

Automatic Reduction in Emission of Bagasse into the Environment in Paper Industry

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ABSTRACT

Pulp is a cellular fibre which is made from wood / Bagasse. The bacteria in sugar cane may lead to degrade the quality of paper. The Paper is being made with different kinds of Pulp. Bagasse is the main raw soft wood, Hardwood, Chemical, Mechanical and Imported Pulp are mixed with some proportionate ratio to produce different varieties of papers for making Paper in paper industry. These pulps are mixed in various proportions to produce seventeen different qualities of paper. Due to the requirement of paper production, the pulp requirement has raised, as a result lot of money is spent on purchasing of hardwood and imported pulp for the paper production. In order to cater for the need of increased pulp demand certain amount of de-ink pulp is mixed along with the other raw materials for the pulp production. The de-ink pulp is produced in the de-ink production plant is allowed to store in a tank and the parameters like consistency, flow rate, level, agitation, lubrication of drives in the de-inking pulp mixing process are controlled with the help of PLC. Then the de-ink pulp is pumped to the mixing tank with required consistency and flow. Finally the mixed pulps are sent to the machine chest and they are drawn as paper. The paper which is produced from the mixing of de-ink pulp which may be treated with chemicals to reduce bacteria are categorized as a medium grade and are used in notebooks. Due to this de-ink pulp preparation the annual production has been raised and the demand for the pulp is also achieved. And the emission of bagasse in the environment may lead to damage the environmental conditions. To avoid that the de-inking pulp can be used to avoid those environmental damages.

KEY WORDS: PROGRAMMABLE LOGIC CONTROLLER, RATIO CONTROLLER, ENVIRONMENTAL CONDITION

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INTRODUCTION

The paper industry consists of two main raw materials for manufacturing paper such as wood and recovered paper. Kaolin, starch and other products are used as supplementary materials in the paper production process. Pulpwoods used for paper making are made from whole mature trees. The Papermaker usually uses parts of the tree that are left after wood, (Priyanka et al. 2015) has been used for other commercial purposes. In paper industry they will use sugar cane as pulp for production of paper. During cultivation if any disease affects the crop it may lead to some bacterial growth in the sugar cane. If we use the same for production of paper in paper industry it may reduce the quality of paper and also affect the entire plant production. The raw products which come as outlet is bagasse (Sagar et al. 2014). The bagasse will lead to damage the environmental surroundings. Thus de-inking pulp chest have been introduced in paper industries to avoid those emission of bagasse in the environment. The paper manufacturing process is outlined below:

1. *Wood preparation:* The bark is removed from the in-coming logs and it will be converted into chipped.
2. *Cooking:* The cooking process is done by heating the wood chips in a solution of NaOH and Na₂S in a pressure cooker, during this process a lot of the lignin the reinforcing substance that make tree cells wood hard and 'woody' rather than soft similar to those of other plants is removed which is removed from the wood, (Kavitha et al. 2012). The pressure is then released suddenly, causing the chips to fly apart into the fibres.
3. *Pulp washing:* The pulp is made to wash with water the purpose of washing the pulp is to remove the cooking chemicals and lignin from the fibre due to this type of washing it will not interfere with forth coming process steps.
4. *Pulp screening:* A sieve which is a pulp screening technique which is used to remove knots and also clumped-together with uncooked fibers from the pulp.
5. *Bleaching:* Bleaching is done in two steps. In the first stage the pulp is treated with NaOH in the presence of O₂. The NaOH is used for removing the hydrogen ions from the lignin and then the O₂ breaks down the polymer. In the next stage the pulp is treated with ClO₂ then a mixture of NaOH, O₂ and peroxide and again it is treated with ClO₂ in order to remove the remaining lignin.
6. *Paper making:* In the paper making process the fibers are mechanically treated in order to make

them bond together and also used for strengthening the paper. The chemicals added to provide special properties such as color and act as the water resistance, and then the water is squeezed out and the pulp is rolled smoothly and dried. Various additional processes result in the recovery of CaO, NaOH and Na₂S, the major chemicals used in the process. Several utilities and techniques are used to ensure that such conditions as sufficient reaction times and adequate mixing criteria are met. On site processing removes the lignin from the liquid wastes and also made to remove solid wastes and the solid wastes are taken to a landfill.

MATERIALS AND METHODS

A. Existing Method of Pulp Production

In paper industry the main raw material is the BAGASSE- the sugarcane residue. Here the bagasse which is used as sugarcane. if the sugarcane is affected by any bacteria during cultivation it may lead to degrade the good conditioned pulp. It also uses certain proportion of hardwood pulp, chemical pulp & imported pulp for the production of paper pulp. As the sugar cane is the raw product used for production of paper that lead to emit the excess bagasse into the environment. To avoid that the de-inking pulp can be used. Currently the paper industry is producing seventeen different qualities of paper. Initially only two paper machines was used for paper production. Now it has erected the third paper machine to increase the production. Due to the implementation of the third paper machine the consumption of pulp has increased .As a result lot of money is spent for hardwood & importing pulp.

B. Proposed Method of Pulp Production

In order to cater for the need of increased pulp demand due to the erection of third paper machine certain amount of de-ink pulp is used along with the other raw materials for the pulp production. De-ink pulp is produced by treating the used paper with certain chemicals for removing the color (Avvaru Ravi et al, 2013) and if it is affected by any bacteria it may be identified and intimation will be given to the production department by testing department. In production department they will treat the pulp with suitable pharmaceutical medicines. And then finally mixed with water in recycler plant. By this method both the demand for pulp and conservation of trees are achieved

C. Process Block Diagram

The overall block diagram for the DIP process (Priyanka Patel et al,2015) is shown in the fig. 1.

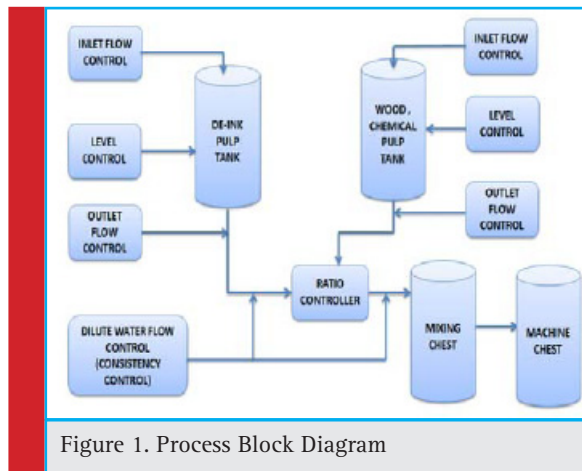


Figure 1. Process Block Diagram

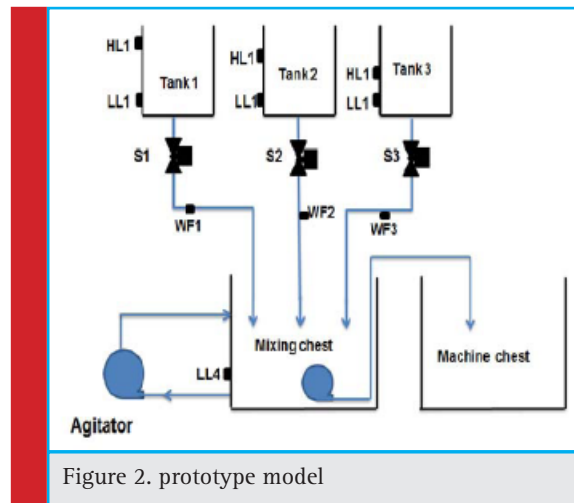


Figure 2. prototype model

D. Process Description:

The De-Inking Pulp which is being pumped from De-Inking Pulp Tower comes to De-Inking Pulp Receiving Chest. The distance between De-Inking Pulp Tower and De-Inking Pulp Receiving Chest is around 1.3 Km. The pulp from the De-Inking Pulp is again pumped to the Mixing Chest. The Level of the Receiving chest is also maintained to avoid overflow of the tank. The Pulp consistency is around 3% to 5%.

All the pulps get mixed up in the Mixing chest as per their ratio set with the Stock Proportioning system such as Ratio Control. The Ratio set point and the Level of the Mixing chest determine the flow set point for each pulp. The Level of the Mixing chest is variable as the Paper Machine speed is variable. The pulp flow set point is variable according to the demand from the Paper Machine section. The consistent quality of the product can be obtained only if the mixing rate of the pulp is uniform.

Finally the de-ink pulp is mixed with the other pulp in mixing chest and then the mixed pulp is pumped into the machine chest where the paper machines get pulp for paper production. The Receiving chest has the following controls in order to achieve the proportionate mix and to have the consistent quality of the product. It also used to maintain the PH range for that they have to maintain the bacterial content in the minimal value.

The following controls are required at Dip Receiving chest in order to achieve the desired quality of the product. Receiving chest Level Control, Pulp Consistency Control, 3. Pulp Flow Control.

E. Prototype Model:

The prototype model is shown in the fig. 2

The three different tanks are initially taken by having level switch at different level in order to mix the three different liquid in different proportions. The operation

is controlled by programmable logical controller. In this model the flow is based on the level of the liquids in the tank. The liquids are manually poured and once the high level is reached the solenoid valve get triggered through a relay assembly(Sanamdikar S T,2013). All the liquids are collected in the mixing tank where the agitator assembly is kept for continuous mixing of liquids and not allowing them to settle and finally they are pumped into the machine chest. The flow of liquids are indicated by means of LEDs.

F. Plc Operation

The SELEC Programmable Logic Controller operating at 230 V is used in this prototype model. When the PLC is turned ON, first it scans for the status of input, i.e. whether the sensor connected to the input pins of PLC is ON or OFF. Then the PLC starts to execute the loaded program. Based on the programming with respective of the inputs the output are turned ON or OFF.

G. Prototype Interfacing

The PLC used is MM1015, it consists of 10 inputs and 6 output ports and operates on 230 V ac .The seven magnetic level switches are connected from the port 0 to port 6. The port 7 is unused and the port 8 and port 9 are used as start and reset inputs for which two button switches are used. A 24V supply is taken from the com port of PLC and the supply is given as the input supply to the sensors and the negative is grounded to PLC (Sagar P Jain et al, 2014). In the output port side the first three ports are used connected to a 6 amps NO relay and these relay are used to trigger the solenoid valve. The port 4 is connected to an agitator pump through a relay. A transformer of 4 Amps is used for operating the pump. Finally the port 5 is connected to an ac submersible pump through a relay contact.

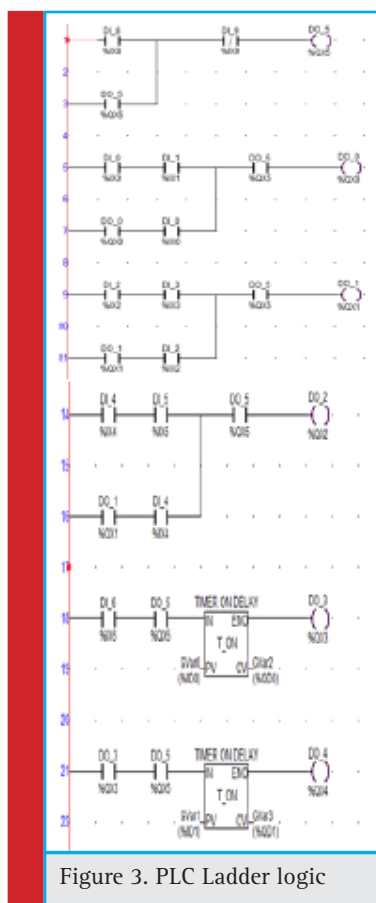


Figure 3. PLC Ladder logic

H. Plc Program:

The Selected PLC is used for the controlling of the process (Gowthami. R,2018). The ladder logic used is shown in the figure (3)

RESULT AND DISCUSSION

The first rung is used for the start and reset operation. Here the button type switches used so the ceiling concept is used. I8 used as start input and I9 for reset input. The second, third, & fourth rung are used to control the opening of solenoid valve. Initially the solenoid valve is closed, when both the level switches are on the valve opens until the water goes below the lower level. If the level switch in the mixing tank I6 is ON, then the agitator pump starts after 25 seconds using the timer T1. After T1 is turned ON, the pump get turned ON after 20 seconds using the timer T2.

CONCLUSION

Thus the implementation of De-Inking Pulp (DIP) project has raised the annual pulp production to four lakhs tons per annum and also the increased pulp demand has been compensated without destroying the forest resources. The pulp which is produced using DIP results in 88 % to 91% of whiteness and can be used for the production of medium quality paper. Further improvements can be done in the consistency control of de-ink pulp and in the production of de-ink pulp in order to increase quality of whiteness so that the quality of the paper can be raised. Thus the affected pulp is treated using suitable pharmaceutical treatment. Thus, from using this kind of method, now there is a reduction in the emission of bagasse into the environment.

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