Energy Conservation of DC Motor with Temperature Stability Analysis to Reduce Heating of the Motor Winding

(At M/S Sunflag Iron and Steel Co. Bhandara)

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Abstract-- dustries as the cost of the DC motor increasing day by day. Also the cooling of DC motor helps the industry to manage the burning issue of DC motor. Hence the industry motivating and promoting the cooling system in industrial application.
Normally the Variable Frequency Drive used for the Speed control of the 3 Phase induction motor for the various applications, Also Variable Frequency Drive used for power saving where the load on the motor is less and Variable air consumption requirement etc. This project work proposes a new concept of using Variable Frequency Drive for controlling the temperature of the main motor by controlling the speed of the auxiliary motor by adjusting the optimum cooling rate. This will result into the cooling without affecting the Main motor performance. The PLC is used to control the optimum speed of the auxiliary motor based on the dynamic load of the main motor smartly without time delay. The speed reference generation for the Variable Frequency Drive formulated on the startup sequence of the main Motor Drive and Load on the Main Motor. The reference generated by the PLC given to the VFD for controlling the temperature of main motor within the limit. This project not only helps the industry to reduce the production cost per tonne but also helps to the industry for managing the cooling factor of the DC motor of main stand in rolling mill.

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I.

II. INTRODUCTION

This project presents the development of a dynamic temperature control system for the DC Motors of Main Stands in Rolling Mill to reduce the heating of the DC motor when

load is increased in M/S Sunflag iron and steel Co. Bhandara. The mill equipped with following capacity main motors where the system to be implemented.

1. 8 Nos. 350 KW DC Motor for roughing Mill
2. 6 Nos. 450 KW DC Motor for Intermediate Mill
3. 4 Nos. 600 KW DC Motor finishing Mill

For each motor forced cooling system is used by using 11KW Blower motor and Heat exchanger for controlling the temperature of the motor within the norms. This is the conventional system used in all industries. The existing system used dynamic cooling system for DC motor of main stands in rolling mill to reduce the power consumption of the blower motor but it does not analyze at what cooling factor or time the main stands DC motor temperature is stable. Hence the present system is again modified to analyze cooling factor of the DC motor. Total 18 nos. 11 KW Blower motors used for the cooling of main stand motors. As Blower of the main stand controlled by the dynamic cooling system but the flow of water and air for cooling purpose is continuous. Current rating of the main stands DC motor 1050A then at 40% of load heat loss is

$$P = I^2R$$
$$420^2 * 0.001 = 176.4W$$

Which is higher value of heat loss? The proposed work increased the cooling rate and reduces the heating Pg of the DC motor up to 30% to 50 %.

III. LITERATURE SURVEY

Literature Survey 1:-

A Constant Air Flow Rate Control of Blower for Residential Applications

Abstract—This paper presents a technique to control a blower for residential applications at constant air flow rate using an induction motor drive. The control scheme combines a variable volt/hertz ratio inverter drive and an average motor current regulation loop to achieve control of the motor torque-speed characteristics, consequently controlling the air flow rate of then blower which the motor is driving. The controller is simple to implement and practical for commercialization. It is also reliable, since no external pressure or air flow sensor is required. Both a theoretical derivation and an experimental verification for the control scheme are presented in this paper.

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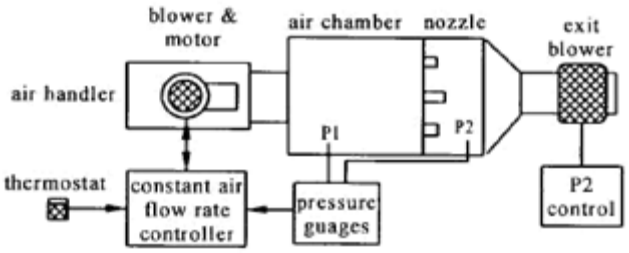


Fig.Scehematic of the experimental setup

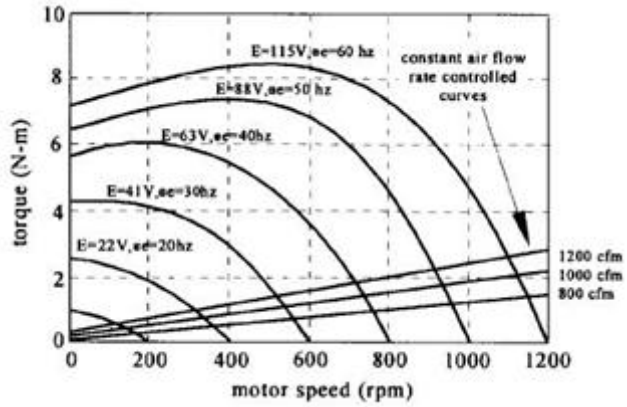


Fig. Torque-versus-speed curves at various voltage E and torque-versus-speed curves when the air flow rate = 800, 1000, and1200 CFM.

Literature Survey 2:-

Water Flow Control for Air-conditioner using Inverter-Controlled Induction Motor Drives

Abstract: Since induction motors are widely, used for water flow control of air-conditioning system, it is possible to apply inverter controlled induction motor drives to achieve variable-water-volume (VWV) control instead of using conventional on-off control. The objective of this paper is to investigate the applications of inverter-controlled induction motor drives to the variable-water volume control for the circulated cooling water pump of air conditioners such that the flow rate of cooling water varies with load conditions and thereby increasing the efficiency of the system. Experimental results derived from the packaged air-conditioning units with 10 hp circulated cooling water pump demonstrate that significant amount of power saving can be achieved.

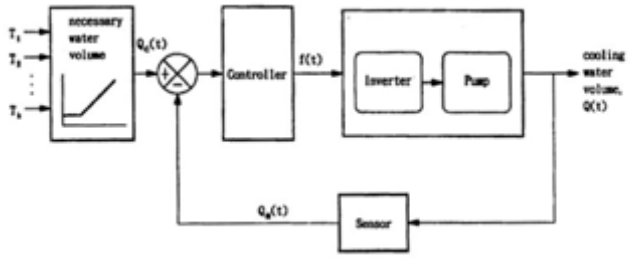


Fig.Block diagram of the control system for experimental set-up

Literature Survey 3:-

A New Approach to Cold Mill Drive Equipment Air Cooling

Abstract:- Dominion Foundries and Steel Limited (DOFASCO) of Hamilton, ON, commenced single-shift production on the new No. 2 Five- Stand Cold Rolling Mill in July 1976. The mill employs a new integrated systems approach to the cooling of the mill drive motors, associated electrical control equipment, mill process and service areas, and buildings. The new approach represents an improvement in cold rolling mill electrical equipment cooling and ventilating methods. As described, the new approach results in cost and operating advantages over established methods.

Integrated Cooling System:-

The cold rolling mill has the following air handling systems combined to form an integrated system:

Electrical equipment room, mill and reel drive converters (control islands), mill and reel drive transformers, mill and reel drive motors, mill building, oil cellar, fog exhaust system.

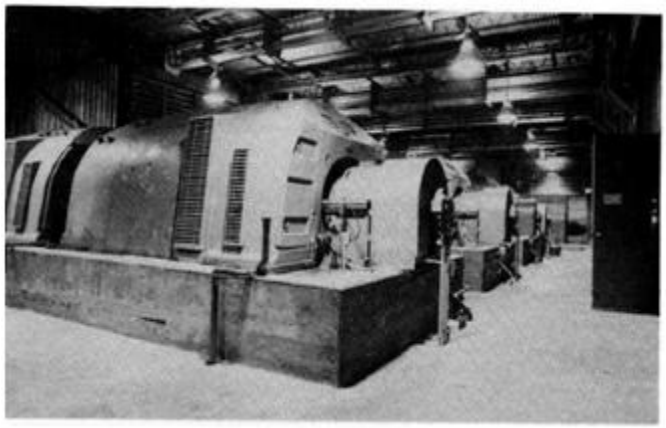


Fig. Main drive motor room.

IV. DATA COLLECTION

(i) Main DC Motor:-

BHEL, 350KW, 750/1500 RPM, 580V (DC), 640A, TYPE:-1HS-5404-5NE Field voltage:-220V (DC), 16A Excitation, S1-Duty Cycle Class F insulation

Description: - Three different ratings DC motor are used to carry the load whose ratings are mentioned as above. These DC motors are controlled by rectifier. When the load on the motor increases the heating of motor winding takes place so that cooling is provided through the impeller connected to blower motor.

(ii) Blower Motor:-

11KW, 2 Pole, 160 M (Frame Size), Foot wounded, 415V, 20A, 50Hz, S1-Duty Cycle Class B insulation

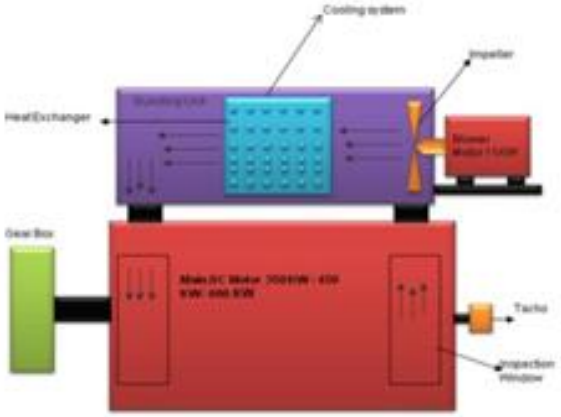
Description: - The blower motor is used to circulate the air through the main DC motor winding. Generally, to this blower motor one impeller is connected which circulates the air through the motor winding.Impeller is nothing but the onecircular mechanical equipment having blades on its circular periphery. The rating of the blower motor is mention as above.

(iii) Load:-

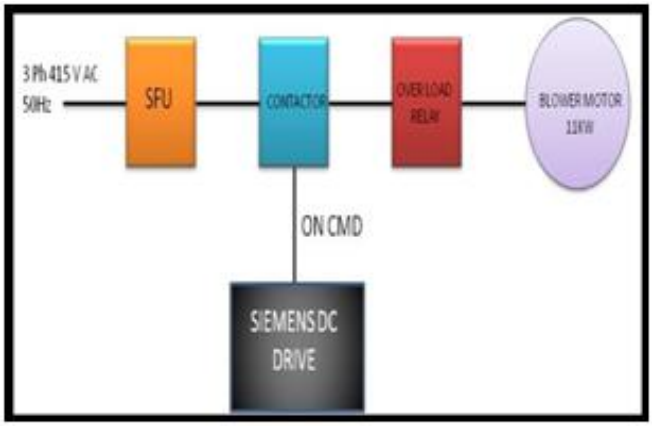
Vary: - 0-120%

Description: - Load is in the form of product i.e. in the form of steel bars with different diameter as per the requirement of customer. As the diameter is small heating of the winding will be less so cooling rate also increases and vice versa. Load can be vary from 0-120% of full load.

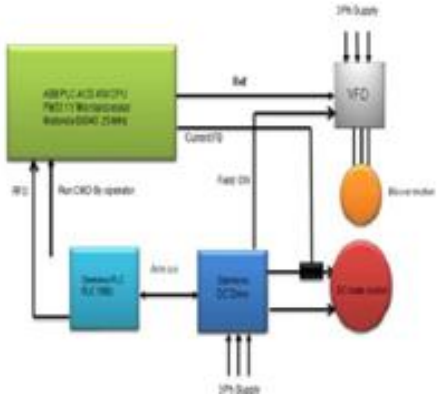
PROJECT SCHEME METHADOLOGY



EXISTING BLOWER MOTOR CONTROL SCHEME



EXISTING CONTROL SCHEME



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