IJournals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 4 Issue 1 January, 2016

Implementation of native starch filtration using PLC and SCADA

Rajarajeswari Dhandapani

Department of EIE, Panimalar Engineering College

rajiarun1709@gmail.com

ABSTRACT

With the emergence of Microcontrollers, associated peripheral chips and developments in the field of software technology, the whole scenario related in Process Control and Automation underwent a radical change. The Programmable Logic Controllers have in recent years experienced an unprecedented growth, as a universal element in Industrial Automation. Paper is a thin material mainly used for writing upon, printing upon, drawing, packaging etc., It is produced by pressing together moist fibers, Starch is an important material in the production of paper. Tapioca is a rich source of starch. When coating on the partially made paper, starch should be of pure liquid form and should not contain any solid particles, even if tiny. In order to filter these solid particles, simple filters with alternate mesh arrangements are used. It has to be cleaned periodically for better filtering. This arrangement has to be flushed in certain intervals of time manually. This causes lag in the coating process and thus resulting in loss of production. The proposed system in our project is to flush these filters automatically using PLC. This results in continuous constant starch coating on the paper which subsequently yields a higher paper manufacturing rate.

Keywords: Starch filtering, SCADA, Coating.

1. INTRODUCTION

Paper is a cellulose material which is used to write, print, packaging etc., It is produced by pressing together moist fibers, typically cellulose pulp derived from wood, rags or grasses and drying them into flexible sheets. There are approximately 600 paper mills in India, of which twelve are major players. The Indian Paper Manufacturing. 8.5 million tonnes in 2008-09 to 13.95 million tonnes in 2015-16. The IPMA member mills alone will invest Rs 120 billion to Rs 150 billion over the next ten years. The installed capacity in the country is also estimated to have grown to 11.2 million tonnes per annum. Currently, the Indian paper industry accounts for about 1.6 per cent of the world's production of paper and paperboard. The growth rate is 8 per cent per year. Paper in India is made from 40 per cent of hardwood and bamboo fibre, 30 per cent from agro waste and 30 per cent from recycled fibre [1].

Paper is made of all sort of things as follows: Soft Wood, Hard Wood, Grasses, Straws, Hemp, Manila, Sisal Hemp, Baggasse, Cotton Linters, Cotton Rags, Linen, Waste Paper.

2. STARCH FILTRATION

The starch filtering and coating process takes place in a module called SPEEDSIZER in a Voith paper machine. The starch rich raw material Tapioca is cooked in a cooker and the crushed juicy starch is sent to the filtering unit. The filter station has 5 filtering units. The job of this filter is to filter the sludge and solid particles from the crushed tapioca juice. Once it keeps on filtering the crushed tapioca it gets settled over the mesh arrangement of the filtering dish ; this will make the filtering process inefficient further. The mesh arrangement inside the filters needs to be cleaned in order to increase the efficiency of the filtering process. So, what they do is that, the input to the filtering dish will be stopped initially. Then the filtering dish is removed and it is flushed using warm water and high pressurized air. After a particular time interval, one of the other filtering dish has to be cleaned by the same process. This flushing methodology is repeated for evenly divided period of intervals.

So, In this case Filter 1 has to be cleaned, the valve v1 is automatically closed thus stopping the input from the working tank. Now the filter is not removed from the arrangement and it is cleaned automatically by the usage of warm water in order to make it more effectively. By the meantime, the filtering process is carried out by the other four filters. And the output from the total filter arrangement gets increased to a reasonable percentage.

The Computer program is controlled using DCS. All the automatic opening and closing of valves is carried out by the DCS panel [2-3].

3. EXISTING SYSTEM

In the production of A4 sheets, the paper has to be cut to the required size, and then arranged into bundles each containing 500 sheets known as ream. These reams have to be turned at an angle of 90 degree for packing in order to reduce the wastage of paper. The older system uses two conveyor belts running at different speeds (one conveyor belt runs faster than the other) to turn the ream. This system has a maximum capability to turn only 30 reams per minute. Also when the speed of the conveyor belt exceeds the specified limit then the reams get collapsed. So this method reduces the production capability and efficiency of the process [4-5].

4. PROPOSED SYSTEM

The Speedsizer unit has 2 filter stations each containing 5 filter units. The job of this filter is to filter the sludge and solid particles from the crushed tapioca. Once it keeps on filtering the crushed tapioca it gets settled on the mesh arrangement. This will make the filtering process inefficient further. The mesh arrangement inside the filter needs to be cleaned in order to increase the efficiency of the filtering process. Incase Filter 1 has to be cleaned, the inlet and outlet valves of the filter is automatically closed, thus stopping the input from the working tank. Now the filter is cleaned automatically by passing warm water in order to make it more effective.

In the meantime, the filtering process is carried out by the other four filters. Which means, only 1.25 times of the load is taken over by other filters. The output from the total filter arrangement gets increased, and is sent to the sprayer which evenly sprays the starch all along the paper roll. At one point of time the sludge settled in the filter wanted to be cleaned. Therefore, the filters are automatically cleaned by closing the input valve from the working tank and opening the warm water valve and filter is cleaned at constant temperature and pressure. The computer program is controlled using PLC. The filtering process is done automatically and it increases the output rate of the filter, thus increasing the coating rate and further increase in productivity of the paper [6].

Paper manufacturing rate is based on the coating of starch on both sides of the paper. When the coating rate is increased, simultaneously the amount of paper manufactured will also increase. PLC panel will take care of the working pattern of the valves opening and closing timing

5. PROCESS DESCRIPTION

The working tanks are supplied with surface starch or coating color from coating kitchen. Each working station, for fixed and pivoted roll, has its own working tank. The control for filling is not done in working station control system. There are signals between working station and coating kitchen for filling for each working tank.

From working station surface starch or coating color is supplied to applicator speed sizer. Each applicator, fixed rolls (bottom side) and pivoted roll (top side), has its own working station. From working tank surface starch or coating color is pumped with variable speed volumetric pump through an ECO-S filter station with 5 filter elements over circulation line back to working tank.

A common stand-by pump can be used either for applicator pivoted roll. There are two circulation modes:

- Lower circulation (short circulation)

Circulation will bypass applicator short before entry to applicator.

- Upper circulation

Circulation will be done over applicator.

Flow of lower circulation is controlled by pump speed only. Upper-circulation flow is controlled by a flow-controller wit magnetic flow meter. After upper circulation is stopped (manual or automatic) flushing can be started manually at operator desk. Starch size or coating color in applicator nozzle will be discharged back to working tank and after discharging nozzle will be flushed to drain and flush water will be automatically drained.

Flushing will start automatically after upper circulation if automatic flush is selected. If 20 minutes after upper circulation the applicator nozzle is stilled filled with starch, an alarm will appear to flush the applicator nozzle.

5.1 WORKING STATION APPLICATOR FIXED ROLL

From working tank surface starch or coating color is pumped with variable speed volumetric pump through an ECO-S filter-station with 5 filter elements over recirculation line back to working tank.

5.1.1 Start lower circulation

Steps	Action
Step1	• Indication "CIRCULATION" light up green (if conditions are not made, indication lights yellow). • Lower circulation valve opens. • Controller flow to applicator starts in force mode with value set point pump speed lower circulation from parameter list.
Step2	• If main pump is selected: Main pump starts with speed from controller output flow to applicator. • If stand-by pump is selected: Stand-by pump starts with speed from controller output flow to applicator.
Step3	• Delay time 60 seconds.
Step4	• Indication "WST READY" is ON signal will be reset if working is empty.

5.1.1.1 Stop lower circulation

Steps	Action
Step1	• Indication "CIRCULATION" switches off • Indication "WST READY" IS OFF • If main pump is selected: Main pump stops • If stand-by pump is selected: Stand-by pump stops.
Step3	• Delay time 3 seconds
Step4	• Lower circulation valve closes

5.1.1.2 Upper circulation and application

In upper circulation or application mode surface starch or coating color will circulate over applicator back to working tank.

Flow for upper circulation and application will be controlled by flow-controller with magnetic flow meter which controls speed of pump to applicator.

5.1.1.3 Start upper circulation

Start of upper circulation must be done by push button at control desk speed sizer. Upper circulation can be started, if before mentioned preconditions are fulfilled. Press button "START UPPER CIRCULATION BS" HS751301-SH11_S at speed sizer control desk to start upper circulation. From working station surface starch or coating color is supplied to applicators speed sizer. Each applicator, fixed roll (bottom side) and pivoted roll (top side), has its own working station. From working tank surface starch or coating color is pumped with variable speed volumetric pump through an ECO-S filter-station with 5 filter elements over circulation line back to working tank. A common stand-by pump can be used either for applicator fixed roll or applicator pivoted roll. Flow of Lower circulation is controlled by pump speed only. Upper-circulation flow is controlled by a flow-controller with magnetic flow meter.

After upper circulation is stopped (manual or automatic) flushing can be start manually at operator desk. Starch size or coating color in applicator nozzle will be discharged back to working tank and after discharging nozzle will be flushed to drain and flush water will be automatically drained. Flushing will start automatically after upper circulation if automatic flush is selected.

20 minutes after upper circulation, if the applicator nozzle is still filled with starch, an alarm will appear to flush the applicator nozzle.

STEPS	ACTIONS
Step1	• Drain valve applicator closes and so does the flush valve. • By-pass valve applicator closes • Supply valve applicator opens • Indication "UPPER CIRCULATION" is on • Lamp ready at speed sizer control desk is flashing • Controller flow to applicator starts in force mode with calculated output from max flow pump to applicator • If main pump is selected: Main pump get new speed set point from controller output flow to applicator • If stand-by pump is selected: Standby pump get new speed set point from controller output flow to applicator. • Timer 1 nozzle filled starts(30 seconds) • Mean valve return opens for 5 seconds • Timer 2 for water discharge starts(20 seconds)
Step2	• Lower circulation valve closes
Step3	• Wait until timer 2 for water discharge(20 seconds) is finished
Step4	• Return valve opens
Step5	• Indication "READY FOR WASHUP" goes off
Step6	• Wait until timer 1 for nozzle filled(30 seconds) is finished
Step7	• Controller flow to applicator release in normal mode with flow set point from parameter list "set point flow under circulation" • Indication "NOZZLE FILLED" is on • Lamp ready speed sizer control desk switch on steady
Step8	• Signal to speed sizer control "working station ready for application" is on.

5.1.1.4 Filterstation for fixed roll

From working tank surface starch or coating color is pumped with variable speed volumetric pump through an ECO-S filter-station with 5 filter elements over circulation line back to working tank.

Flushing of filter is done with an automatic sequence and can be done during operation of working station, because only one filter element will be flushed, so that remaining filter elements can screen surface starch or coating color during operation.

Operation of filter-station is done automatically, for mode selection, selection of filter elements and manual flushing sequences a control box is installed locally at filter station.

There are two (2) flushing modes,

1. with recovering, In this mode surface starch from filter-element will be blown with compressed air back to working tank before flushing (back-

flushing)

2. without recovering, In this mode surface starch in filter-element will be drained to sewer before flushing (back flushing)

6. RESULT

The proposed project is implemented to increase the manufacturing rate of the paper. Implementing automation for filtration system in paper machine made it very much useful as it helped in increasing production and to achieve goals. In future, this system can be updated for more tanks with the same program. And it may be possible to implement using the same PLC or disturbed control systems. The below figure describe the overall system design and relavent implementation figure shown in Fig.2 to Fig.5.

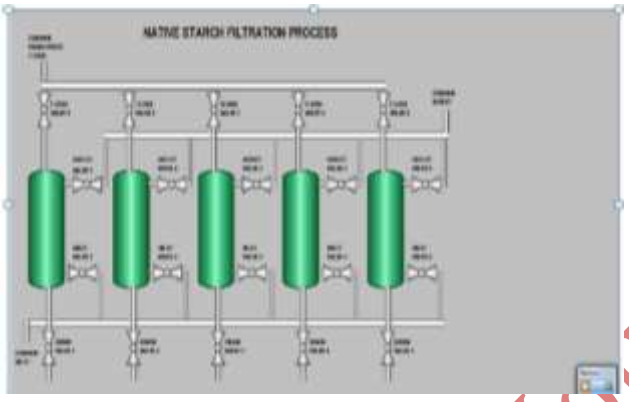

Fig 1: Native starch filtration process

Fig 2:Ladder of native starch filtration

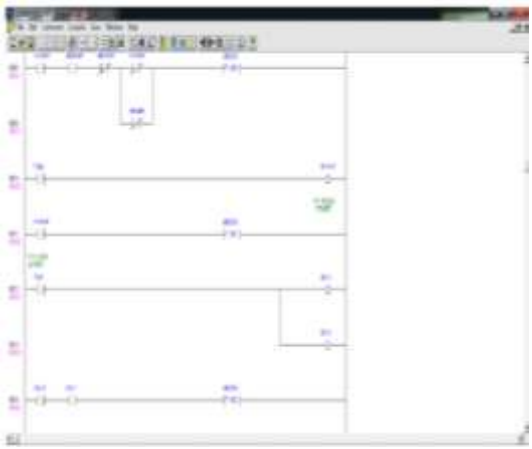

Fig 3:Ladder of native starch filtration

7. CONCLUSION

The proposed project is implemented to increase the manufacturing rate of the paper. Implementing automation for filtration system in paper machine made it very much useful as it helped in increasing production and to achieve goals.

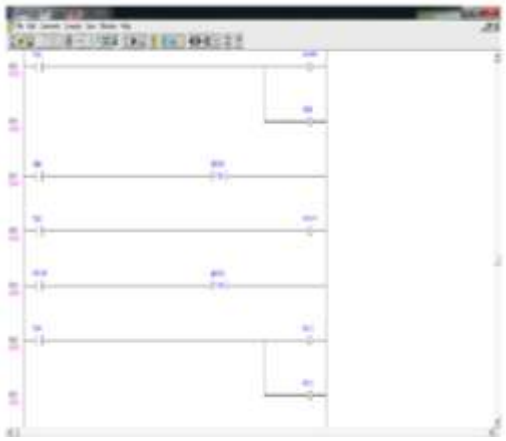

Fig 4:Ladder of native starch filtration

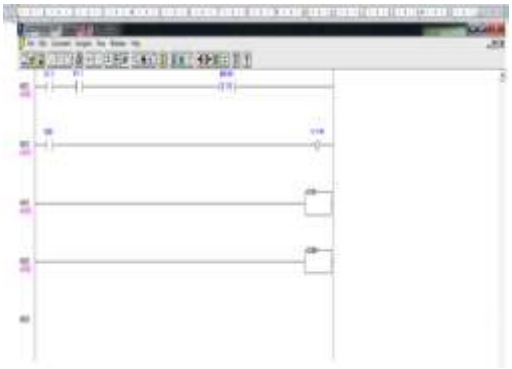

Fig 5: Ladder of native starch filtration

In future, this system can be updated for more tanks with the same program. And it may be possible to implement

using the same PLC or disturbed control systems.

8. REFERENCES

[1]. Boys, Walt (18 August 2009). "Back to Basics: SCADA". Automation TV: Control Global - Control Design.

[2]. Boyer, Stuart A. (2010). SCADA Supervisory Control and Data Acquisition. USA: ISA - International Society of Automation.

[3]. IEEE Communications Surveys and Tutorials.

[4]. M. A. Laughton, D. J. Warne , Electrical Engineer's Reference book, 16th edition,Newnes, 2003 Chapter 16 Programmable Controller

[5]. "The father of invention: Dick Morley looks back on the 40th anniversary of the PLC". Manufacturing Automation.

[6]. Harms, Toni M. & Kenner, Russell H. P.E., Enhancing PLC Performance with Vision Systems. 18th Annual ESD/HMI International Programmable Controllers Conference Proceedings, 1989.