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Furnace Monitoring and Billet Cutting System

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ABSTRACT: A new generation of industrial electrical furnace has been developed during the last 25-30 years. Present practices followed in electrical furnace are discussed in this paper. Through a literature review accounts of various practices present being followed in steel industries using electrical furnace has been carried out in few industries in India.
The Furnace control which is the most important part of any steel plant. Microcontroller is also used measure furnace temperature by using sensor (PT100). In Automate a steel plant we can monitor the furnace temperature and minimize human intervention.
Steel plants require continuous monitoring and inspection at frequent intervals. The objective of the proposed work is to develop steel plant. We can continue monitor the furnace and observe/see the overview of the system seen on the PC.
In our project we can also work properly billet cutting billet cutting of metal rod are properly.

KEYWORDS: Electrical Furnace, Billet Cutting, Molten Metal, Billet Counting.

1 INTRODUCTION

Over the years the demand for high quality, greater efficiency and automated machines has increased in the industrial sector of steel plants. Steel plants require continuous monitoring and inspection at frequent intervals. There are possibilities of errors at measuring and various stages involved with human workers .The Furnace control which is the most important part of any steel plant.

In order to automate a steel plant and minimize human intervention, there is a need to develop a system that monitors the plant and helps reduce the errors caused by humans. **Microcontroller** is also used measure furnace temperature level using ADC.

Errors due to the involvement of humans in the data collection and processing using complicated mathematical expressions.

1.1 WHAT IS FURNACE?

A furnace is an equipment used to melt metals for casting or to heat materials to change their shape (e.g. rolling, forging) or properties (heat treatment).

Since flue gases from the fuel come in direct contact with the materials, the type of fuel chosen is important. For example, some materials will not tolerate sulphur in the fuel, in which case you can use light diesel oil. Solid fuels generate particulate matter, which will interfere the materials placed inside the furnace, therefore coal is not often used as fuel.

Furnace ideally should heat as much of material as possible to a uniform temperature with the least possible fuel and labor. The key to efficient furnace operation lies in complete combustion of fuel with minimum excess air. Furnaces operate with relatively low efficiencies (as low as 7 percent) compared to other combustion equipment such as the boiler (with efficiencies higher than 90 percent.

This is caused by the high operating temperatures in the furnace. For example, a furnace heating materials to 1200 oC will emit exhaust gases at 1200 oC or more, which results in significant heat losses through the chimney.

1.2 BILLET PRODUCTION

Billets are the best raw material to produce steel bars, as compared to ingots.Plant is capable of giving an output of 45 tons of billets in one heating. Given below is the production process.

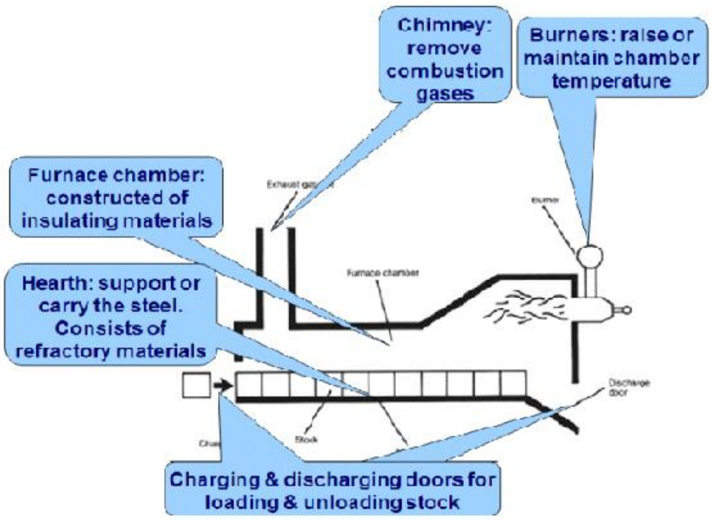
The first step of Billet production is of procurement of sponge iron. Best quality sponge iron is procured and stored in Raw Material Yard. This sponge iron is later fed to the furnace by a giant crane. The sponge iron is melted by the induction furnace at a high temperature.

The plant has two induction furnaces of high capacities. The furnaces are run by a power station which is controlled via computerized systems.

After the quality of the molten iron is insured, the furnace tilts and pours it into a ladle maneuvered by a crane. The crane moves this ladle towards the caster and pours the molten iron into it. The caster then casts the molten iron into Continuous Casts. These casts are cooled with the help of water and air pressure and form the billets of required size.

As the billets pass towards the cooling bed, they are accurately cut into the required size by a team of expert foremen. Finally, the hot billets are laid on the cooling bed, where they cool down and get ready for being transported.

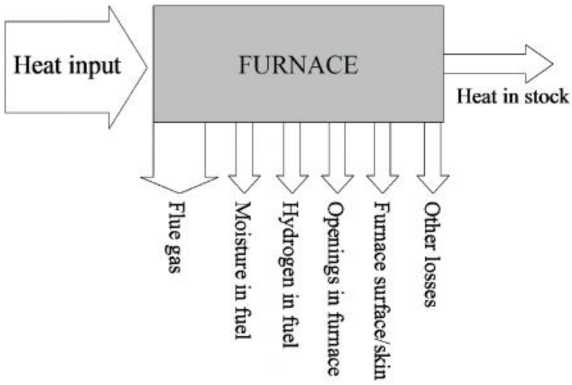
2 CONSTRUCTION AND WORKING



FURNACE COMPONENTS

All furnaces have the following components as shown in the figure:

- Hearth to support or carry the steel, which consists of refractory materials supported by a steel structure, part of which is water-cooled.
- Burners that use liquid or gaseous fuels to raise and maintain the temperature in the chamber. Coal or electricity can be used in reheating furnaces.
- Chimney to remove combustion exhaust gases from the chamber.
- Charging and discharging doors through which the chamber is loaded and unloaded. Loading and unloading equipment include roller tables, conveyors, charging machines and furnace pushers.
- *Heat Losses Affecting Furnace Performance*



Ideally, all heat added to the furnaces should be used to heat the load or stock. In practice, however, a lot of heat is lost in several ways as shown in the figure.

These furnace heat losses include:

- Flue gas losses: part of the heat remains in the combustion gases inside the furnace. This loss is also called waste-gas loss or stack loss.
- Loss from moisture in fuel: fuel usually contains some moisture and some of the heat is used to evaporate the moisture inside the furnace
- Loss due to hydrogen in fuel which results in the formation of water
- Loss through openings in the furnace: radiation loss occurs when there are openings in the furnace enclosure and these losses can be significant, especially for furnaces operating at temperatures above 540°C. A second loss is through air infiltration because the draft of furnace stacks/chimneys cause a negative pressure inside the furnace, drawing in air through leaks or cracks or when ever the furnace doors are opened.
- Furnace skin / surface losses, also called wall losses: while temperatures inside the furnace are high, heat is conducted through the roof, floor and walls and emitted to the ambient air once it reaches the furnace skin or surface.
- Other losses: there are several other ways in which heat is lost from a furnace, although quantifying these is often difficult, for example, losses due to formation of scales.

WORKING

Furnace's temperature, level is measured using sensor PT-100 respectively. These sensors are interfaced with microcontroller using ADC with signal conditioning.

When temperature exceeds above limit, cooling pump will be on. Pressure exceeds above limit, pressure release valve will be on to release the pressure.

All parameters are given to PC via serial communication protocol using MAX232.

When the pipe near to the proxy sensor then they indicate that the pipe cut at specific size.we assign to microcontroller which size of pipe we have to cut and how many pices of that metal we have to cut.the proxy sensor is used for the cut and stop purpose.

3 TYPE OF FURNACES

- Forging furnaces
- Re-rolling mill furnaces
- Continuous reheating furnaces

3.1 FORGING FURNACE

- The forging furnace is used for preheating billets and ingots to attain a 'forge' temperature.
- Forging furnaces use an open fireplace system and most of the heat is transmitted by radiation.
- The furnace temperature is maintained at around 1200 to 1250 oC. The typical load is 5 to 6 ton with the furnace operating for 16 to 18 hours daily.

3.2 RE-ROLLING MILL FURNACES

- A box type furnace is used as a batch type re-rolling mill.
- This furnace is mainly used for heating up scrap, small ingots and billets weighing 2 to 20 kg for re-rolling.
- Materials are manually charged and discharged and the final products are rods, strips etc.
- The operating temperature is about 1200 oC.
- The total cycle time can be further categorized into heat-up time and re-rolling time. During heat-up time the material gets heated up-to the required temperature and is removed manually for re-rolling.
- The average output from these furnaces varies from 10 to 15 tons / day and the specific fuel consumption varies from 180 to 280 kg. of coal / ton of heated material.
- Generally, these furnaces operate 8 to 10 hours with an output of 20 to 25 ton per day.
- The material or stock recovers a part of the heat in flue gases as it moves down the length of the furnace. Heat absorption by the material in the furnace is slow, steady and uniform throughout the cross-section compared with batch type.

3.3 CONTINUOUS REHEATING FURNACES

- In continuous reheating, the steel stock forms a continuous flow of material and is heated to the desired temperature as it travels through the furnace. The temperature of a piece of steel is typically raised to between 900°C and 1250oC, until it is soft enough to be pressed or rolled into the desired size or shape. The furnace must also meet specific stock heating rates for metallurgical and productivity reasons.
- To ensure that the energy loss is kept to a minimum, the inlet and outlet doors should be minimal in size and designed to avoid air infiltration.
- Continuous reheating furnaces can be categorized by the two methods of transporting stock through the furnace.

4 CONCLUSION

The Furnace Monitoring and Billet cutting System is very useful for industrial purpose and it is easily to handle the system. With the help of Microcontroller the handling and controlling of furnace monitoring and billet cutting system is totally automatic. Thus the system minimizes the loss of materials and accidents in industries and also increases the accuracy or efficiency of product.

The process in developing this innovative circuit is successfully done. High priority has been given to make the circuit simple but efficient with high reliability.

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