ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering
Vol. 2, Issue 7, July 2013

Control, Automation and Monitoring Of Hardboard Production Process Using PLC-SCADA System

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ABSTRACT: Human necessities are increasing day by day where as the factories are running out of resources. To meet these demands industries need to improve the quality and quantity of their production. Programmable logic controllers (PLCs) have been used for many decades for standard control in industrial and factory environments. Over the years, PLCs have become computational efficient and powerful, and a robust platform with applications beyond the standard control and factory automation. This paper deals with a hardboard industry designed automatic with the help of PLC. This paper focuses on an innovative and intelligent monitoring system of process using SCADA (Supervisory control and data acquisition).

Keywords: Automation, Hardboard production, PLC, SCADA, Hot press

I.INTRODUCTION

Hardboard is often referred to as "masonite". In a most real sense "hardboard" is *hard board*. It is made in sheets in a wide variety of thicknesses but most commonly 1/8" to 1/4". It is made from wood but is denser. Placed in water many hardboard products will sink or barely float. It is hard on saws. Beyond this simple explanation, hardboard is a very complex commodity. Average characteristics of hardboard produced by one plant often are vastly different from those produced by another.

Hardboard manufacture [5]consists of breaking down wood into its basic fibers then putting the wood back together with the fibers rearranged to form hard panels which have their own set of separate and distinct characteristics. Fiberizing of the wood is accomplished by a variety of methods but basically they consist of steaming chips to soften them followed by grinding between abrading discs to tear the fibers apart. Green wood is about 50% water. This water plus any added in the process must be removed before hardboard manufacture is complete. The method and time of water removal is what distinguishes the various hardboard manufacturing processes.

Wet process manufacture includes adding water during the fiberizing process to make pumpable slurry of wood fiber. This slurry is delivered to a screen where water is drained from the fiber leaving a soft mushy mat. More water is removed by vacuum and pressing between rolls. The wet mat, now able to support it-self, is cut to length and placed on another screen which carries it into a hot press. These hot presses usually have 20 or more "decks" or openings. They are capable of applying several thousand tons of pressure to the wet mats while heating it to a temperature of 35OºCor more.

When fully loaded the press is closed and quickly brought to high pressure, A torrent of water is squeezed out of the mat through the carrying screens and cascades over the edge of the platens. In a few seconds, water remaining in the mat is heated to steam. Press pressure is reduced and held for several minutes while the rest of the water is evaporated, the board is reduced to the desired thickness, and the chemical reaction to reconstitute the lignin bond is completed. The press is unloaded, the screens peeled off and we have S1S (smooth one side) hardboard, or traditional "Masonite': smooth on the face with a screen pattern on the back. Additional operations are necessary to make it practically usable, but the process of "making hardboard" is complete at this point.

This paper deals with design and implementation of monitoring and control of different process in Hardboard production using Programmable logic controllers [7] and the Scada systems.

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II.PROGRAMMABLE LOGIC CONTROLLERS

In manufacturing and logistics systems, rapid reconfiguration, easy integration and hot-backup redundancy are the most essential design requirements. To achieve those features, a combination of heterogeneous automation hardware and software is necessary. However, the increasing complexity of such heterogeneous systems poses new challenges to achieving reconfigurability, interoperability, and reliability. A commonly industry adopted solution for addressing these requirements in the low-level control area is currently associated with programmable logic controllers. This paper focuses on the Allen-Bradley ControlLogix brand of PLCs, due to their high performance and extensive use in industry[8]. Here only part of the process flow has been designed which are under the following heads.

III.AUTOMATION PROCESS

A. *Wet forming machine control system*

This system includes series of steps which facilitates the removal of water from the fiberized wood. For this the fiberized wood passes through following units which can be categorised as follows.

1) Rectifier roller.

The rectifier roll is an empty stainless steel cylinder with large holes in its surface. The rectifier rolls rotate at a controlled rate below the water-line of an air-padded head box. The function of a rectifier roll is to even out to flow of fibres within the head box and prevent settling. The speed of rotation can be optimized to minimize defects such as barring (periodic MD-variations in weight) and flocs associated with the holes in the rectifier rolls. The programme [1] is shown in the ladder diagram as in fig 1

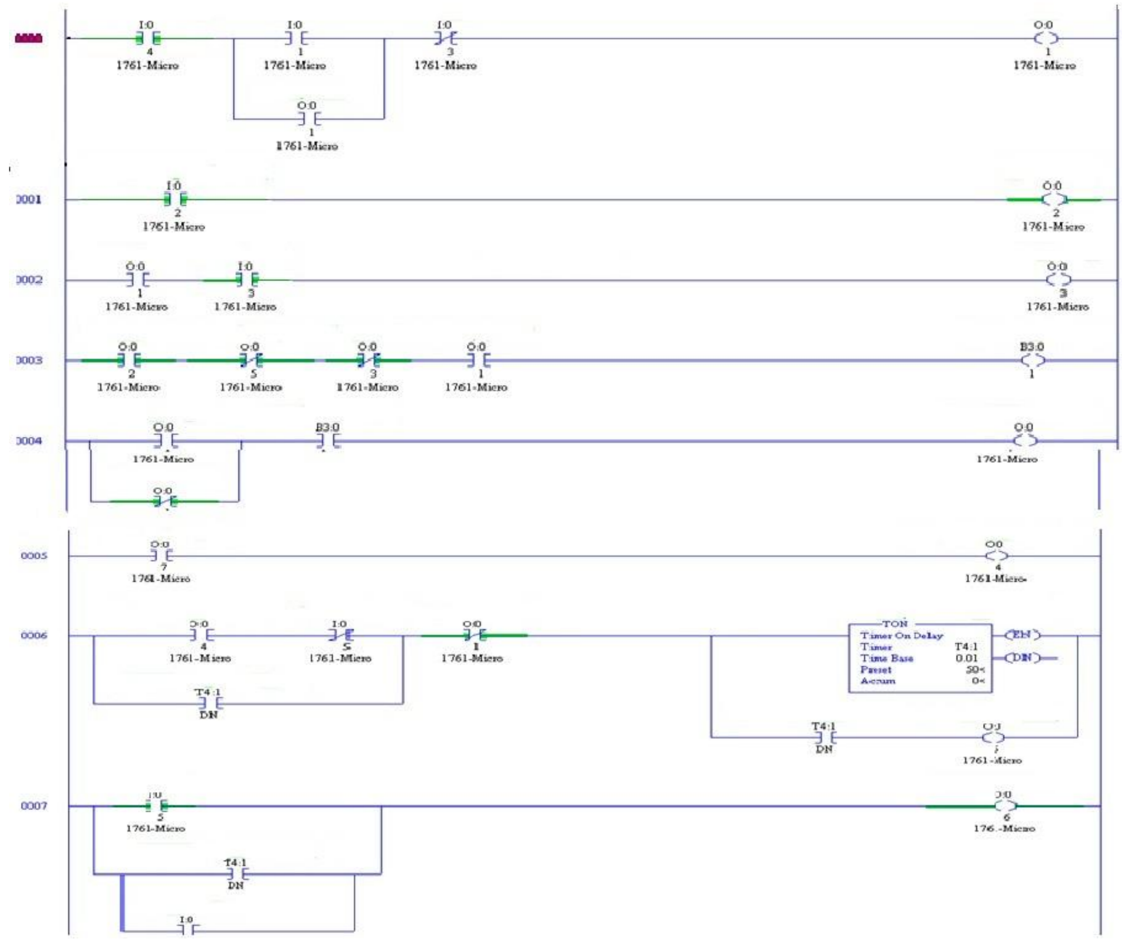

Fig.1 ladder diagram of rectifier roll

2) *Roller sieve*

The slurry coming from the rectifier roller is passed to the conveyor through the roller sieve. In between 60 to 70% of water is removed here via two vacuum fans. The required thickness can be achieved from the roller press and plane

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press within the roller sieve. The sieves of the WFM (Wet Form Machine) are of four types namely long, bottom, suction and top sieve. These are driven using eddy current drive.

3) *Plane press and roller press*
Plane press is the part of the sieve from where the water content in the wet lap is reduced to 8%. Plane press consists of a fixed long sieve on the bottom side and above that a movable sieve is placed. The required pressure is applied on the upper sieve. This pressure is obtained from the hydraulic pump. Similarly a roller press is arranged to reduce the water content of the wet lap to 4%, immediately after plane press. In roller press there is fixed roller on the bottom side and a hydraulically operated movable roller on top side [6].

B. *Conveyor control system*
Conveyor control system, the entire operation starts automatically, when a Start Button is pressed. The conveyors end their journey in front of their respective machines for the corresponding output. There are several sensors used in critical areas of the system, which informs the operator either entire system is running normally or any fault occurred in any device. Several pressure sensors are used to employ power saving technology and to avoid unwanted running process[2].

C. *Hot press control system*
Multi platen hot presses are usually used to compress the mat and to cure the resins in conventional hard boards and resin bonded particle boards. These are equipped with automatic loaders and unloaders to reduce labour costs and to keep to a minimum time that the press is inoperative. Hot presses are usually of the 4-by 8 or 4-by 16-foot size. The maximum number of openings in each press is 20. The pressure capacities of presses depends on the density of board desired and the pressing cycle employed. Platen pressures for pressing and curing of the resin in the particle boards are dependent upon the density desired and the type of particle used.

At a time maximum of 20 boards are pressed in the hot press. The process in hot pressing is classified into three stages. First one is the squeezing stage where a pressure of 250kg/cm^2 is applied for about 40 sec. Next stage is drying where the pressure applied is 70kg/cm^2 for 4 min. Final stage is the calendaring stage. Here the pressure applied is 250kg/cm^2 for duration of 50 sec. After pressing any type hardboard may be tempered that gives it a harder, more paintable surface, greater strength and more resistance to liquid water. This process is shown in fig 2.

IV. MONITORING SYSTEM

Automation systems in industrial world need a kind of method to control automatically all continuing process from one to another. Besides, they also require monitoring process and remote controlling. For that reason they use SCADA which are using PLC(s) to implement such demand. This paper deals with design and implementation of monitoring and control of hot press. In terms of the software is a site monitoring and control of temperatures provided by SCADA system in wonderware environment. Communication between application (SCADA) and hardware structure (PLC) is implemented using RS 232[4].

SCADA [3] is an acronym that stands for Supervisory Control and Data Acquisition. SCADA refers to a system that collects data from various sensors at a factory, plant or in other remote locations and then sends this data to a central computer which then manages and controls the data. There are many parts of a working SCADA system. A SCADA system usually includes signal hardware (input and output), controllers, networks, user interface (HMI), communications equipment and software. All together, the term SCADA refers to the entire central system. The central system usually monitors data from various sensors that are either in close proximity or off site (sometimes miles away). PLC is connected via a serial interface into control computer.

A) Image for hot pressing
The fig.3 shows image for hot press control in hard board production. These images consist of bitmap that display hot press. In the edit fields we can see the current process which is running. Also the time required for each step is displayed. The user can switch on pressing by utilization of two state buttons, which is placed in the screen. After switching on the hot press, the boards move through the conveyor which is the output of the conveyor control system. Each board is loaded one by one into the polish plates of the presser units. After 20 boards are loaded the presser unit closes the door.

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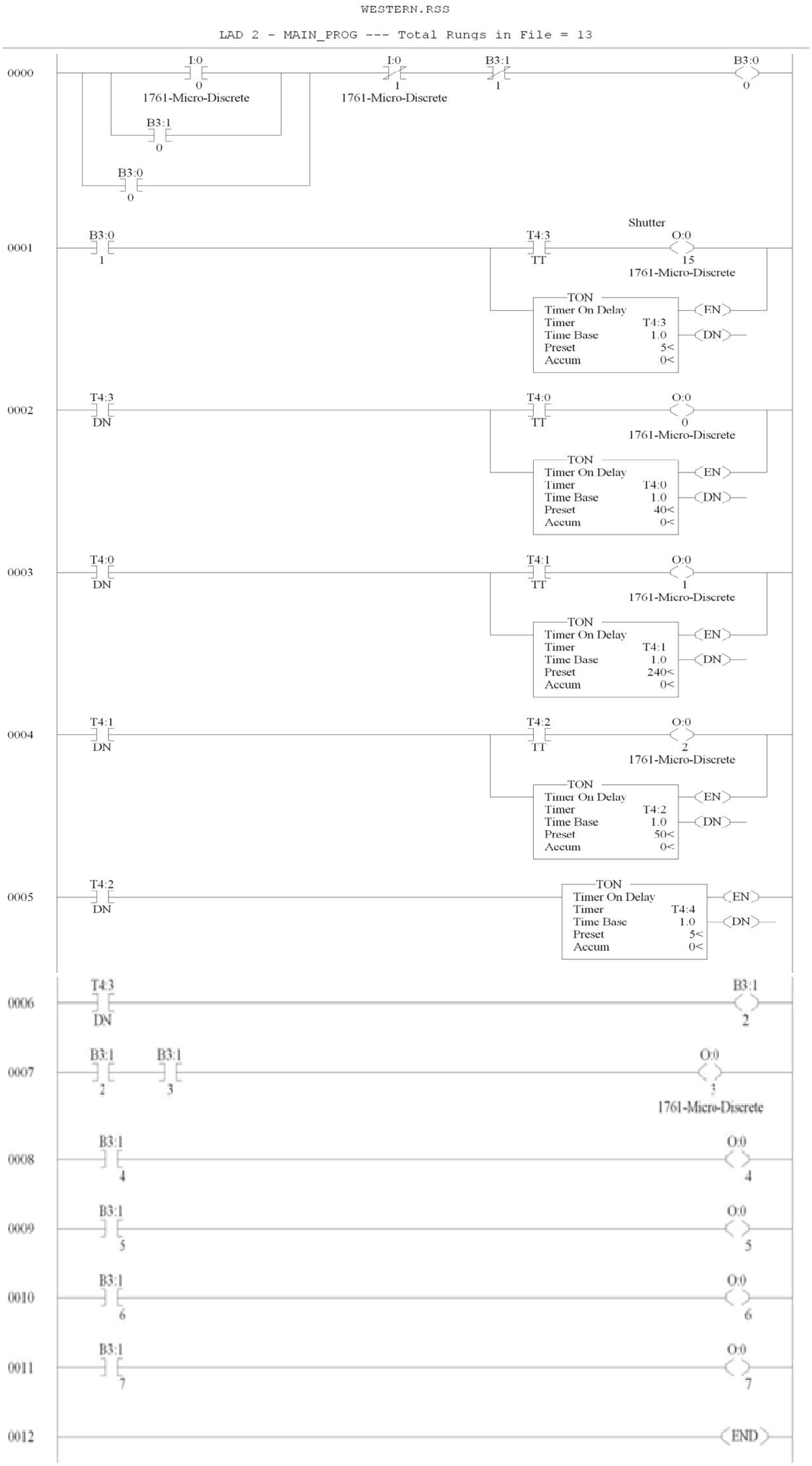

Fig.2 ladder diagram of hot press

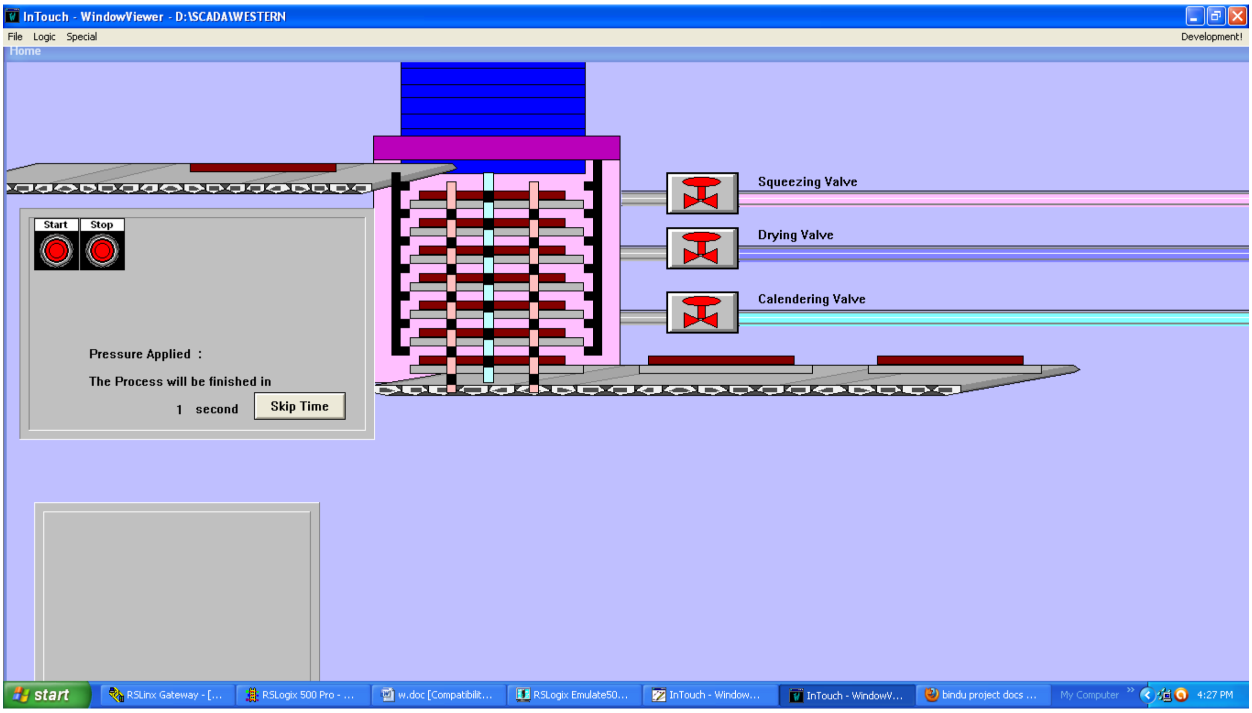

Fig.3 Image of hot press monitoring

Next squeezing valve opens which is indicated by the green color on the valve. Squeezing action continues for 40 sec. End of this period is indicated by red light on the squeezing valve. This step is followed by the drying process automatically which repeats the earlier steps. But in this stage time duration and the pressure applied are different. Final pressing is done in calendaring stage in the same way. Change the color is for easy optical recognition of active or inactive hot pressing stages. The basic parameters that we must to enter for automatic control are required pressure and time duration of each period.

V. CONCLUSION

A computer is as essential to business as PLC to the industrial world. The whole logic is developed in MICROLOGIX software and is verified in Allen Bradley PLC. A ladder logic program of a typical application often results in complex software that is difficult to manage during configuration, and especially, during maintenance. The difficulty lies in a typical problem with real-time control software that is exacerbated by ladder logic: individual components of PLC software are characteristically asynchronous, resulting in unpredictable interactions. This makes the initial configuration of the software (i.e., commissioning) extremely difficult and labour-intensive, but also makes reconfiguration risky. However the system creates a fast, real-time decision making environment. Also the use of SCADA in the industry will not only allow them to minimize the cost associated with the display and recording instruments but will also account for better quality and higher productivity. The process is adaptable to any changes in production capacity or safety requirements. In short integrated automation process produces a reliable quality hardboard production industry

ACKNOWLEDGMENT

The authors would like to thank Managing Director and staff, The Western India Plywoods Ltd,Valapatanam, Kannur, Kerala for providing necessary facilities and help for doing this work. We also express our gratitude to the Head of Department and Staffs of the Department of Electrical and Electronics Engineering of M.E.S College of Engineering Kuttipuram, Kerala who were always a help during the course of our work. We also thank the God almighty for all the blessings received during this endeavor.

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