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DIP COATING CONVEYOR AUTOMATION SYSTEM FOR BRAKE SHOES using Programmable Logic Control (PLC)

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ABSTRACT: The present project is about the design and implementation of dip coating conveyor automation system for brake shoes based on Programmable Logic Controller (PLC) technology. The PLC correlates the operation parameters control required by the user and monitors the system during normal operations and under dipping condition. Tests of dip coating system is driven by three phase AC induction motor driver using Variable Frequency Drive (VFD) controller. PLC provides higher accuracy in regulation as compared to human works, PLC is proved as a versatile and wide effective tool in industrial control of electric drives. Here it is correlating hardware and software together to control parameters of DIP coating system.

KEYWORDS: Dip Coating Conveyor, Programmable Logic controller (PLC), DOL, Variable frequency drive (VFD).

1 INTRODUCTION

The industries are coming up with some well developed technologies in recent years [8]. To avoid the manual work load automation were introduced as production rate increases in short span of time [6]. All the control devices such as communication related interfaces statistically enters the internet information center[1]. Control of equipment are done by computers. In most industries control of equipment are carried through PLC (Programmable Logic Controller), as it has many advantages with it [9]. The advantages are read as easy installation, inexpensive, flexible to applications [2]. PLC can be get connected with machines as an application in the manufacturing automation [3]. It gets connected to the external world by its inputs and outputs [4]. For driving the motor Variable Frequency Drive (VFD) is used and the system is operated by means of three phase AC motor. By using PLC the entire operation can be controlled and here parameters such as level, speed, temperature will monitored. Before the brake shoes gets dip coated it passes through three tanks to remove unwanted resins and materials. The tanks are maintained at a desired temperature. This project presents the PLC based monitored Dip Coating. PLC helps in correlating hardware and software control units [5].

2 PLC AS A SYSTEM CONTROLLER

PLC is a control system designed for automation processes in industries. Inputs are sensors and controls. Outputs are motors, solenoids, valves, indicators. The traditional PLC control read all inputs in the initial process and determine new outputs and finally set new outputs. The output application range differs depend on the variety of outputs.

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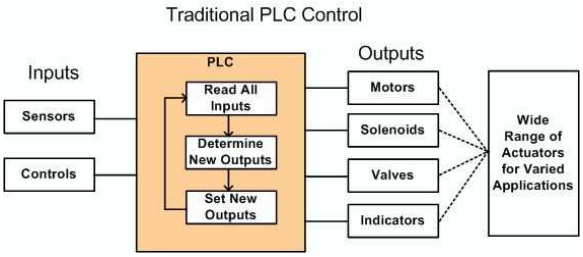
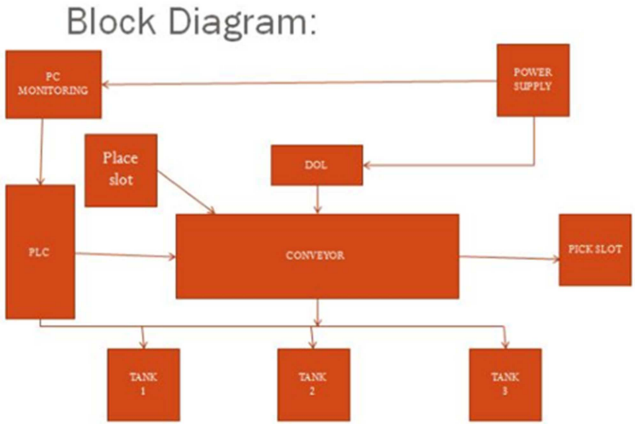


In this application, it controls through analog/digital inputs and outputs by varying the speed through VFD of an induction motor. Also the PLC reads the input and control the outputs according to the PLC program. This PLC is a Delta type of ISP software where the link is made to the system through RS232 cable. It has an advantage that the initial configuration can be expanded for the other applications as machine systems and computer related linking

3 CONTROL SYSTEM OF DIP COATING CONVEYOR

The brake shoes are placed in a rectangular slot containing steel carriers for brake shoes. They are passed through three different tanks containing three water filled beds maintained at a desired temperature, So as to remove the unwanted resins and oils in the brake shoes. The entire system is monitored by the PC and they are controlled by PLC [7]. Panel board in designed in a way that, it in builds all essential switches and controls for the process. The brake shoes then passes through the heater will reach dip coating reservoir where the enamel is coated. Finally brake shoes are picked at pick slot after passing through heater.



The configurations that are obtained from the setup are Computer to record the status of dip coating conveyor system, PLC being programmed with ladder logic diagram and connects PC through RS232, AC induction motor is used, where the speed is controlled by VFD (Variable Frequency Drive), Panel board contains entire signals from emergency switch to auto/manual switch, tank level indicators, startup switch and hooters, A rectangular plate containing ten hooks where ten brake shoes can be placed, as such 100 brake shoes can be coated during a cycle.

4 HARDWARE DESCRIPTION

PLC and Control circuit operations are carried in different items. Similar for heater control, motor control, sensors, main powers. Here the hardware is designed with series of MCB connected with terminal blocks. Transmitter is placed such that, The supply can be directed in a positive way. AC motors drives the system and VFD controls the speed, since torque is directly proportional to speed. High quality low cost motors are supplement. For short circuit and overload protection 2P 6A MCB is used. For 440VAC to 230VAC control transformer is used. In heater control SSR 40A 3P is for linear controlling of heater with 4-20Ma. For motor control contractor is used for turning on motor, For overload and tripping of contractor OLR is necessary, for short circuit and overload protection 3P 6A MCB is used.

Operation Wise Instruments

SL NO	AREA OF OPERATION	ITEM	USAGE	QTY
1	PLC AND CONTROL CIRCUIT	SURGE PROTECTION FUSE MOV	FOR PROTECTION FOR HIGH VOLTAGE SPIKE	1
2		PLC - DVP14SS211-R	PLC FOR CONTROLLING	1
3		DIO- DVP16SP11	8 DI, 8 DO ADD ON MODULE FOR PLC	1
4		2P 6A MCB	FOR SHORT CIRCUIT AND OVERLOAD PROTECTION	1
5		SMPS	230VAC TO 24VDC CONVERSION	1
6		RELAY PATCH CARD	FOR ISOLATION ON PLC OUTPUT	1
7		CONTROL TRANSFORMER	FOR 440VAC TO 230VAC	1
8	HEATER CONTROL	SSR 40A 3P	FOR LINEAR CONTROLLING OF HEATER WITH 4-20Ma I/P	2
9		3P 20A MCB	FOR SHORT CIRCUIT AND OVERLOAD PROTECTION	2
10		DTB4848	PROCESS PID WITH 4-20mA CONTROLLING	2
11	MOTOR CONTROL	CONTACTOR	FOR TURNING ON MOTOR	2
12		OLR	FOR OVERLOAD TRIPPING OF CONTACTOR	2
13		4 C/O RELAY WITH BASE	FOR MANUAL OPERATION	4
14		3P 6A MCB	FOR SHORT CIRCUIT AND OVERLOAD PROTECTION	1
15	SENSOR	CAPACITIVE SENSOR	FOR LEVEL DETECTION ON SOLUTION	1
16		FLOAT SENSOR	FOR LEVEL DETECTION ON WATER	2
17	SIGNALING AND INDICATIONS	EMERGENCY PB	FOR EMERGENCY TRIP	1
18		KEY SELECTOR SW	FOR AUTO MANUAL	1
19		PROCESS START/STOP PB	FOR TURNING ON THE PROCESS	1 SET
20		CONVEYOR START/STOP PB	FOR MANUAL OPERATION OF CONVEYOR	1 SET
21		RINSING MOTOR START/STOP PB	FOR MANUAL OPERATION OF RINSING MOTOR	1 SET
22		BLOWER START/STOP PB	FOR MANUAL OPERATION OF BLOWER	1 SET
23		PILOT LAMP	FOR LEVEL INDICATION	3
24		TOWER LAMP	FOR PROCESS INDICATION AND HOOTER	1
25	MAINS POWER	POWER ON RYB LAMP	FOR POWER ON STATUS	1 SET
26		3P 63A MCCB	FOR SHORT CIRCUIT AND OVERLOAD PROTECTION	1

In sensors capacitive sensor is used in level detection on solution in the conveyor and float sensor is used in detecting water in tanks. Signaling and indication hardware units such as emergency PB for emergency trip and key selector switch for auto manual. Process start/stop, Conveyor start/stop, Rinsing motor start/stop PB's are used for their respective manual operations. Pilot lamp and Tower lamp for level indication and process indication and hooter. Main powers include Power on RYB lamp for power on status and 3P 63A MCB for short circuit and overload protection.

5 SOFTWARE DESCRIPTION

PLC is flexible, programmable, alternative to electrical circuit based control system since they are available in analog/digital devices. The programming method is ladder logic type. PLC provides a design circumstance in the form of software tools which allow the ladder diagram to develop, testify and verify. First the program is to be written in a ladder logic type later in will be converted into binary instruction codes that can be stored in Random Access Memory (RAM) or Erasable Programmable read-only memory (EPROM). Here in Delta PLC inputs are notified as X and outputs are as Y. Each input and output connection point in PLC has an address to identify input and output bit. PLC memory unit is classified into three different regions a. Discreet input, b. Output relay and c. Internal memory.

ID_1_SV	D102	WORD	0	
ID_1_MV	D104	WORD	0	
ID_2_PV	D106	WORD	0	
ID_2_SV	D108	WORD	0	
ID_2_MV	D110	WORD	0	
_EMERGENCY	X0	BOOL	FALSE	
_MANUAL_SW	X1	BOOL	FALSE	
_TRIP_STS	X10	BOOL	FALSE	
_ACCEPT	X11	BOOL	FALSE	
_PROCESS_START	X2	BOOL	FALSE	
_PROCESS_STOP	X3	BOOL	FALSE	
_TK_1_LOW	X4	BOOL	FALSE	
_TK_2_LOW	X5	BOOL	FALSE	
_TK_3_LOW	X6	BOOL	FALSE	
_SDENSOR	X7	BOOL	FALSE	
_TK_1_LOW	Y0	BOOL	FALSE	
_TK_2_LOW	Y1	BOOL	FALSE	
_TK_3_LOW	Y2	BOOL	FALSE	
_TW_RED_GREEN	Y3	BOOL	FALSE	
_HOOTER	Y4	BOOL	FALSE	
_BLOWER_1	Y5	BOOL	FALSE	
_BLOWER_2	Y6	BOOL	FALSE	
_CONVEYOR	Y7	BOOL	FALSE	
UTO_MODE_ON	M0	BOOL	N/A	
LL_TANK_HEALTHY	M1	BOOL	N/A	
ID_1_ON	M2	BOOL	N/A	

The output values stored in PLC are used in setting and resetting the physical values of PLC. RS232 is cable by which the PLC and PC is get connected. The PC provides the software by which the file editing, printing, storage and operations of the program are monitored. The entire system can be controlled both in online and offline mode. When the PLC is in online

mode it is monitored and controlled via operations that are programed already. This makes operations easier and also allow the PC to check the data for the operations.

6 RESULT

The system was tested during its operation with dip coating conveyor automation system for brake shoes. The PLC monitors the entire operation performed and different parameter were detected. It statistically proved that over a period of cycle hundred brake shoes can dip coated in twenty to twenty five minutes duration time.

Tank1(water) Dip Time	Tank2(water) Dip Time	Tank3(water) Dip Time	Conveyor Dip Time (Enamel)
0-3mins	0-3mins	0-3mins	0-3mins

7 CONCLUSION

Positive resulting experimental details were obtained previously describing PLC can be used in automation system with three phase AC induction motor, where speed is controlled by VFD as it provides high accuracy at constant speed.

The present work reveals that dip coating conveyor automation effectiveness with PLC based control system is satisfactory and affordable. Inspite being simple control methods this presents advantages such as constant voltage, economically beneficial, high accuracy, constant driving speed, higher efficiency. Since the dip coating conveyor automation system for brake shoes with PLC proves to be efficient and effective versatile tool in industrial automation application.

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