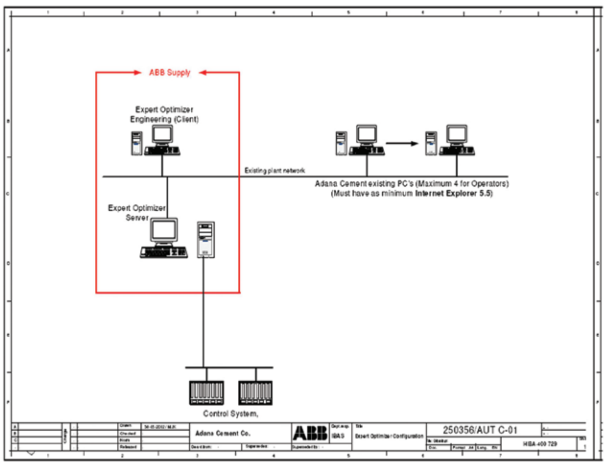


Diagram for EO integration into existing control system.



Typical configuration diagram of EO system.

- Minimum 2.0% production increase.
- Better and more consistent quality.
- Decrease in grinding cost.
- Minimum 20% decrease in standard deviation.

Other benefits that are difficult to quantify include:

- Assistance for burning of various waste fuels.
- Control of plant emissions to meet environmental legislation.
- Being free from the routine process concerns so that operators and engineers are able to concentrate on other matters.
- Providing plant management with the tools and information to analyse and manage the production process more objectively.

Operating logic and application phases for EO

The EO system was first started up, together with ABB experts, at Adana Cement on 11 May 2009 for process optimisation of clinker production line 4, which has an average capacity of 4500 tpd, including the control of the rotary kiln, calciner and clinker cooler. In a second step the raw mill of line 4 and coal mill 2 were included in the EO system.

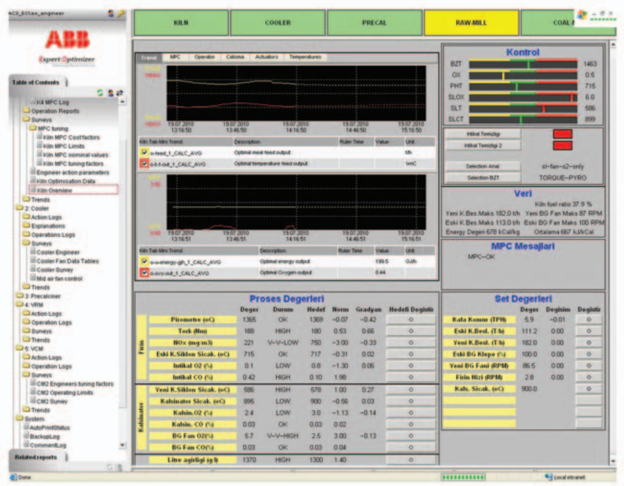
The rotary kiln line, raw mill and coal mill were being operated by a PLC based central automation system in the plant.

In general, it is quite difficult to ensure process control with such a conventional automation system, looking at long term stability and consistency, due to shift-to-shift variations. Therefore, many unexpected negative instances may occur in the process conditions, leading to higher production costs.

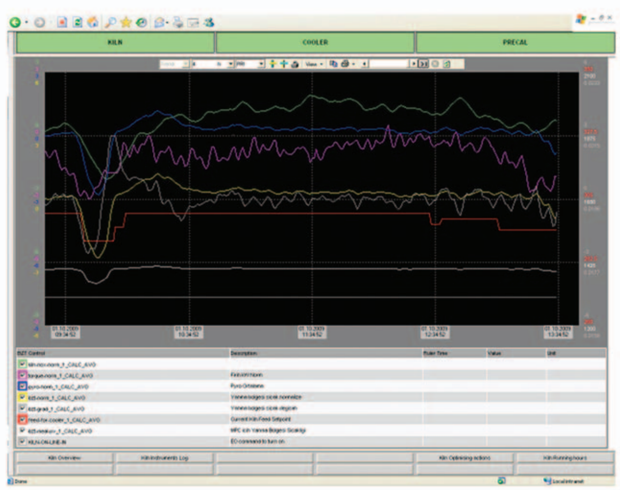
The EO system is able to analyse all required process data simultaneously with a high sampling rate, while an operator normally follows a limited amount of data within a much greater time period. The result of the higher sampling rate with a much broader range of information is that all necessary actions are realised in time by EO. This leads to a much more stable and consistent operation, with the result that unnecessary energy consumption is prevented and process efficiency increases.

First, the communication between EO and the existing Scada system, Siemens PCS7, was achieved by means of current Ethernet infrastructure. In this way, the starting of mutual data traffic was enabled between EO and PLCs. The first three months was the period during which EO acquired process recognition. Within this period, process parameters and related operators actions were verified and saved by EO in its database. Then, a mathematical model was formed by means of using the data already stored by EO and through discussions between the operators and process engineers. Process target parameters were determined and the final mathematical model was implemented. Transition software for both operator mode and EO mode was prepared using the mathematical model.

Before running the mathematical model and in order to be sure about the system safety, EO online/offline transitions were tested. Some probable communication problems and process upsets were created, and the reactions of EO were observed. The aim of this exercise was to check the process parameters and the reaction of EO during the safety



A process picture in EO screen.



A process picture in EO screen.

A cooler picture in EO screen.

process flow. After being sure of the system's safety, a trial run for mathematical model was realised to observe the actions as taken by the best operator over 24 hours.

The EO was designed to run separate strategy modules for the different process areas, which are independent from each other in their operation. This makes it a flexible system and new modules can be added at any time.

During the first phase of optimisation at the Adana plant, EO was designed to control the kiln, calciner and clinker cooler with three modules. After the performance tests and final acceptance of EO system for these process areas, two further modules were added for the raw meal mill and coal mill. In this manner, the system now runs five separate modules for five process areas.

It is up to the operators to set EO online by selecting any of those five modules independently.

As long as the system is online, all PID controls are executed by EO. The program determines the set values in accordance with the strategy selected by the operator and assigns them to PIDs. After each data sampling, EO compares the process changes that occurred with the predicted changes calculated by the system and determines the new set values between the minimum/maximum limits given by the operator.

Deviations on parameters of control strategy can be monitored with trends and with EO signs and tools. EO provides comprehensive and easy to use tools based on web browser technology to create rich graphical user interface.

The operator sets the system offline during unexpected cases like breakdowns, process stops, etc. until the process recovers and then the operator sets it back online. EO does not start up the kiln and takes control when the kiln feed is low or the instrumentation is not in good working order.

When required, the possibility exists to interfere with the EO system by the firm expert via ADSL remote connection.

Operating strategies of five modules are briefly described below.

Kiln module

EO operates the kiln using a control strategy designed to minimise the production of overburnt and underburnt clinker and to stabilise the kiln process. The system changes the energy entry (coal feeding), the amount of raw meal feeding, the airflow and the kiln speed as required to achieve the targeted operating conditions.

The most important parameters for EO control strategy are the outlet temperature of cyclone 3 at the old cyclone tower, temperature of sinter zone and CO and O_2 values at the kiln inlet chamber. The system adjusts the set values of coal feeding at the kiln hood to provide the optimum burning conditions.

If EO cannot realise those target values it changes the amount of raw meal feeding into the kiln as well as altering the kiln speed.

Having been suspicious of EO at the beginning, operators have now adapted and support the case of continuous use of the system for process control...

Cooler module

The correct operation of the cooler has a large influence on the operation of the kiln as it is not possible to stabilise the kiln without also stabilising the cooler. EO adjusts the bed depth and the airflow of the cooler so that a stable recuperation of heat into the kiln system is achieved and the clinker is sufficiently cooled. The control strategy is as follows: the program adjusts the cooler fans' flow and the cooler electro filter fan flow according to the kiln hood pressure.

Moreover, EO determines the set values of mid-air fan speed, both in relation to the exhaust fan outlet pressure while the raw mill is stopping, and to the inlet pressure of the raw mill while it is running. EO also adjusts the speed of cooler grates no.1 and no.2 to achieve the target operating pressure values of cooler department no.1.

A raw mill picture in EO screen.

A coal mill picture in EO screen.

Calciner module

EO changes the set values of the calciner coal feeding according to the target values of the calciner operating temperature and CO - O_2 at exhaust fan outlet.

Raw mill module

EO determines the amount of feed to the mill by controlling inlet and outlet temperature of the mill, inlet pressure of the mill, differential pressure, main drive power for mill and elevator power for return feeding. The feeding conveyors are controlled by the set values of mill feeding. In addition, EO controls the separator speed with regard to fineness value, which is sent from the laboratory every two hours and manually entered into the system by an operator.

EO also adjusts the amount of coal feeding to the hot gas generator, by taking into consideration the mill outlet temperature.

Coal mill module

The structure of the coal mill module is similar to the raw mill module. EO determines the speed of the feeding conveyor by controlling inlet and outlet temperature of mill, inlet pressure of the mill, differential pressure and power of main drive for mill. EO also controls the temperature of the hot gas generator, the amount of coal feeding into the hot gas generator and the position of the fresh air flap. It controls the separator speed as to fineness value, which is again sent from the laboratory every two hours and entered manually to the system. EO adjusts the amount of coal feeding to the hot gas generator, controls the speed of the system fan by taking into consideration the mill inlet pressure, mill outlet pressure and differential pressure, and adjusts the air flow inside the mill.

Conclusion

The run factor of the Expert Optimizer in the units where it has been applied is approximately 90%. It has also reached the targeted efficiency levels. Having been suspicious of EO at the beginning, operators have now adapted and support the case of continuous use of the system for process control since it has proven its reliability and increased process efficiency.

After this successful implementation, the optimisation system will also be applied to clinker production line 3 and clinker production lines 1 and 2 in order.

Bibliography

- ABB, Expert Optimizer Document Ref: 250356/AUT-C7&C8.
- ABB, Expert Optimizer Document Ref: 2057-2009/AUT-CO2.