

Automatic Bell less Top Charging System of a Blast Furnace Using PLC and SCADA

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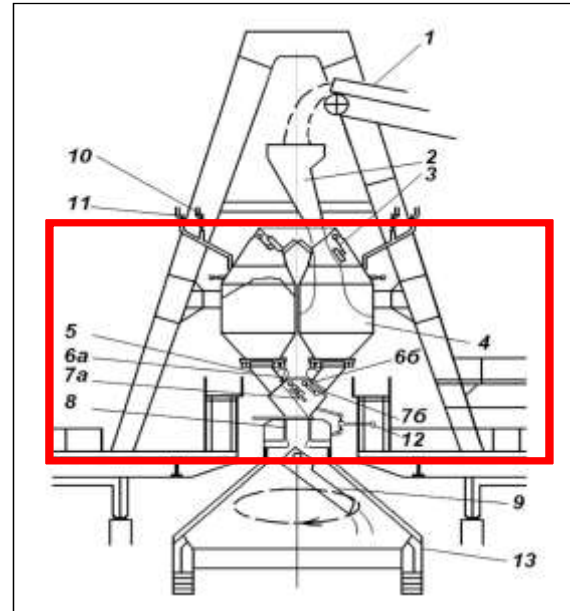
Abstract- Blast Furnace is one of the major equipment where the conversion of raw materials like iron ore, Sinter and coke into molten metal (pig iron) takes place. To charge raw material into Blast Furnaces, which are operated at 2kg/cm² pressure, Bell-less top (BLT) charging system. The Bell less Top Charging System (BTCS) which is a continuous system for charging raw material into a blast furnace for iron making. The valve casing comprising material gate, lower sealing valve and distribution chute assembly is an important unit of the system. This assembly helps to retain the charging material inside the hopper; protect the lower sealing valve during charging; control charging material discharge rate; seal gases of Blast furnace reactions; and seal high counter pressure of furnace. In addition, with leakage of Blast furnace gas being eliminated, safe working conditions have been established, and productivity has increased with downtime of Blast furnace reduced. Good control of the gas flow in the blast furnace ensures greater productivity and a longer life span of the installation.

Various failures of BLT mechanical equipment are studied and noted. Based on this failure analysis Sealing valve failure is taken for further study which is causing highest production loss to the company due to high burden. In proposed work modification of blast furnace bell-less top charging system sealing valve, there is changes in sealing valve operation which helps in reduce time delay, low maintenance and higher productivity. The modification is based on the alternatives designs suggested to the gland joints and hydraulic circuits and Calculation of forces by the mathematical process

In this project sealing valve and chute can be controlled by using PLC and SCADA, to avoid burden an sealing values, and chute is also controlled for the proper distribution of coke and non-coke material in the furnace

Index terms- PLC, SCADA, HMI, Relay, Sensors

I.INTRODUCTION



1 - Charging belt conveyor, 2 - receiving hopper, 3 - upper sealing valve, 4 - material bin, 5 - Sealing tract, 6 - material flow regulating gate valve (a - open, b - closed), 7 - Lower sealing valve (a - open, b - closed), 8 - spoute, 9 - rotating distributing chute, 10 - equalizing valve, 11 - relief valve, 12 - clean gas delivery, 13 - blast-furnace top or blast-furnace throat.

PLC (Programmable Logic Controller) is a small computer with a built-in operating system (OS). This OS is highly specialized and optimized to handle incoming events in real time, i.e. at the time of their occurrence. The PLC has input lines, to which sensors are connected to notify the events. (Such as temperature above/below a certain level, liquid level reached, etc.) and output lines, to which actuators are connected to effect or signal reactions to the incoming events (such as start an engine, open/close a valve, and so on). PLC is very powerful and smart electronic device that can automatically control

electrical appliances. Execute a user defined logic program, and write the resulting digital and analog output values to various output elements. Graphical representation can be done using SCADA. This projects helps to control the bell less top charging system automatically

II PROBLEM FORMULATION

As we know that, Blast furnace is operated around 2000 degree Celsius so it is difficult to operate manually, because of that in most of the blast furnaces are operated automatically. But the furnace is operated at high temperature, maintaining the containers with good quality is important, it need some modifications to work with better efficiency

III PROBLEM SOLUTION

By using some sensors for the better operation, as like pressure sensor is used to match the furnace pressure and the bins pressure, IR sensors for the better values operation, quality maintaining tools are also used

IV MATERIALS

A. Programmable Logic Controller (PLC)



A programmable logic controller (PLC) is an industrial grade computer that is cable of being programmed to perform control functions. The programmable controller has eliminated much of the hardwiring associated with conventional relay control circuits. Other benefits include easy programming and installation, high control speed, network compatibility trouble shooting and testing convenience and high reliability.

The programmable logic controller is designed for multiple input and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance vibration and impact. Programs for the

control and operation of manufacturing process equipment and machinery are typically stored in battery- backed or non- volatile memory. A PLC is an example of a real time system since the output of the system controlled by the PLC depends on the input conditions.

Initially the PLC was used to replace relay logic, but it's ever increasing range of functions means that it is found in many and more complex applications. In addition to cost saving, PLC provide many more other benefits including increased reliability, more flexibility, communications capability, faster response time.

B. SCADA

A system gathers information, such as where a leak on a value has occurred, transfers the information back to a central site, altering the home station that leak has occurred, carrying out necessary analysis to control, such as determining if the leak is critical, and displaying the information in a logical way and these scada systems are simple, can monitors its work with smartness

C. HMI



A Human machine interface (HMI) is a user interface or dashboard that connects a person to a machine, system or device. While the term can technically be to any screen that allows a user to interact with a device, HMI is most commonly used in the context of an industrial process

Here HMI can be used to monitor machine inputs and outputs and also it do controlling actions

D. Pressure sensors



This sensor is used to match the furnace pressure and the bins pressure same for the movement of cock materials into the furnace

E. Temperature Sensor



It is a device to measure the temperature through an electrical signal. It requires a RID [Resistance Temperature Detectors] or thermocouple. Temperature sensor is a measurement of the hotness or coldness of an object. This sensor is working based on the sensors of the sensors, voltage that reads across the diode.

F. Metal detector



Metal sensor is required to check the proper operation of the valves i.e. to find the proper closing and opening action

V IMPLEMENTATION DETAILS

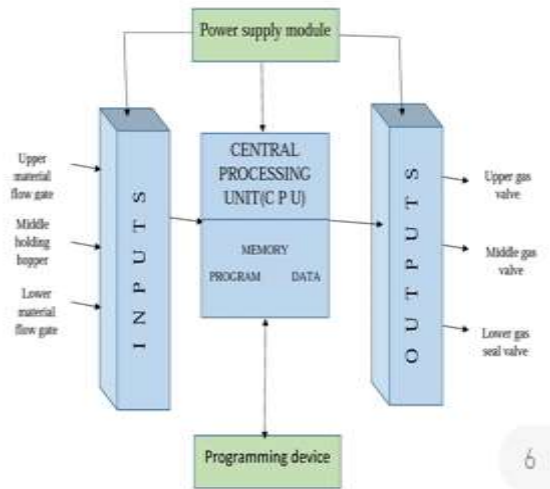


Figure 1: Block diagram of PLC

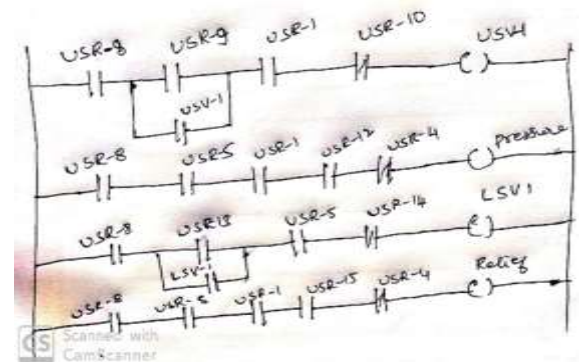
In our implementation we operate the bell less top charging system in three ways i.e. manual, semi-automatic and automatic through a simulation, so that we used PLC, SCADA and HMI

Three inputs and outputs are in the upper, middle and lower values for controlling flow of materials in to the furnace

Pressure sensor is used at the top of the furnace to match the pressure of furnace and bins

Pressure releasing values are also used to release a pressure, when the raw materials taken in to the bins

PLC Ladder Logic:



The above logic diagram is used for the manual operation of a blast furnace

One of the upper seal valve opens when the material flows in to bin, at that particular time pressure will release from the bins through relief values

After the release of pressure from the bins material is flowing in to bins, after that valve will be closed then

material move to furnace through middle sealing valve, chute is present inside of the furnace to arrange the material inside the material in pre-defined way

VI CONCLUSTION

Bell less top charging system of a blast furnace is operated manually, semi-automatically and automatically for the flexible operation and also some sensors used for the better performance and this type of research helps for knowing the new languages and understanding purpose

REFERNCES

- [1] The Blast Furnace Facility and Equipment”, The AISE Steel Foundation, Pittsburgh, Tamoghna Mitra J. P. Wallace, A. J. Dzermejko, F. W. Hyle, N. J. Goodman, H. M. Lee, R. W. Zeigler, ” 1999.
- [2] Mathematical Simulation of Material Trajectory for Compact Bell-less Top of ‘F’ Blast Furnace Tathagata Bhattacharya Samik Nag, Vipul Mohan Koranne, Uttam Singh and Somnath Basu
- [3] Sealing Valve Bell Less Top Blast Furnace Increasing Productivity-Visakhapatnam Steel plant (VSP) Meenu Sahu and Shiena Shekhar