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Survey on Automated Cement Pyro Processing and Cooling Technology Using PLC

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Abstract: Cement is the most important essential component to the building infrastructure development. Cement is the mainly used in the construction industries in case of Government's housing programs and the bridge construction projects, which is necessary for the country growth and development. In India constructional activities are increasing day by day due to the increasing in the population, as the result the market demand of cement is also increased. In order to increase the production of the cement, there by upgrading the new technologies to the cement kiln in the Cement Plant. The fully automated process in the cement kiln using the PLC (Programmable Logic Controller) and the output is displayed and controlled with the help of the HMI (Human Machine Interface). The whole system has been designed and tested using Siemen's PLC..

Keywords: Cement kiln, Control system,HMI, PLC, Pyro processing.

I. INTRODUCTION

India is the second largest producer of cement in the world. In this Process the overall concept of the Cement RotatoryKiln Process is taken from the various cement manufacturing groups of India.Cement manufacture process consists broadly of different stages, Mining, Crushing and Grinding a mixture of Raw Materials to make a fine rawmix, Blending, Pyro Processing (i.e.) "Heating the rawmix to sintering temperature (up to 1450degree C) in a cement kiln", Clinker Cooling and Storage, Grinding the resulting clinker to make cement, Packing and Loading.This paper review only the Pyro processing Process, how the flow and temperature is controlled with the help of Programmable Logic Controller.The rawmix is fed into the kiln and gradually heated by contact with the hot gases from combustion of the kiln fuel. The partial melting causes the material to aggregate into lumps or nodules, typically of diameter 1-10mm.This is called clinker. The hot clinker next falls into a cooler which recovers most of its heat, and cools the clinker to around 100degree C. The whole Automation Process is designed with the help of Siemens 1200 series PLC "TIA Portal" and the output is monitored with HMI (Human Machine Interface).

II. LITERATURE REVIEW

[1] In the paper**,** Due to the complex environment in rotary kiln, it is difficult to measure and control the temperature of rotary kiln. Initially they used to collect the rotary kiln calcining zone temperature by the PYROSCAN SYSTEM of HGH company, then by using the least square method to identify the calcining zone temperature model that belongs to a typical operation condition, at last by applying the generalized predictive to the calcining zone temperature control. If the firing temperature is too low, the calcium carbonate will not be completely decomposed, affecting the quality of clinker; however, the high temperature lead to clinker's excessive burning, dead burned, and too high temperature will make the kiln skin off, even affecting the service life of rotary kiln. Because of the complicated physical and chemical reactions in the kiln, the modelling and control of rotary kiln system is difficult to implement.

[2] This paper aspires to contribute to the heavy industry sector by presenting a successful application of power electronic techniques in a cement kiln drive system illustrating how modern technology facilitates a scientific method for reducing energy consumption and required resources while improving operational efficiency and performance. The kiln's shape is a key factor to system alignment and consequently to the distribution of the kiln's mechanical load over the rim gear and support bearings. The kiln shell, due to high thermal loads, tends to lose its circular shape and resembles more to an ellipse. This kind of flexing and distortion of the kiln's shell shape greatly increases mechanical wear, especially gear tooth wear and leads to roller, bearing and backlash problems. simultaneously, the second drive motor became overloaded and was forced to rotate the girth gear by itself, thus causing electrical overload problems.

[3] Cement is an essential component of infrastructure development.an integrated solution of material handling in cement plant is discussed. The overall operation is timing control so brownout may be avoided. Most of the energy is consumed to transfer the bulk materials between intermediate stages.to reduce energy

consumption and operational efficiency energy consumption is more. Due to increase in demand it results in low production speed.

[4] The paper proposed a new methodology to detect and replace faults in the sensor that ensures the burning zone temperature in a rotary cement kiln. However, due to the flying dust within the rotary kiln, frequently there exist faults in the measurements. Several faults were injected in the output variable and therefore the capabilities of fault detection and replacement of the proposed methodology could be evaluated. The results show that all faults were detected and the replaced measurements were closer to the original measurements without the injected faults, when compared to the faulty measurements. The results obtained in the fault detection and sensor replacement of the temperature sensor in the burning area of the cement kiln shows that the proposed methodology was successfully used. Several measurements, mainly where the estimated temperatures are higher that the measured temperatures, were identified as faults and therefore were replaced by the unscaled model output. During the burning process, the control of the temperature inside the kiln is crucial: insufficiently high maximum temperatures in the kiln result in incompletely reacted products and poor-quality cement.

[5] A review of emerging trends in plant control systems. This paper explores the changing roles of traditional distributed control systems (DCS) and programmablelogic controllers (PLC) used to automate cement manufacturing processes. In addition, the role of the plant control system has been expanded from just process visualization and control to include process optimization, plant asset management, energy management, and inventory control. In any case, the manufacturing process continues to have the most significant, quantifiable influence on overall cement quality and efficiency, sustainability, and environmental impact of the plant. The automation requirements of the cement industry are unique, even though on the surface they may seem similar to other industrial processes. The implementation of the new capabilities of the integrated process control systems will allow cement producers to optimize their energy consumption and improve operational efficiencies throughout their facilities. The integration of energy and asset management information is now available in one central location, increasing operability and streamline plant cost of operation.

[6] Third generation clinker cooler for reduced operating and maintenance cost Operational performance has shown significant savings in fuel consumption and electrical energy consumption. Unlike previous system upgrades, the primary driver of the upgrade was not to increase the hourly throughput. Blast air is directed into the grate.it is determined that gas did not need to be dedusted in a cyclone, as mill and burner operation could be changed to accommodate a higher dust concentration. Coal mill fan power was consumed by the pressure drop through the cyclone and high-grade heat in the tertiary air was being wasted.

III. PROPOSED WORK

In the above papers, the different Techniques and sensors are used to measure and control the temperature of the cementkiln. The Proposed system uses the same techniques but to measure the temperature with the Thermocouple sensor which has greater Accuracy level of sensing and controlling the Process with the help of PLC. By introducing the PLC the whole system is full automated with safety interlocks and the output can be monitored by the HMI (Human Machine Interface). This is the main advantage of this Proposed work.

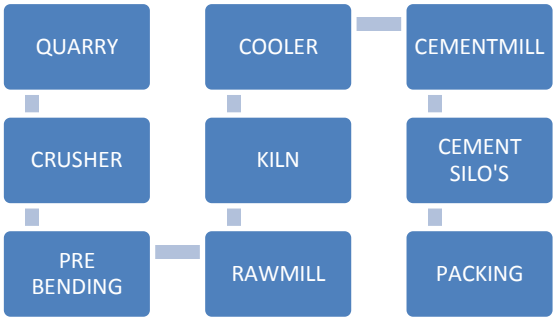

Figure 1. PROCESS FLOW CHART OF CEMENT PLANT.

In the above Fig.1 Process Flow chart, this paper consider only the kiln process. The temperature of the kiln is controlled by PLC. The temperature inside the kiln bed is maintained and carbon dioxide is exhausted to control the calcination process. The output is monitored and some control command is given through the HMI.

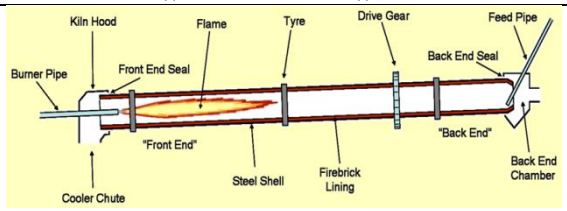

Figure 2. Block Diagram of Kiln

1.1 PROGRAMMABLE LOGIC CONTROLLER

In 1960's PLC where introduced, MODICON 084 was the world first PLC as commercial product to the US car Manufacturer. Programming is done with the help of ladder logic language. Siemens 1200 series Controller is used to control theprocess. Basics concept of relay working plays the main role in the programming(i.e.,) NO (Normally Open) and NC (Normally Closed) Contacts. NO and NC Contacts are consider as the input and Coil is used to indicate the Output. Temperature of the kiln is measured and controlled with the help of the burner. Temperature range maintained between (800 to 1400 degree Celsius). K-type Thermocouple is used as the measurement sensor and used to control the burner fuel inject for the inlet and mid region. Thermocouple sense the temperature of the rawmix inside the kiln and the sensed value is given as the feedback to the PID controller where the controller action is taken to get the desired output. The control action is used to control the burner to get the desired temperature.

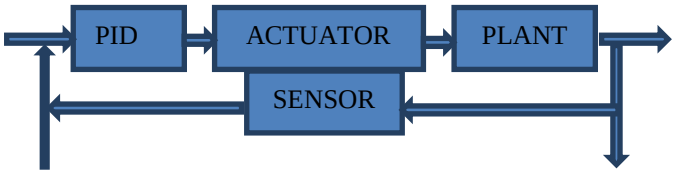

Figure 3. FEEDBACK CONTROLLER ACTION

During the Pyro Processing, Calcination of Lime takes place in the cement rotatory kiln due to high temperature. This Thermal treatment process carried out in the absence of or limited supply of air or oxygen to the rawmix to bring about the Thermal decomposition.

IV. RESULTS

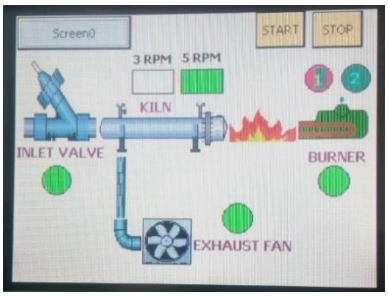

Figure 1. HMI Output Screen

Control panel from which we can control the process and the status of the process is indicated in the screen.

Figure 1 TEMPERATURE AND CO2 INDICATER

V. CONCLUSION

In the above papers, the different techniques and temperature sensor are used to measure the Cement Rotatory Kiln. The proposed work conclude that the measuring of temperature with the Thermocouple Temperature sensor and Controlling of the whole system with the help of the PLC and the output is monitored with the HMI. It reduces the manpower and increase the clinker production rate.

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