Automation of Production and Recycling Paper Tissue Using PLC, PAC, HMI and Ethernet/IP

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***Abstract*—This paper aims to present a proposal for automation for the optimal performance of the equipment used in the process of disintegration of production Tissue engineering performing the necessary programming the Programmable Automatic Controller (PAC), development of Human Machine Interface (HMI) and the integration of all devices in the automation through the Ethernet / IP protocol. Submit a cleaning system high density as a major component in the system disintegration to reduce the various contaminants in the process feedstock causing deterioration in the equipment in order to obtain higher quality Tissue. Get a functional design that would reduce production costs and increase product quality.**

***Index Terms*—PLC, PAC, ETHERNET/IP, DTI, TCP/IP, yankee**

I. Introduction

Industrial production of paper today represents a very high percentage in the deterioration of the planet by the excessive logging, companies in their quest to produce, without liability to the environment and society, should make an effort to change the way they produce, leaving aside other factors of equal or greater importance, such as the quality and competitiveness. The production process Tissue is very old and also tends to fail constantly causing stoppages in production and maintenance costs too. Note that when using virgin raw material becomes even more expensive process and production companies' paper that does not modernize their production systems tend to disappear as this reduces their production capacity and quality. Taking advantage of the technological advantages of automation, aims to design a paper recycling process based on Ethernet/IP communication, which provide various advantages of operation, higher production quality and reduce raw material costs, using the new generation of controllers (PAC) and a PanelView (HMI) that controlled a cleaning system high density which process the material for recycling.

Figure 1. High Density Cleaning system (HDC).

II. Methodology

A. Tissue

It is called Tissue paper to a soft, absorbent paper for domestic and sanitary use, which is characterized by low weight and crepe, for all its surface covered with micro wrinkles, which give elasticity, absorption and softness, allowing higher absorption capacity and more flexibility than a plain paper sheet. It is intended for the manufacture of personal hygiene and toilet paper, napkins, diapers, tissues, in the domestic sphere rolls of paper towels, napkins, paper towels, laundry and sanitary material and industrial cleaning [1]. Tissue papers are those manufactured from:

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- Virgin fiber.
- Recycled paper.
- A mixture of both.

It is proposed to use a cleaning high density that is installed after phase pulping and used for the continuous removal of contaminants such as stones, wood, metal parts and plastic contents in the pulp, waste paper or cellulose consistency between 2-6%, and all with the aim of protecting the equipment installed in the successive phases of work (Fig. 1).

B. Manufacturing Process

1) Raw materials (fibers)

Paper occurs with all vegetable fibers (cellulose), which after being dispersed in an aqueous mixture, are intertwined and then dried to form a continuous sheet which is rolled then be processed into final products conversion [2]. The fibers may have different origins as pine (long fibers), eucalyptus, poplar and other (short fibers), as well as products from other vegetable fibers such as sugarcane virgin fiber (cellulose). Secondary Fibers or recycle old papers which contain cellulose which were made more other strange items that were added for final use as plastic covers, brackets, adhesives and lacquers, inks, etc., and should be removed in the process.

2) Preparing pasta

The fibers should be selected, prepared and blended according to the characteristics and uses as required; a role for kitchen towels, have a higher proportion of long fibers and treatment of these fibers that gives good strength and absorption, while a tissue have a higher proportion of eucalyptus fibers and treatment of low intensity, for softness. The fibers are metered and mixed with water in a giant blender called pulper [3]. Virgin fibers, which contain impurities, pass through some simple filters to remove pebbles or minor contaminants that may have adhered during transport, and are sent directly to ponds feed the Trash Machine. Recycled Fibers, after its disintegration in the pulped are processed on different computers and different stages for removing impurities accompanying fibers, centrifugal cleaning, removes heavy elements such as clips and sand; pressurized scrubbing strainers (holes and slots of different sizes) to remove small pieces and lumps of plastics, adhesives, etc.; washing and flotation to remove inks and mineral fillers [4]. Once the fibers have been refined, the paste is ready to be fed alone or in mixture for paper machine (Fig. 2).

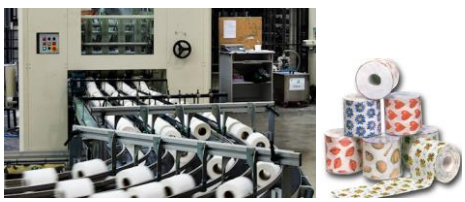

Figure 2. Prepared and blended according to the characteristics.

3) Papermaking (trash machine)

In the paper machine chosen pasta mix is processed and transformed into a large role of paper "Jumbo Roll", should produce very light papers and are "crepados" to give them flexibility, softness and absorbency that requires the final product. These characteristics are obtained in the machine with the following processes.

Training: involves injecting the paste on one or more meshes endless moving, leaving a web of fibers forming a continuous sheet, but moist.

Pressing: The wet sheet is transferred toward the perforated roller (1 or 2) which presses the blade against a huge Yankee cylinder, extracting water.

Drying: This is done with the sheet adhered to the Yankee dryer cylinder, which is over 100 ℃ (heated to steam), and blowing across the surrounding hot air hood with an envelope 500 ℃. this whole process takes just a couple of seconds since the paper travels at a speed of around 100 km / h.

Creping & Winding: Creping blade separates the Yankee for moving it is free to be wound on the last part of the machine, the sheet tends to remain against the sheet, thereby generating creping. Finally it is wound into a coil dimension of 2 meters in diameter and 2 tons which is called "Jumbo" [5].

4) Conversion line

It is the phase that transforms paper and designs the format of the final products: toilet paper, paper towels, tissues, baby diapers and absorbent towels, etc.

5) Conversion of jumbo rolls of toilet paper

The jumbos are unwound at high speed and passing through the embossing, which are steel cylinders Stamping dry a (Fig. 3) relief with figures flexographic printer is installed between the embossing and the winder and then be rolled into "logs" (toilet paper approx. 12 cm and paper towels, about 20 cm) in continuous rotary saws [6]. The finished rolls are driven packaging machines, becoming thus the finished product.

Figure 3. Flowchart for the development of tissue.

III. Results and Discussion

A. Technique used for Industrial Process Automation

Why use PAC's main controller? The most significant difference between a traditional PLC and PAC (Fig. 4) (Programmable Automation Controller) is the ability to manage multidisciplinary control from a single platform. The PAC, have the capacity to handle applications discrete, motion, drive, safety, batch and process from a single common control platform. The control system manufacturers not only offer a PAC but incorporate PAC machine control in a range of controller families. For example, the control platform technology that Rockwell Automation Control Logix PAC offers also implemented

in all the families of the Logix control platform including CompactLogix, GuardLogix, FlexLogix, DriveLogix and even a "soft cap".

Figure 4. Image of a PAC.

B. Platform Compactlogix

The Logix platforms Allen-Bradley architecture provide a single integrated control for discrete, process, motion, drives and safety, machine control software environment for programming and support for common communications across multiple platforms hardware. All Logix controllers operate with a multitasking operating system and multiprocessing and support the same set of instructions in multiple programming languages. A RSLogix 5000 software program all Logix controllers. And, as part of the Integrated Architecture, offer the advantages of the Common Industrial Protocol (CIP) to communicate via EtherNet / IP, ControlNet and DeviceNet networks. The CompactLogix controllers monitor and control I / S CompactBus through 1769, as well as through networks of E / S remote. They communicate with other computers or processors via RS-232-C networks (DF1 / DH-485), DeviceNet, ControlNet and EtherNet / IP. To provide communication, install the appropriate interface module or select a controller with integrated communications. The multitasking operating system can be prioritize, a task can be continuous and the other periodic or event, may include 32 programs, along with their local data and logic, allowing virtual machines to operate independently within the same controller.

C. The Programming Software

The RSLogix 5000 Enterprise Series software is designed to work with Rockwell Automation Logix platforms is a software that complies with IEC 61131-3 and offers publishers relay ladder logic, structured text, function block diagrams and sequential Function Charts for developing application programs. Create your own instructions by encapsulating a section of logic in any programming language in an additional instruction, also supports configuration and programming of axes for motion control, you need only one software package for sequential control programming, processes, variable, of movement and safety (Fig. 5).

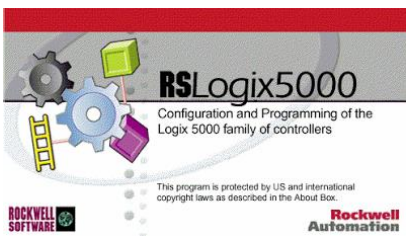

Figure 5. RSLogix 5000 software image.

D. RSLinx Software

El RSLinx (Fig. 6) software is a server for a wide variety of software applications such as RSLogix 5, RSLogix 500 and RSLogix 5000, RSView32, RSView Enterprise Series and RSSql / RSBizWare. In addition, unparalleled connectivity to Logix processors. The RSLinx Enterprise software currently works as RSView Machine Edition server information products widely distributed RSView Supervisory Edition, RSSql, RSBizWare Historian, and RSBizWare PlantMetrics applications, software platforms including PanelView Plus and VersaView hardware and software RSView Supervisory Edition Station. Several open interfaces to third-party HMI packages, data collection and analysis, and client application software designed to measure are provided. In addition RSLinx software allows multiple communicate simultaneously with a number of devices on different networks. You can communicate from anywhere to anywhere using RSLinx software.

Figure 6. RSLinx software image.

E. Programs PAC (PLC) and HMI TAG

This sheet escalations of some alarms for drivers recycle loops 306, dilution water loop 304 and 303 consistency, these escalations are needed for optimum performance on the PanelView Plus 600 were scheduled.

F. Main Routine (Fig. 7)

This part will only be sent to call existing routines and the Scan jumps to each of them, remember that these subroutines are inside the main task that is continually updated.

Figure 7. Main routine.

In line 7 (Fig. 8) to be in manual mode bit called "Startup _System _Active" which gives way to the green light on line 10 is activated.

Pressing the stop button in the row 8 red light goes off and you must press the reset button to start an unbootable row 9.

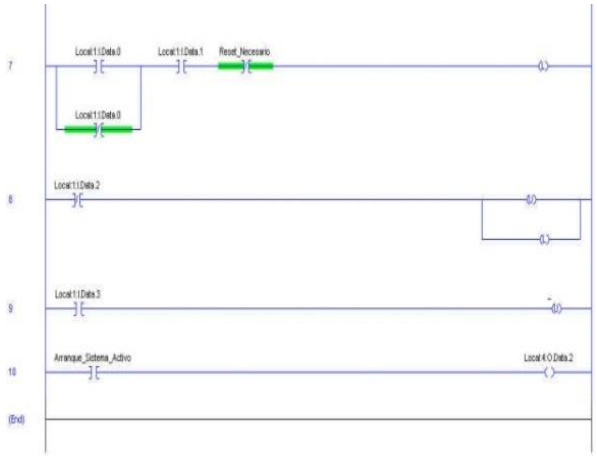

Figure 8. In the line 7.

G. Dilution Water

In the row 0 (Fig. 9) when in automatic mode you must press the button again start as a security measure to boot the system in automatic mode.

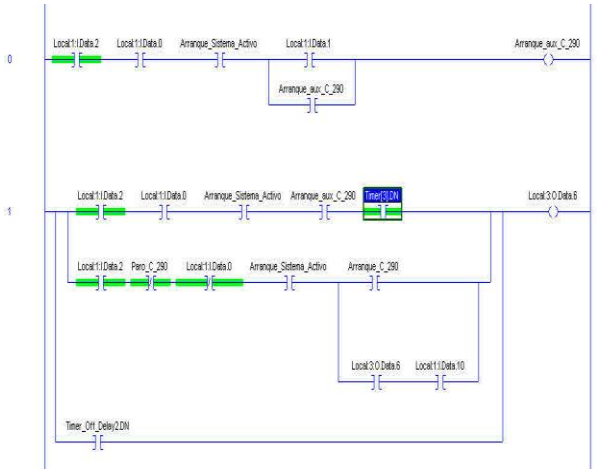

Figure 9. In the row 0.

After pressing the start button and when in automatic mode ripped the dilution water pump provided there is a certain level in the tank secondary fiber, ripped C-290 pump water dilution (row 1), and stopping the system injected water again for a pressurized washing the screen for 30 seconds (row 2) (Fig. 10)

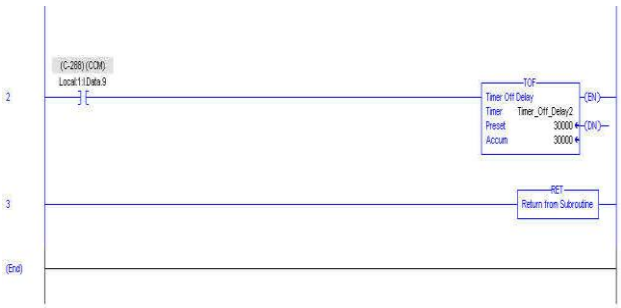

Figure 10. The screen for 30 seconds (row 2).

H. Alarms

These alarms were scheduled in the periodic routine controllers, which are associated with other bits to make the shot of the alarms in the PanelView Plus, this association of bits is given of lines 0-7 (Fig. 11) but in rows 8 (Fig. 12), 9, 10 and 11 (Fig. 13) the audible siren is activated in case of alarm and flashes a red light every second.

Figure 11. This association of bits is given of lines 0-7.

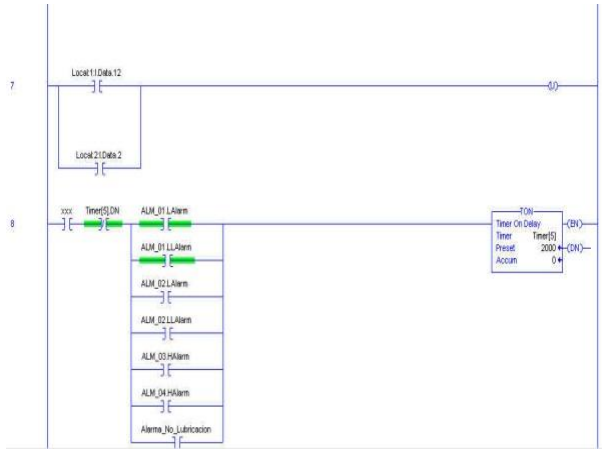

Figure 12. In the rows 8.

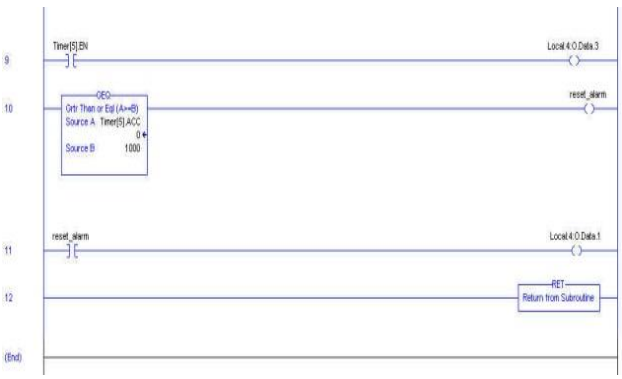

Figure 13. In the rows 9, 10 and 11.

I. Vibratory Criba

In automatic or manual mode, start the pump C-290 will automatically open the SV315 (row 0) (Fig. 14)

valve, so will the motor Riddle pressurized C-288 as long as the switch to C-288 flow is active in Manual mode can also be driven this engine (row 1)

In row 2 (Fig. 15) to start the C-290 pump and engine C-288 and be in auto starts the motor vibrating screen C-291, but can also be operated in manual provided so as to start it reaches us your feedback will be a lock and you can stop by bit paro_C_291.

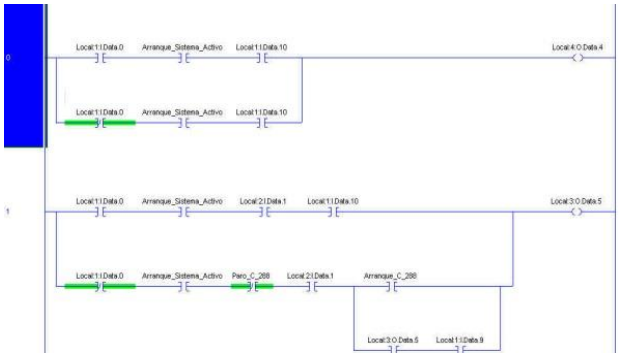

Figure 14. Start the pump C-290 will automatically open the SV315 (row 0).

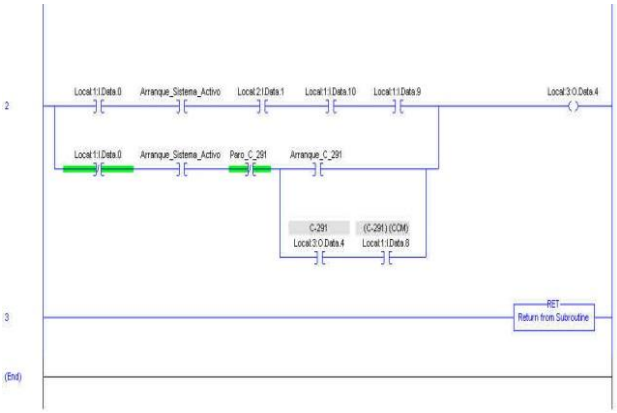

Figure 15. In the row 2.

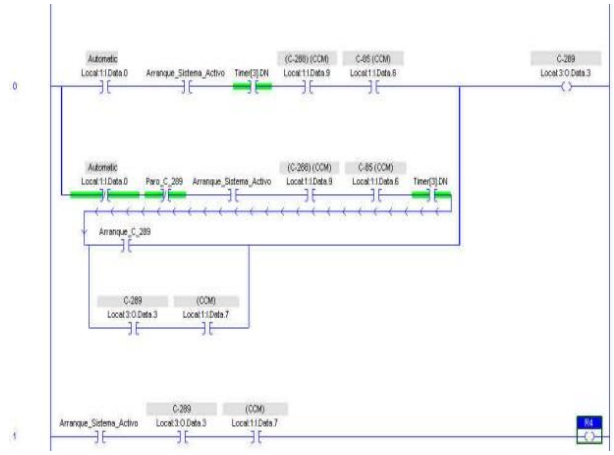

Figure 16. A certain level in the tank secondary fiber and the agitator tank is running (HDC).

When starting the discharge pump tank secondary fiber C-289 enters HDC sequence, so that the pump is operated C-289 is necessary in auto mode the engine starts beyond the sieve pressurized, a certain level in the tank secondary fiber and the agitator tank is running (Fig. 16) (row 0).

Once you start the operation of the High density cleaning system (HDC, start the pump C-289)

The moment you start the pump C-289 (Fig. 17) and we get your confirmation initiates the sequence of HDC, SV308 and SV307 valves closed and must be confirmed with ZSC308 and ZSC307 respectively, the main water valve opens SV314 and trap waste is filled with water through the filling valve SV309 and air is expelled through the valve SV310 period TR-2. After term TR-2 (Fig. 18), the SV309 and SV310 valves close. On top of the waste trap valve SV307 is opened only if the closing of the valve SV308 was confirmed by ZSC308 at the bottom, this is done we go to normal operation

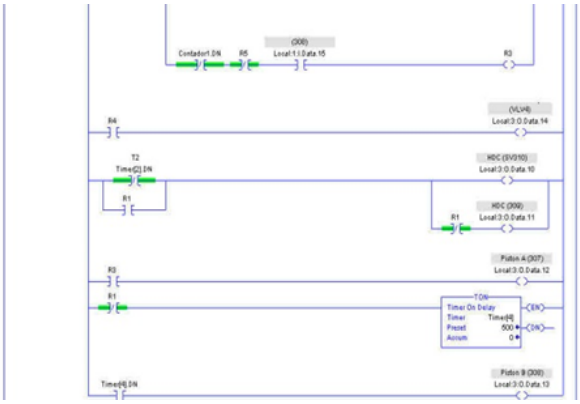

Figure 17. The moment you start the pump C-289.

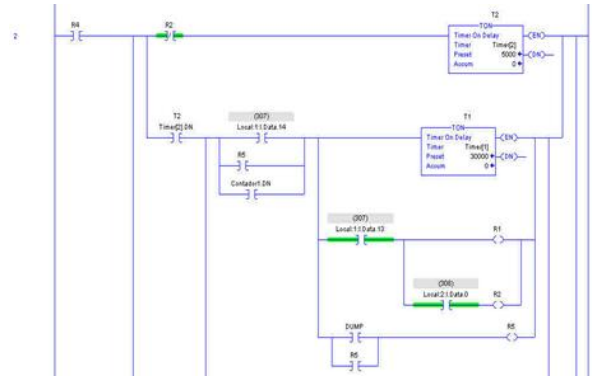

Figure 18. After term TR-2.

J. Norma Operation

The TR-1 starts its own timer, the SV307 valve at the top of the trap opens, SV308 valve at the bottom of the trap closed, the valve SV310 closes air outlet, SV309 filling valve closes, the SV314 main water valve opens.

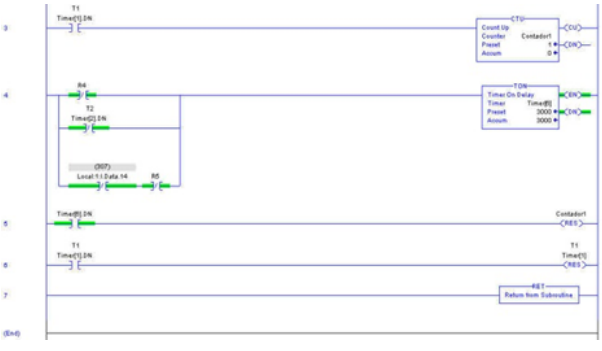

Figure 19. When the timer TR-1.

K. Stream Download

When the timer TR-1 (Fig. 19) terminates your account or a local button DUMP on the Panel View Plus 600 is pressed, waste discharge is triggered, for manual download at any time during normal operation press the button to start downloading see figure C1. In lines 3, 4 and 5, a timer counts hours performed by an accountant.

L. Hidrapulper (Breaker)

In row 0 (Fig. 20) was scheduled permissive level, which in this case if not greater than or equal to 60 can t boot the hopper.

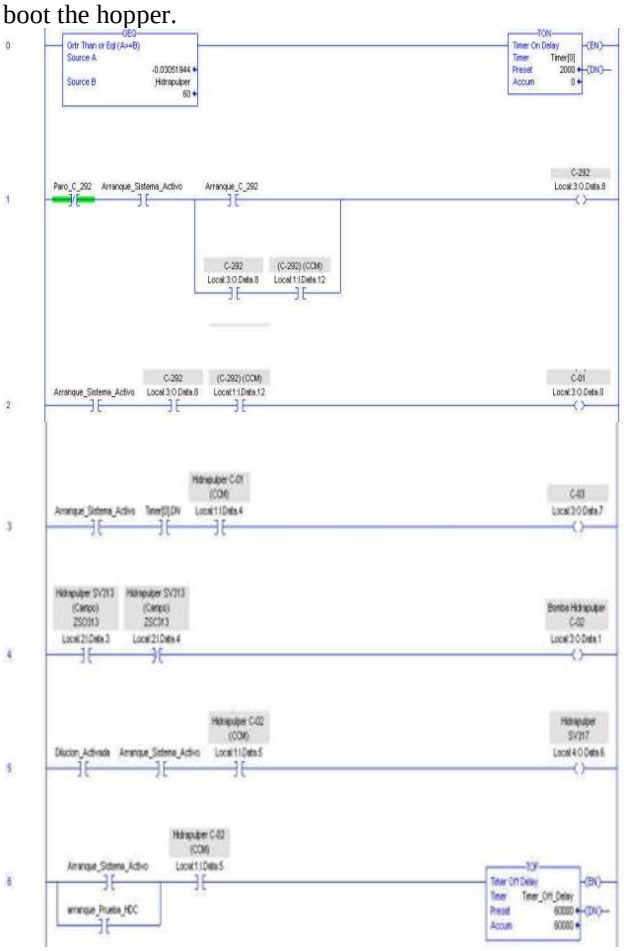

Figure 20. In the row 0.

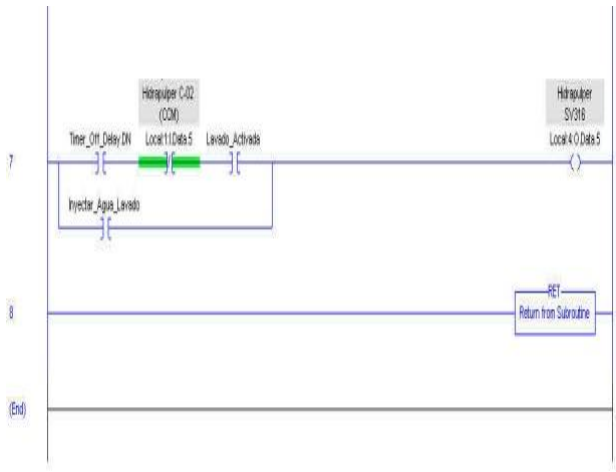

Figure 21. In the lines 5, 6 and 7.

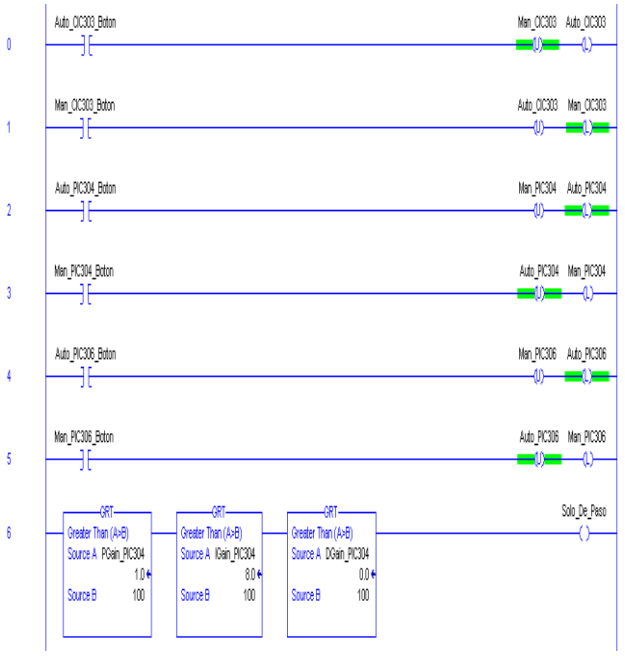

Figure 22. These tags.

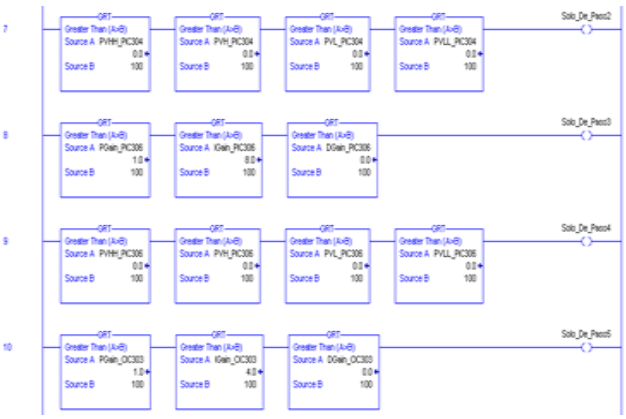

Figure 23. These tags.

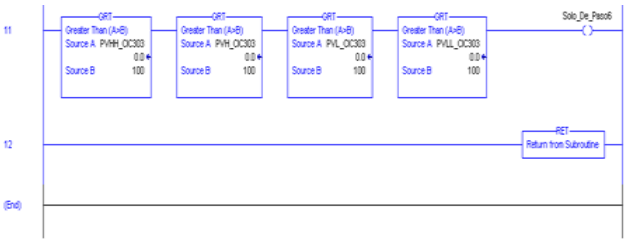

Figure 24. These tags.

In line 1 startup lubrication system was programmed.

In row 2 are permissive boot for hidrapulper, note that are just starting lubrication system and confirmation.

In line 3 the permissive for the hopper, here are level, and confirmation boot hidrapulper were scheduled.

In row 4 was scheduled to start permissive discharge pump C-02 is necessary to open the valve SV313 download.

In lines 5, 6 and 7 (Fig. 21) water injection dilution and washing to be starting the engine C-02 was programmed, will be injecting dilution water and injected water when you stop for a minute.

M. Tags Panel

These tags (Fig. 22-Fig. 23) are only statement, for optimum performance and addressing the Panel View Plus

These tags (Fig. 24) are only statement, for optimum performance and addressing the PanelView Plus.

N. Tank Secondary Fiber

In row 0 (Fig. 25) was scheduled permissive level, and in row 1 in automatic mode if that level is fulfilled tart the stirrer.

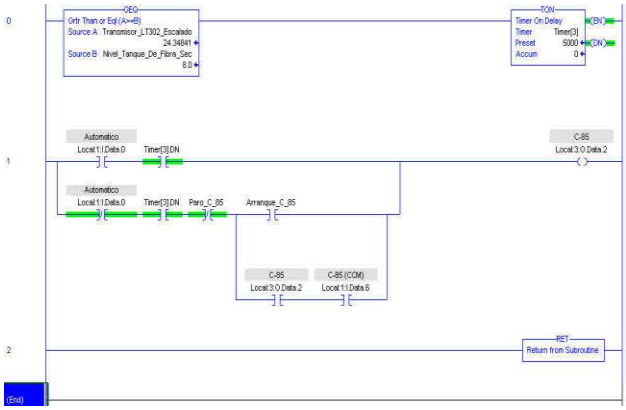

Figure 25. In the row 0.

Note that you can also be started in manual mode.

O. Procedure to the Establishment of the PAC Program Source (PLC)

Overview (Fig. 26): Is required to establish the source program in the PLC, Lap Top connect to PLC, establishing communication between the PLC and the Lap Top, down to the PLC memory the source program, save the source program in to memory PLC, clear alarm on the computer screen, start the computer, end.

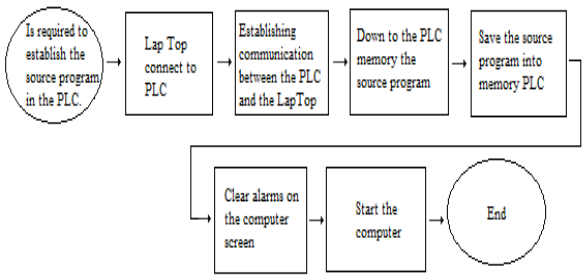

Figure 26. Procedure to the establishment of the PAC program source (PLC).

Addition Establishment of Program PLC: Initiation, connecting wire between PIC and PLC, open application RLinx, PIC and PLC check settings between, PIC and communication between PLC, open RSLogix 5000, open file backup program, put on line program, download program, PLC operation check, end.

IV. Conclusions

Communication based on the ETHERNET / IP protocol provides great advantages for interoperability with different devices from different brands, thus greatly facilitates the selection of equipment required to form an industrial network, which is based on the Common Industrial Protocol (CIP) that allows us to form a Controller Area Network (CAN), this means that increasingly takes more strength in industrial applications. We all know the great benefits of automating an industrial process, such as: increased production capacity, higher product quality and competitiveness. However it should be noted that producing in a responsible manner with the environment, every day becomes more important, that is why we must reorient towards the culture of recycling, industrial production, taking into account that such processes can also be automated recycling and even so may be reflected in reduced costs for the company.

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