IMPROVING THE EFFICIENCY OF WEIGHER USING PLC CONTROLLER

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Abstract

Static and dynamic weighing systems are now the most prominent measurement and control instruments of raw materials flow rate. Considering the development of technology in industries, fabrication of special progressive systems of weighing in which the used state of art modern control methods of mechatronics has changed the process of classical control principles based on fieldbus technology development and use of the various types of data exchange protocols have led to the creation of flexible ways of interconnections between DCS system and main controllers with related modular boards. In industrial sectors, the raw material that is entering to the system must be in an equal ratio for the production and it should be weighed properly for further use. In this project the main focus is on the raw material handling system that is to know the amount of raw material entering to the system by using load cell and controllers. Weigh feeders are used to weigh and to handle the raw material. It weighs accurately the raw material for maintain proper blend for sinter. This blend is called as basemix material. Programmable Logical Controller controls the weigh feeders by using speed sensors, load cell, VFD and by using the control input. By designing the certain parameters whole system is controlled by using Programmable Logic Controllers. In this paper PLC is used to control overall system because it is capable of controlling weigh feeder system. Main focus is given to weigher to weigh accurate amount of material entering to the system.

KeyWords: *Static, Dynamic, weighing and DCS*

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1. INTRODUCTION

In this article we will report the successful revamping model of control of weighing systems of weigh feeders plant in JSW Steel Ltd. The revamping was based on Schenck weighing controllers and Saimo weighing system[1].

At first, the traditional control system in section of hard wiring and interlocking has been described with the old control systems which included the terminology of belt weighers and weigh feeder automation technology. We will follow the discussion by declaring the function of new control and communication system based on the new hardware and software technology used in project.

Combination of electronic and mechanical different systems may be used in operation, although there will always be some deviations in the final system errors if you use non- integrated systems. Most of the time, because of the economic conditions, and not having a noticeable distinction in result, we had better use some different electronic and mechanical equipment in combination.

Considering two types of typical errors, “Actual feed rate” error, “Nominal feed rate” error, efforts to keep performances in control ways of weighing system can lead to final acceptance errors in systems combinations. In actual feed rate terminology, feed rate is always percentage of flow rate. For a system with Actual Feed Rate of 1% for the (I), flow rate in (t/h), flow rate is always between I+1% and I-1%. Weigh feeders are used to weigh and to handle the raw material. It weighs accurately the raw material for maintain proper blend for sinter. This blend is called as base mix material. PLC controls the weigh feeders by using speed sensors, load cell, VFD and by using the control input.

2.OBJECTIVE OF THE PAPER

1. To find the error in the weigh feeder
2. Finding the parameter by which the weigh feeder performance is affected.
3. Solving the error problem by using DCS .

2.1 Present System

Present system has five iron ore weigh feeders in proportionating bin 1. These weigh feeders are operated according to quantity required. Weigh feeders weighs the raw material which is on the conveyor belt. Operating principle is that the raw material enters from bunker to weigh feeders in which it has moving conveyor belt which is operated by induction motor through VFD. Load cell is mounted on weigh feeder to weigh the material and to send weighed parameter in mili volt. Tacho generator senses the pulses of belt speed and displayed all these parameters in weigh feeder controller.

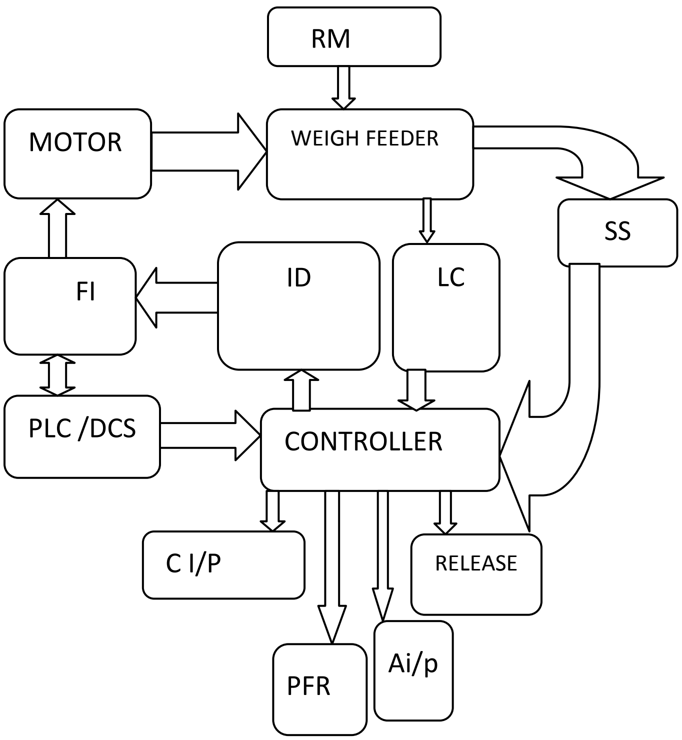

Fig-1: schematic diagram of weigh feeder and controller connection

Where, RM= Raw Material
FI= Frequency Inverter
ID= Interlock Device
C I/P= Control input
SS= Speed sensor
PFR= Pulse input ratio
A I/P= Anolog input
LC= Load cell

Caliberation of weigh feeders is done for 15 days to check the efficiency of feeders. Profibus is been used for communication from controller hardware to DCS, to control whole weigh feeders.

2.2 Weigh Feeder and Controllers

Weigh feeder controllers are used to display all the parameters like load cell value in milli volts, tacho generator speed and its pulses, set point and feed rate, belt load and actual speed of conveyor belt. VFD is used to control the speed of the induction motor and variable frequency drive is controlled by weigh feeder controller.

Fig-2: Iron ore weigh feeder

Fig-3: Iron ore weigh feeder Controllers

A variable-frequency drive (VFD) is a system for controlling the rotational speed or torque of an alternating current (AC) electric motor by controlling the frequency of the electric power supplied to the motor.

From this controller various datas like belt load, set rate and feeder rate can be moved to DCS software by using PROFIBUS as communication between hardware and software.

2.3 Modification Suggested

In this weighing technique, there is some error in percentage in weighing. The various factor may affect the entry of raw material i,e induction motor, conveyor belt, speed sensors, load cell, controllers and VFD.

Main aim is to find the error or problem in which part does the system performance is affected. To find the solution, different weigh feeder reading are taken in loaded condition. Different parameters are noted to find the error in weigh feeder. Parameters like belt load in kg/m, actual speed in m/s, controller speed in m/s, feeder rate in t/h, set point in t/h, tacho pulses which are displayed at controller.

In the present system, there is some percentage of error in weigher, so for the improvement of weigher certain modification suggested is to weigh the empty belt in operating condition and to monitor the same for few days. From the parameters obtained, percentage of error can be calculated and the present can be corrected by using DCS , and certain corrections can be made by auto recorrecting if the error is more or less than 2 percent, or giving alarm signal if error exceeds 5 percent for caliberation process. Hence by modifying the weighing procees can be improved.

3. DESIGN

Some considerations were made while designing the percentage of error in weigh feeders, those considerations are as follows:

1. Belt load in kg/m, feeder rate in t/h, actual speed and set point in t/h.
2. Error percentage should not exceed 5% and if suppose exceeds give signal to alarm
3. If error percentage is within + 2 or -2%, then give signal for auto correction or for recalibration.

3.1 Calculation

Iron ore weigh feeder 1

Set point =500 t/h Feed rate = 2 t/h
Actual speed = 0.340 m/s
Belt load = 1.370 kg/m

For belt load in percentage
1.370-0.12/1.370*100
= 91.2%

For tones in percentage
0.4658-0.0408/0.4658*100
= 91.24%

So 500t/h- 2t/h
= 498 t/h
= 498*1000/3600*0.34
=406.8 kg/m

For 500 t/h
= 500*1000/3600*0.34
= 408.4 kg /m
408.4-406
= 1.696 kg/m
= 1.696/408.4
= 0.415% error.

To calculate actual feed rate using formulae based for Weigh feeder 1are as follows:

1.Feed rate: kg/m*actual speed*3.6
=406*0.309*3.6
= 451.6 t /h

2.Feed rate: kg/m*actual speed*3.6
= 455.2*0.233*3.6
= 381.8 t/h

3.Feedrate: kg/m*actual speed* 3.6
400.9*0.313*3.6 = 451.7 t/h

Coke weigh feeder 14

Set point= 100 t/h Feed rate= 1 t/hr
Actual speed= 0.202 m/s Belt load= 0.883 kg/m

For belt load in percentage
0.883-0.03/0.833*100 = 96.39%

For tonnes in percentage
0.178-0/0.178*100
= 100%
So 100-1= 99

= 99*1000/3600*0.203
= 135.46 kg/m

For 100 t/hr
= 100*1000/3600*0.203
= 136.83 kg/m
136.83-135.46
= 1.362
= 1.362/136.83
= 0.99% error

4. RESULTS AND DISCUSSION

To improve the efficiency of weigher, error has been calculated by taking the parameters of empty belt load in operating condition. Finally we design a system in order to overcome this percentage error in the weigher.

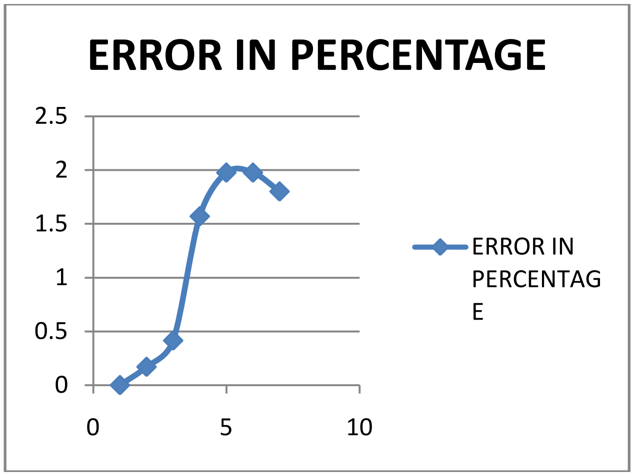

Chart-1: Iron ore weigh feeder

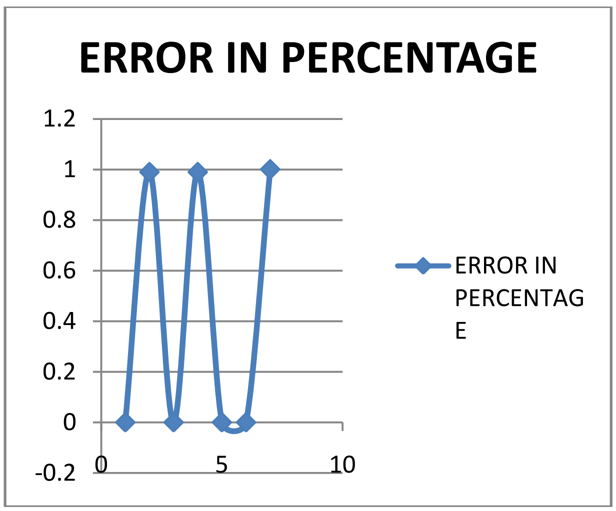

Chart-2: Coke weigh feeder

Above graphs shows the percentage of error variation with respect to number of days.

5. CONCLUSIONS

Weigh feeders are controlled by using DCS controllers, so that problem can be overcome by calculating the error in belt load and can be auto recorrected by using DCS and can improve the efficiency of weigher by reducing the percentage of error in weigh feeders.

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