CEMENT PRODUCTION AT DEVA CEMENT FACTORY FROM ROMANIA

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Abstract: This paper describes the experiences relating to the modernization of the production process and environmental protection at Deva Cement Factory, Carpatcement Holding S.A. The production process, equipments and installations improvement was considered. Besides the technological flow modernization measures, the company adopted certain solutions for improving the performances linked to the technological process automation and optimal control. A local control in each particular operation and an optimum control of entire plant are enforced. The technological flow on-line simulation and control through specific software in order to get optimal process parameters represent possibilities of improving the performances.

Keywords: Control system, automation, renewing, environment

1. INTRODUCTION

Since 2004, Deva Cement Plant, along with the cement plants of Fieni and Bicaz form together the company called Carpatcement Holding S.A.

The Deva Cement Plant was built among 1972 – 1978 and it was commissioned in 1977 – 1978. It was projected to have two production lines of 1.9 millions tones/year capacity. In 1990 The Cement Plant changed its name and became a joint stock company called S.C. CASIAL S.A. DEVA.

In 2000 HeidelbergCement became the main shareholder and started an important investment and restructuring program, aiming at:

- productivity increase
- improvement of products quality
- modernization of the technological flow
- improvement of environmental quality

The company's development policy is materialized by reinvestment of the profit in modernization and technology. During the last 6 years at Deva Cement Plant there were invested 36,421,050 EUR in replacement and modernization of the equipments on one side, and 6,234,314 EUR in environmental protection.

2. TECHNOLOGICAL FLOW AND PRODUCTS

In present, the plant owns three quarries: limestone, clay and gypsum and operates with one production line. The clinker kiln has a daily capacity by 3125 t/day. This means 1026. 563 thousand t/year, (at a 90% utilization). The grinding of the cement is done with three cement mills of a total capacity by 1269 thousand t/year, at a 75% utilization.

The cement is produced through the following steps:

- extraction, processing and storage of the raw materials;
- grinding of the raw material (limestone, clay and pyrite) in the mill where the mixture is proportioned according to the fabrication recipe (75-79% limestone, 20-22% clay and 1-3% pyrite);
- clinker fabrication, by burning the raw meal in the clinker kiln;
- cement fabrication, by grinding of the clinker in the cement mills together with the grinding additives (slag, gypsum, fly ash) according to the cement type we want to obtain;
- Storage of the cement.
- Dispatching;

A cement kiln - the world's largest manufacturing machine - is the major component of the cement line. The kiln is a large rotating furnace. It heats raw materials, such as limestone, clay and shale, at temperatures over 2700 F degrees to produce clinker, which is then ground together with gypsum to form cement.

Types of cement produced, according to the standard SR EN 197-1 is:

- II A-S 32.5R and II B-S 32.5R, Portland cement, with slag and high initial strength;
- II B-M 32.5, Composite Portland cement with high initial strength;
- I 42.5 and I 52.5, Portland cement with initial strength;
- CD 40, cement for roads and airports;
- H II A-S 32.5, cement with limited hydrating heat.

3. RESULTS OF MODERNIZATION AND AUTOMATION PROCESS

The objectives of the modernization of the technological flow are next:

- Reduction of energy specific consumption
- Reduction of fuel specific consumption
- Reduction of maintenance costs
- Reduction of unplanned shut downs
- Improving the work condition
- Improving the management
- Improving the work safety

- Improving the cement quality
- Improving the client satisfaction
- Reduction of the negative impact on the environment.

The transportation flow has been modernized as follow:

- The raw meal is transported by the means of belt bucket elevators from the raw mill to the silos and from the silos to the heat exchanger;
- Resizing of the raw meal transportation ducts at the heat exchanger (clinker kiln);
- Replacing of the chain transporters with mechanical transporters (clinker transportation from the grate cooler);

The renewing of the technology was achieved by:

- Modernization of the grate cooler was made by introducing the IKN cooling technology for clinker.
- Modernization of the internal furniture, shields and grinding balls at the cement mills.
- Introduction of a new injector for all types of fuels: solid, liquid and gas, shown in Figure 1.

Figure 1. The injector for all types of fuels

- Replacement of the burned gases fans with efficiently and modern ones;
- Commissioning of the installation for the burning of the used tires and scrapped rubber), is presented in Figure 2. The capacity of the installation is 3 tones/hour;

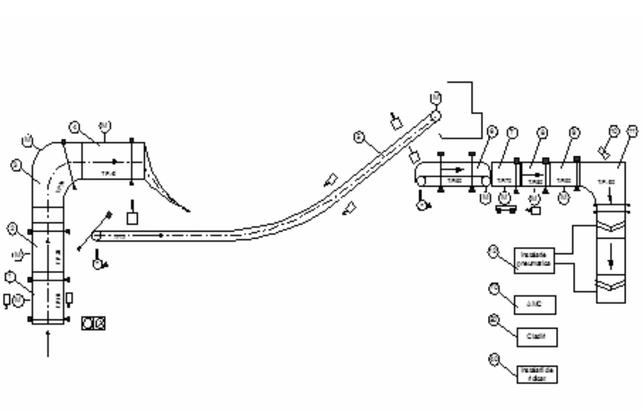

Figure 2. Scheme of burning equipment for rubber waste used like alternative fuel

- Commissioning of the alternative fuel equipment for the burning of the solid alternative fuels (ECO-Fuel) like in Figure 3;

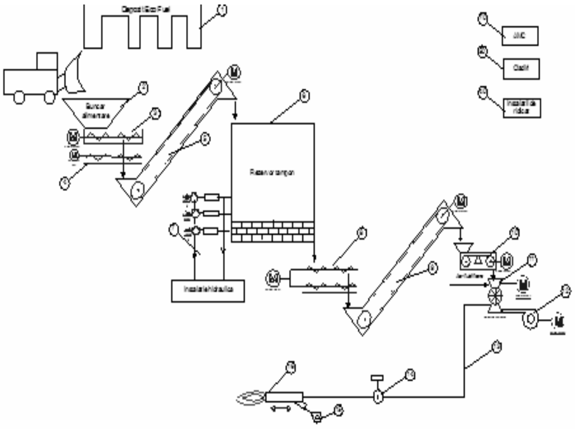

Figure 3. Scheme of the Eco Fuel technological system

For the automatic dosing of the raw materials there was installed gravimetric dosing equipment.

The care for the environment protection was materialized by the modernization of the mills' EPS (electrostatic precipitators) and the introduction of the bags filters for the auxiliary dedusting.

The packaging of the cement is preceded by a bagging automate machine supplied, with a productivity of 2,400 bags / hour. Also, each silo has an automated loading system for the cement bulk loading and own dedusting.

4. THE AUTOMATED CONTROL OF THE CEMENT FABRICATION FLOW

The process automation offers the biggest and most satisfying challenges in terms of combining traditional engineering skills with technological innovation. The continuously monitoring and control of technological flow through specific software in order to get optimal process parameters represent possibilities of improving the performances. The automate control is achieved by modern hardware and software.

The technological flow from Cement Plant is controlled automatically by ECS system (Expert Control and Supervision) from the control-room using the ECS/NTech platform. The ECS environment offers a set of basic programmed interlocking sequence in process-control.

This software program enhances the operator to control (using a computer network) the whole technological flow, having the continuously monitoring system of the entire process. The system allows the monitoring of the flow using desktop PCs, the video cameras and in the same time permits the control of the flow at the raw mill, kiln and grate cooler, see picture below, Figure 4. The feeding system of the kiln with conventional fuel and the alternative fuel are also monitored.

The automation of complex control systems such as those used in pyro processes is becoming increasingly important to ensure the optimisation of resources in a competitive environment. A new generation of high level control has been developed, promising even better results.

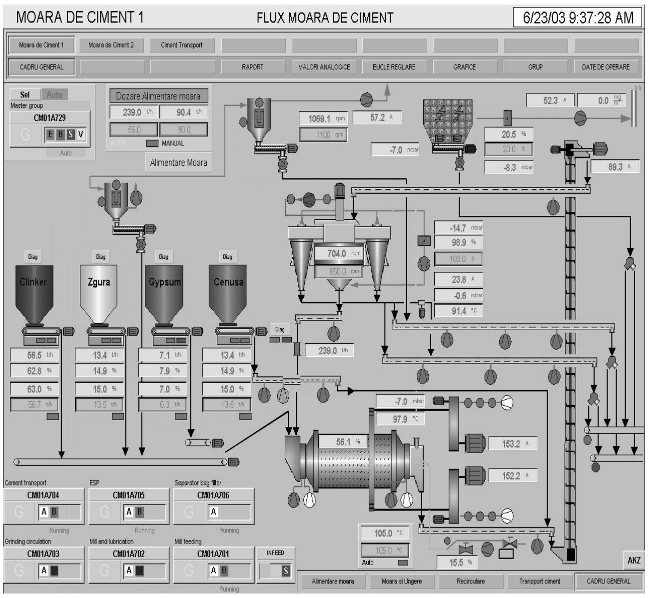

Figure 4. Cement mill flow from control- room

The CemScaner system controls the kiln (shield) temperatures and it was specially developed for supervisory control, monitoring and reporting functions, see Figure 5. The adjustment of temperature is done in real time and in the same time the safe operation of the equipment is assured.

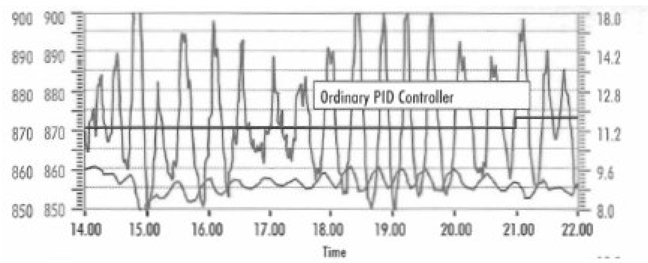

Figure 5. Control of temperature in kiln

From this point of view, the installation was equipped with measuring and control devices. The programmable logic controllers as other computer-based control systems are controls solution offered by Rockwell Automation.

A local control in each particular operation and an optimum control of entire plant are enforced. Local process automation and monitoring were accomplished.

The extensive theoretical insight on process dynamics, and the latest software technology, it has developed an absolute realistic simulator of cement plant processes.

The Expert system is built on a true real-time process control platform that can be easily linked to the process, through communication with an existing control system (PLC or DCS-based). Simplified structure of a control system is presented in Figure 6. The system is not based solely on fuzzy logic but on a hybrid system that utilises a number of techniques such us Statistical Process Control (SPC) and Model –based Predictive control (MPC)

The operator user interface with full SCADA functionality for technological flow control in the cement factory is presented in Figure 7.

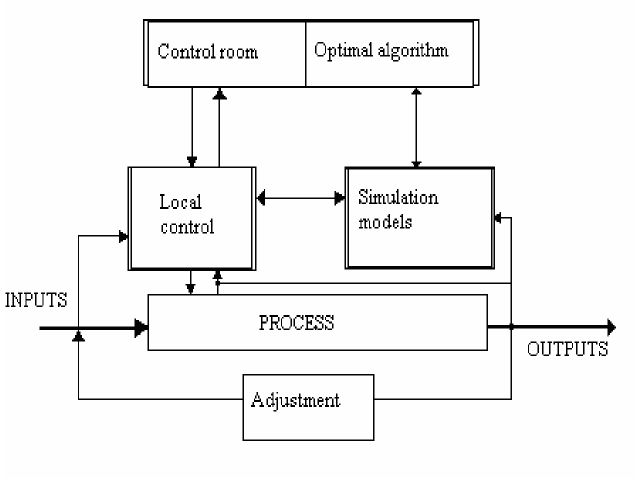

Figure 6. Simplified structure of a control system

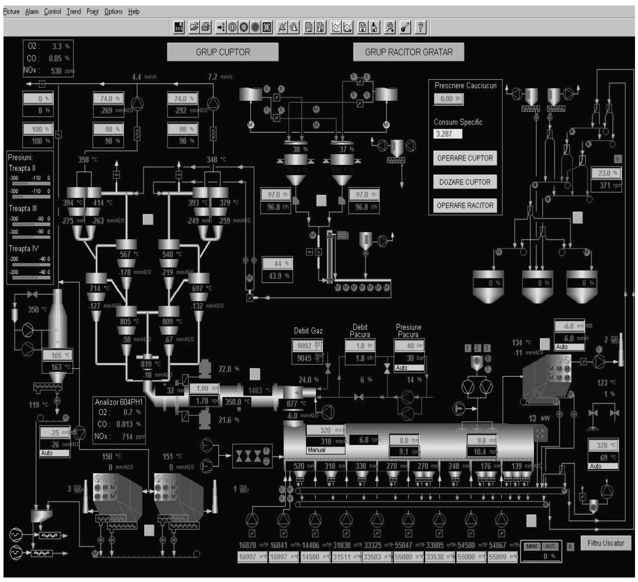

Figure 7. Operator user interface with full SCADA functionality

5. CONCLUSIONS

The cement manufacturing by dry procedure is a huge energy consuming process.

Electrical energy, fuel and raw material consumption decreasing was obtained as a result of decommission of the installations for the waste rubber burning and for the burning of the solid alternative fuels by kiln. These operations had a direct effect on production economy and competitive environmental.

Indeed, cement system are considered more complicated many other process and so expert system for cement process control are enforced.

The technological flow from Cement Plant is controlled automatically by ECS system. This software program enhances the operator to control (using a computer network) the whole technological flow, having the continuously monitoring system of the entire process.

Insufficient insight in process dynamics and interactions, high stress factors in real time operation conditions, and lack of adequate experience in utilizing the existing control system are typical reasons for incorrect operator actions. The consequences of this may result in low production quality, production interruption, equipment damage, and in worst case risk on human safety.

The versatility of the computers enables the implementation of the automatic estimation algorithms for the parameters of the discrete model describing the raw burning and cement production.

In the next years the Romanian cement industry is expected to become more prosperous and demand for new building project heightens.

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