Paper Moisture Based Steam Usage Reduction in Paper Plant

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ABSTRACT

Since the energy required in the paper drying process gives rise to substantial costs for the paper producing companies, it is of great interest to reduce the input of primary energy resources to the dryer. Either process changes or further heat recovery can be employed. In this paper, to reduce the steam usage for paper production industry to dry a paper as much needed. In a normal time the industries need 6 tons/hour, (i.e) 144 tons/day. Based on that reduce the steam level usage by using moisture set point variation to reduce the steam usage. From this method 0.5 to 1 tons/hr of steam will save.

Key words: Paper dryer, steam, energy

1. INTRODUCTION

No manufactured product plays a more significant role in every area of human activity than paper and paper products. Its importance in everyday life is obvious from its use in recording, storage and dissemination of information. Virtually all writing and printing is done on paper. It is the most widely used wrapping and packaging material, and is important for structural applications. The uses and applications for pulp and paper products are virtually limitless. Apart from the products and services that it provides, the paper and pulp industry is one of the major manufacturing industries in the world providing employment for vast number of people and contribute to national economy[1]. The paper making process is essentially a very large dewatering operation where a diluted solution of pulp suspension with less than 0.5% fiber solid is used. The major sections of a paper machine consist of: forming section, press section and dryer section. Essential part of paper production industries is dryer section, here the wet paper will dry by using hot steam. The dryer section of a paper machine moves between 1.1 and1.3 kg of water per kg of paper compared to 200kg and 2.6kg in the for ming and press sections respectively. It is significantly more expensive to remove this water than for any other section of the machine (Reese, 1988). The relative costs of dewatering are: forming section 10%; press section 12% and dryer section 78%. The dryer section is by far larger consumer of thermal energy of a paper machine. Other important facts about the dryer section and paper drying are the dryer section constitutes approximately 60% of the total length of a paper machine, except for a tissue machine; and almost 40% of total capital cost of the machine. The lack of knowledge about drying also persists in the mills.

2. DRYING PROCESS

The multi-cylinder drying process consists of repeated cycles in the direction of web travel. Each cycle has different phases depending on the dryer configuration Diagram shows the four phases of drying cycle for two-tier and double felted Configuration[2]. Every phase has individual heat and mass transfer mechanism, a specific evaporation rate and a
web temperature
The four phases can be detailed as follows:

- The sheet is in contact with the outer surface of cylinder, while it other side is exposed to air and evaporation is low in this phase.
- The sheet remains in contact with the cylinder surface and is covered donning it Souter surface by the felt that applies pressure on the web. Heat transferred is increased but mass transfer is limited because of the fabric covering this heat surface. Sheet temperature increase during this long phase and most of the heat transfer occurs.
- The fabric comes away from the sheet, which remains in contact with cylinder. Evaporation occurs from the newly exposed surface of the sheet not in contact with the cylinder.
- The sheet is no longer in contact with the cylinder and is moving toward the next cylinder. Evaporation occurs from both sides of the sheet, resulting in a decreasing sheet temperature. It is during this phase that the evaporation rate is highest.

3. MULTI CYLINDER DRYING PROCESS
Generally all multi-cylinder dryers are configured either two-tier or single tier. Two-tier configuration is the most common. Such system is continuing since the beginning of paper drying using steam heated cylinder more than 100 years ago. Use of single tier configuration has been commercially introduced in late 1970. In all paper machines that have single tier dryer cylinders also have two-tier cylinder, normally in the later part of the dryer section to avoid single sided appearance of the finished products.

A multi-cylinder dryer section consists of cylinder groups each having its own felting and drive system. Most paper machines have 5-7 independently driven cylinder groups. Each group comprises of several dryer cylinders and has variable speed control to maintain sheet tension between the groups and adjust to any machine direction sheet shrink age that can occur. The two-tier configuration has two rows of steam heated cylinders and could be single or double felted.

The double felted configuration is the so-called conventional system where all the cylinders participate in evaporation. The major disadvantage of such system is that the web moves from one cylinder to the next un supported. In many modern paper machines, the two-tier system is single felted over an individual dryer group where the web passes through the dryer section with alternating sheet surfaces coming into contact with the successive heated cylinders surfaces[3].

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Figure 1. Paper web, contact in steam cylinder.

Figure 2. Drying Process using Multi cylinder
4. WORKING PROCESS
In the working part, paper will analyze by moisture sensor, based on the moisture content in the paper, the valve open at short timing. Timing will be based on the moisture content.

4.1 Level – I
In the first step the moisture sensor sensing the paper moisture below or equal to 4.00% the solenoid valve will open for 3 sec and the usage of steam level also indicate in final part[4].

The steam will flow to the main pipe and it will split into two way. It’s for pre dryer, after dryer. Pre dryer will release the hot steam first and then after dryer will release the hot steam. In the pre dryer solenoid valve open at 2 sec and after dryer open at 1 sec.

4.2 Level – 2
In the second step the moisture sensor sensing the paper moisture below or equal to 4.30% the solenoid valve will open for 7 sec and the usage of steam level also indicate in final part

The steam will flow to the main pipe and it will split into two way. It’s for pre dryer, after dryer. Pre dryer will release the hot steam first and then after dryer will release the hot steam. In the pre dryer solenoid valve open at 5 sec and after dryer open at 2 sec.

4.3 Level – 3
In the third step the moisture sensor sensing the paper moisture below or equal to 4.70% the solenoid valve will open for 11 sec and the usage of steam level also indicate in final part[5].
The steam will flow to the main pipe and it will split into two way. It’s for pre dryer, after dryer. Pre dryer will release the hot steam first and then after dryer will release the hot steam. In the pre dryer solenoid valve open at 8 sec and after dryer open at 3 sec.

![Figure 5. Process Level - 3](image)

4.4 Level – 4
In the third step the moisture sensor sensing the paper moisture below or equal to 5.00% the solenoid valve will open for 15 sec and the usage of steam level also indicate in final part[6].

The steam will flow to the main pipe and it will split into two way. It’s for pre dryer, after dryer. Pre dryer will release the hot steam first and then after dryer will release the hot steam. In the pre dryer solenoid valve open at 11 sec and after dryer open at 4 sec.

![Figure 6. Process Level - 4](image)

5. SIMULATION AND RESULT ANALYSIS
Here the result will analyzed by based on the paper moisture and then output of steam used in an hour. Very easy to calculate the process. The response of the process shown in the graph[7]. Using MATLAB in this process efficiency analyzed. Here the range of paper wetness and the pulp wetness has been choosing random value. Based on that, the steam usage will be allocated.

![Figure 7. Drying rate and steam usage ratio](image)
6. CONCLUSION

The progress in Science & Technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. In the proposed system based on ATmega8 controller is found to be more compact, user friendly and less complex, which can be readily used in order to perform several tedious and repetitive tasks. From this project we automatically reduce the steam usage from 15 to 24 tons/day. In real time model this concept applicable for the valve closing half or one by fourth it’s all based on the paper moisture. So, we reduce external energy of coal and water also. The waste steam again re connected to pre dryer to and it used as feed water and it will send to dryer.

REFERENCES


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