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MATERIAL BALANCING, OPTIMIZING THE INPUT WILL GIVE GOOD OUT PUT IN PAPER MACHINE

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ABSTRACT

Paper making involves total harmony of cellulosic fibres, chemicals, fillers, dyes, and additives put in the system to get the desired and required properties and value added production of product, the paper. When the costly cellulosic fibres, chemicals and additives are put into the system it is imperative to know whether the result is in line with the requirement anticipated. This is to ensure the cost effectiveness of the product and value addition effect of chemical on the paper. In paper making low cost, high cost pulp, low strength, high strength pulp, low brightness, and high brightness pulp are proportioned in such a way so that the total cost of paper is optimized without deviating from the requisite properties demanded by the customers and machine runnability. It is totally a tight rope walk any increase / reduction in any one will invariably affect the other one. A clear balance is struck to get the optimum level.

KEYWORDS: Cellulosic fibres, chemicals, alkaline sizing, fluff count, filler, first pass retention, consistency, dryness, furnish, cobb and moisture.

INTRODUCTION

A simple material balance involving the process parameter, paper and pulp test report with tailor made excel sheet to arrive the individual section in paper machine efficiency and understanding of each section in paper machine.

Definite advantage of doing material balance of paper machine is

1. Clear understanding of requirement of input and output of chemicals.

2. Clear understanding of high cost and low cost pulps.
3. Clear understanding of high and low brightness pulp.
4. Parameters set in each section viz, wire, press, dryer, and reeler.
5. Broke generation due to trim, and finishing loss and addition of broke in furnish.
6. To understand the broke generation due to machine breaks.
7. Do not need high cost experts / software package to carry out the calculation.
8. Daily collection of process data is quite sufficient to do the calculation.
9. All the data are available in the mill site itself.

This is achieved by regularly doing the material balancing of the input and output of the materials and evaluated from the paper test report regularly.

The laboratory test result like consistency, cobb, freeness, moisture, ash percentage and strength properties are regularly checked in all mills in different places of pulp street. These values at regular interval obtain from the laboratory is quite sufficient to arrive and plot the material balance of the machine in an excel sheet format. By invoking the built in function of the excel work sheet in MS office, material balance for any particular machine is made and it is tailor made and can be repeated time and again.

A sample work sheet is attached for the reference where the required data are fed and the result is obtained in no time.

The parameter required and which are easily available in any mill are listed below

1. Dye gpl
2. Filler gpl
3. Consistency of every street pulp
4. Consistency of thick stock pulp
5. Head box consistency
6. Back water /white water consistency / gpl
7. Fibre loss
8. Wire speed
9. Reel speed
10. Grammage of paper
11. Moisture of paper at reeler
12. Ash of paper on reeler

13. Paper deckle at reeler
14. Moisture of sheet entering dryer
15. Dryness of sheet entering press
16. Press trim width if any
17. Wire trim width

Following are taken based on the machine previous experience

1. Finishing loss percentage
2. Furnish mix percentage
3. Pulp to Paper ratio
4. Recirculation in approach flow screens and head box 8 to 10 %
5. Ash retention percentage 50 %

After collecting all the data the values are entered to the excel programmed work sheet to get the individual section performance of the machine and the quantity entering, leaving, moisture, water evaporated, tonnage of machine /hour, dyes flow, filler flow and pulp flow based on the furnish mix.

The sample data is collected and worked out is for the twin wire former with the appropriate closing of the system in place. However, the same type of material balancing can be adopted for all the machine with size press also with small change and modification at required place in the excel worksheet.

Assumptions made in this calculation, there is no loss of fibre in wire, press and in re-circulation of broke into the system. Re-circulation of screen and head box is assumed. Pulp to paper ratio is taken as 0.860

Material Balance of Paper Machine			**21-02-2016**
Sl No	**Description**	**Value**	**Units**
1	Wire Speed	500	Mpm
2	Reel speed	530	Mpm
3	Grammage of Paper	60	GSM
4	Moisture in Paper	5	%
5	Ash on Paper	10	%
6	Deckle at reeler	6.58	Meter
7	Moisture of sheet entering Dryer	59.5	%
8	Dryness of sheet entering Press	16	%
9	Press Trim		
	Front Side	0.1655	Meter
	Back Side	0.1885	Meter

	Total Press Trim	0.354	Meter
10	Bel-Baie Trim		
	Front Side	0.2155	Meter
	Back Side	0.2505	Meter
	Total Bel-Baie Trim	0.466	Meter
11	Head box consistency	0.8	%
12	Bel-Baie Channel Consistency		
	Channel no.1	1.3	Gpl
	Channel no.2	1.4	Gpl
	Average Channel consistency	0.135	%
13	Head Box Pond Width	7.4	Meter
14	Ash Retention percentage	50	%
15	Head Box Recirculation percentage	10	%
16	Furnish Mix		Cy %
	1. CP-2 (WOOD PULP)	72	3.8
	2. CP-1 (BAGASSE)	22	3.5
	3. ICP (SOFT WOOD PULP)	3	3
	4. BHWSP (HARD WOOD PULP)	3	3
			3
			3
	TOTAL	100	
	Broke		3
17	Fiber loss percentage	2	%
18	Pulp : Paper	0.860	Ratio
19	Primary screen reject percentage	8	%
20	Finishing Loss	5	%

The above data are entered and the following result will get with the programmed formula with appropriate referencing of the cells. The in built functions of sum, subtraction, division, and multiplication functions are used in creating the worksheet. It is also made some of the cells are locked so that accidental erasing of formulas did not take place. The results after the in putting of values are self explanatory.

Sl No	Description	kgs/min	TPH	TPD	
1	Machine Production	209.24	12.55	301	
	Machine Production (O. D.Basis)	198.78	11.93	286	
	Moisture	10.46	0.63	15	
2	First Pass Retention	**83.13**		%	
3	Width of sheet Leaving Bel-Baie to Press (Pond width - Bel-Baie Trim)			7.4	Meter
4	Width of sheet Leaving Press to Dryers (Bel -Baie to Press - Press Trim)			7.046	Meter
5	Shrinkage in Dryers			**6.61**	%
6	**Water Evaporated in Dryer**	**kgs/min**	**TPH**	**TPD**	
	Paper Prodn including moisture at reeler	209.24	12.55	301	
	Total Quantity entering Dryers	490.82	29.45	707	
	Water Evaporated in Dryer	**281.58**	**16.89**	**405**	
7	**Broke Generated in a day**				
	1. Broke due to Finishing Loss	9.94	0.60	14.31	
	2. Broke due to Press Trim	9.99	0.60	14.38	

	3. Broke due to Bel - Baie Trim	13.15	0.79	18.93
	Total	**33.07**	**1.98**	**47.63**
8	**Water Removed in Press**	**kgs/min**	**TPH**	**TPD**
	Total quantity entering the Press	1305	78	1879
	Total quantity leaving the Press	491	29	707
	Total	**814**	**49**	**1172**
	Percentage of Water Drained in Press	**62**	**62**	**64**
9	**Water removed in Bel – Baie wire**			
	Total quantity going to couch pit	82.17	4.93	118.32
	Total Quantity after couch roll	1387	83	1997.24
	Total soild (Fiber + Fillers)	221.92	13	319.56
	Filler in Paper at press section	69.35	8.32	199.72
	Fiber at Press section	**152.57**	**4.99**	**119.83**
	Considering First Pass retention	266.97	16.02	384.43
	Total quantity at outgoing couch dryness	1668.54	100.11	2402.70
	Total quantity after H/B at H/b Consistency	33370.77	2002.25	48053.91
	Total water drained in Bel – Baie	**31702.24**	**1902.13**	**45651.22**
	Percentage of Water Drained in Bel-Baie	**95.00**	**95.00**	**95.00**
10	**Quantity coming from Primary screen**	**kgs/min**	**TPH**	**TPD**
	Head box re-circulation is considered	26.70	1.60	38.44
	Total soild (Fiber + Fillers)	293.66	17.62	422.87
	Total quantity (Fiber+Filler+Water)	36708	2202	52859
	H/b Consistency is arrived value	**0.79**	**0.79**	**0.65**
11	**Quantity coming to Primary screen**			
	Primary screen Reject is considered	23.49	1.41	33.83
	Total soild (Fiber + Fillers)	317.16	19.03	456.70
	Total quantity (Fiber+Filler+Water)	39644	2379	57088
12	Fibers+Fines+Filler coming in the system	92.99	5.58	133.90
	as rejects and rejection			
	Thick stock required	224.17	13.45	322.80
	Thick stock required after removing broke	191.10	11.47	275.18
	Thick stock required after consider F. L %	194.92	11.70	280.68
13	Furnish Mix required considering Pulp:Paper			
	1. CP-2 (WOOD PULP)	120.69	7.24	173.80
	2. CP-1 (BAGASSE)	36.88	2.21	53.10
	3. ICP (SOFT WOOD PULP)	5.03	0.30	7.24
	4. BHWSP (HARD WOOD PULP)	5.03	0.30	7.24

	Total	167.63	10.06	241.39
	Flow required at above Tonnage & Cy	**LPM**	**M^3/Hr**	**M^3/Day**
	1. CP-2 (WOOD PULP)	3176	191	4574
	2. CP-1 (BAGASSE)	1054	63	1517
	3. ICP (SOFT WOOD PULP)	168	10	241
	4. BHWSP (HARD WOOD PULP)	168	10	241
	Total	4565	274	6574
	Including the broke flow Thick Stock	5667	340	8161

By calculating each and every section of the machine and the in put and out put of each section gives a best idea of what is going on in each section and whether these are contributing to the requisite level of the anticipation or intended requirement. Based on these values necessary correction is required or not or any intervention in the form of small investment is change of equipment to do the correction can be done. This is used as improvement tool for any machine to know the actuality and correction/intervention. The quantity of water drained in wire section gives an indication whether the wire section performance is up to the expected level. Like wise the quantity of water squeezed out in press section, and water evaporated in dryer section. Water drained, squeezed, water evaporated in individual section did not up to the expected level, these will result in some form of defects on the paper which in turn production of not acceptable quality. By arriving and narrowing down the problems points in the machine, the generation of off quality product can be eliminated.

It is also important to note that generation of broke and addition into the system back is very difficult and lead to many problem in controlling the parameters. It is always difficult to handle the broke at a constant percentage (once formed sheet) since it not only affects the machine runnability and also quality problem, adjusting the pulp freeness, ash %on machine, and again bringing back the machine to normal run.

For small, medium and big mill irrespective of size and capacity this in house tool can be developed and applied. This helps in problem solving, trouble shooting and identification of paper defects arising out of any section can be narrowed down and corrected.

By doing the material balance once in a week or whenever there is problem will be of immense help to mill to take check whether the parameters in order and any deviation need to be corrected can be made with appropriate level of interference at correct time. This will help in avoiding / minimizing the off quality material production.

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Terminology used

CP-1 Chemical Pulp plant 1 (Bagasse pulp)

CP-2 Chemical Pulp plant 2 (Wood Pulp)

ICP - Imported chemical pulp soft wood pulp

BHWSP – Bleached hard wood sulfate pulp

Gpl – grams per liter

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