Monitoring of Average Basis Weight of Paper on the Rewinder Using Paper Length Measurement

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ABSTRACT

Basis weight is normally checked by using frequent sampling on the paper machine, but in case there exists pressure pulse in head box, sudden high and low zones will be present in paper and there exists a possibility that the smaple is drawn from the point where the basis weight is very high or low, in other words, it does not represent the average basis weight of paper. The present work is an aim to instrumentally find out the average basis weight in a reel of paper.

INTRODUCTION

The most common method used for checking the basis weight is to take sample from the paper machine and tear if off to the template size in accordance to the quadrant scale in use. Though, this method can be used to get as much as 0.5% accuracy, it has certain drawbacks. Primarily, it indicates the GSM of paper sample and not of the whole reel as average, secondly, when there are frequent quality changes to reel and sheet orders, many machine operators have a tendency to increase or decrease the quadrant screws to read grammage a little on the upper and lower side, in order to maintain slightly lower gsm for sheet orders and slightly higher gsm for reel orders.

CONCEPT

The length of paper can be determined by multiplying the revolutions of the drum roll of the rewinder by circumference of drum roll. The width of paper is also known as the width of the reel. Now, it is obvious that the weight of the reel will be-

Reel Wt. =

Drum Rev. * Drum Circumference * Reel Width * GSM

Drum circumference, reel width and reel weight can be measured easily, and drum revolutions can be measured by using a suitable measurement system. Thus, from the formula average gsm can be obtained.

SETUP

To try this concept on the rewinder, the only instrumentation required was measurement of drum revolutions. In our case, there were two drum rolls out of which one was being driven by the DC motor, and the other rotates by itself due to the friction of paper. This second roll had a keyway in its shaft.

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A proximity sensor was mounted near the shaft in such a way that the gap between the shaft and the sensor is less than the sensor range, and with keyway in front of sensor, the gap is higher. This proximity sensor was then connected to a 6-digit counter powered by 220 VAC power supply.

RESULTS & DISCUSSIONS

When the rewinder is running, the drum roll rotates, thus the counter reading increases. After every set the readings were taken and the difference was assigned to "Drum Revolutions" in the formula above. The weight of reels was obtained from calibrated weighing machine. The results are given in Table-1.

Table 1: Basis weight of paper computed from suggested method.

Tested GSM	Reel Weight	Drum Revolutions	Reel Size	Calc. GSM
48.2	321.2	5964	81.5	47.20
48.9	336.5	6150	81.5	47.95
48.7	320.3	5874	81.5	47.79
48.3	296.0	5487	81.5	47.28
49.4	360.7	6529	81.5	48.42
48.2	355.4	6589	81.5	47.27
48.7	327.6	6026	81.5	47.65
48.6	339.3	6245	81.5	47.62
48.5	345.5	6381	81.5	47.45
49.3	352.2	6392	81.5	48.29

** Weight of core pipe has been subtracted while writing reel weight.*

On analyzing the data obtained, it was found that there existed a difference of around 2% in the results. This could be attributed from the following-

* There exists an error in the quadrant scale.

* The sample gains moisture from the atmosphere while bringing it to the laboratory for testing.

* Due to tension at the rewinder, the paper sheet gets clongated, thus reducing the gsm by a fraction.

To confirm that quandrant scales are correct, the quadrant scales were calibrated with electrical single pan balance, chemical chainrise balance, and with standard weights, and found the balances were correct.

The next possibility was of obtaining moisture from the atmosphere. This was tested by drawing samples from the pope reel into a HDPE airtight bag, and check the moisture content instantaneously, and after allowing exposure for the time equivalent to time taken by the lab chemist in testing gsm. There were only about 0.5-0.7% difference, which could be transformed to nearly 0.3 gsm in our case.

DETERMINATION OF PAPER ELONGATION DURING REWINDING

It is not very difficult to determine the percent elongation the paper shows on rewinder. The machine speed was taken accurately at the pope reel. The start time and end time of roll were also noted, the difference between these represents time duration to produce the roll. This duration multiplied with the machine speed gave length of paper, provided the machine has a breakless run during the study period.

Similarly, the counter reading was taken from the rewinder at the start and end of the roll. From this length of paper was available that was made from the rewinder. Comparing these readings, it was found that the length of paper increased by about 1.5% on the rewinder. All of these experiments were carried out for Newsprint, 48 gsm, produced from waste paper. For other grades of paper, the results may vary numerically, but the concept remains the same. It is recommended that these experiments to be conducted for wood and agri-residue pulps.

From the above, it is clear and justified that the method suggested will indicate a lower grammage of paper by around 2% or so. If a correction factor of 2% is incorporated in method suggested, and we consider -

Average GSM = 1.02 * Calculated GSM,

We can have a simple and handy way to determine average paper gsm for reels.

LIMITATIONS

Several limitations do exist in full

implementation to this system, which are being given as under -

1. In case the rewinder operator runs rewinder without paper, the drum rolls will rotate, thus increasing the counter reading, in many a small paper mills, second hand imported core pipes are used, To adjust these core pipes properly in the core pipe shaft, rewinder is run at full speed for a few second without paper. Also, in case of a paper break, some paper is wasted even after passing through rewinder. To overcome this problem, a suitable solution is to be found out.

2. Particularly in case of reel orders, joints too close are avoided. In case a joint is observed very close to other one, the in-between paper is tore off from the rewinder, which results in error. A theoretical solution could be to weight the tore off paper along-with the reel, but some practical problems were observed with this. Yet, this problem is not very significant as the problem of joints too near is rarely observed.

In view of above, it is recommended to use this method for reels having nil or very less number of joints.

INSTRUMENTATION EXPENDITURE

This work initiated with an aim to have a close watch over the machine direction as well as cross direction gsm variations. Due to long time of industrial recession, the mill wanted to have a low cost, but fully reliable system. The counter reading was incorporated in the lab chemist's logbook, so that they can check averaged gsm for each and every reel. The cost of components procured is as under -

1.	Magnetic Proximity Switch, Range 8 mm 5/8" dia. with one NO+NC contact.	Rs. 1225/-
2.	Electronic Digital Event Counter 6 digit	Rs. 600/-
3.	Control Cable & power Supply Cable 1.5 mm^2, 4 core, Unarmoured, 20 M@ Rs. 16/-	Rs. 320/-
4.	Lugs & Thimbles, Ferrules, Sleeve etc.	Rs. 100/-
	TOTAL SYSTEM COST	**Rs. 2245/-**

The installation of Magnetic Proximity Switch took about an hour, while the Electronic Digital Event Counter and its wiring work were finished within half an hour. No rewinder shut down was required for this instrumentation and the total work was accomplished during two roll changes.

CONCLUSION

This work was initiated to assure that no off-weight paper is going to customer, and to keep a watch over the weight variations. Since no other published work is known to authors in this area, this technique was designed and conceived and it was found very effective for having a recorded supervision on grammage variations. It is suggested that more solutions in this area need to be developed.