Effect of Recycled Fiber on Strength Properties of Paper

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ABSTRACT

Whenever Broke and Secondary fiber like Purchased waste paper is to be utilised as a source of fiber along with Virgin pulp, it is essential to understand the behaviour of the concerned secondary fiber when it is admixed with virgin pulp. Preliminary laboratory experiments, though not able to mimic exact plant conditions, yet throw somelight as a guidance to the process personnel to optimise the broke addition without sacrifycing ultimate product quality. Repulping by refining is an accepted method to improve the strength of secondary fiber[1]. Effect of blending of mechanical and kraft recycling pulps is also reported in the literature[2]. As APPM is not using Secondary fiber i.e., Purchased waste paper in its bleached verities, laboratory experiments were conducted with Internal Dry Broke and Virgin pulp. The findings of this experimental work are presented in this paper.

INTRODUCTION

Every paper maker's ambition is to turn out first time right product without any quality rejections. But, unfortunately, inspite of close monitoring and control process systems, at times there will be quality rejections. Thus the off-standard quality may have to be recycled into the system. Also, whenever, Secondary fiber i.e., Purchased waste paper is to be utilised as a source of fiber along with Virgin pulp, it is essential to understand the behaviour of the concerned Secondary fiber when it is admixed with Virgin pulp. Preliminary laboratory experiments, though not able to mimic exact plant conditions, throw some light as a guidance to the process personnel to optimise the Broke addition without sacrifycing ultimate product quality. As APPM is not using secondary fiber i.e., purchased waste paper in it's bleached verieties, laboratory experiments were conducted with internal Dry Broke and Virgin pulp. The findings of this experimental work are presented in this paper.

EXPERIMENTAL

Chlorine dioxide bleached pulp is used as Virgin pulp (15% Bamboo and 85% Mixed wood). Broke admixture from plant was collected and used in the experiments. (The ash content in Broke is 10.1%). The Virgin pulp as well as the Broke pulp collected were centrifuged, stored in polythene bags and used for experimentation. Different proportions of Broke viz, 0%, 10%, 30%, 50% and 70% (on oven Dry basis) were mixed in Virgin pulp and blended pulps were refined in laboratory PFI Mill at 10% consistency

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at different revolutions viz, 500, 1000, 2000 and 3000. In another set of experiment, Broke pulp after disintegration (i.e., without refining) was added at different percentages viz., 0%, 30%, 50% and 70% to the Virgin pulp refined at 2000 revolutions. The beaten pulp was disintegrated for 10000 revolutions at 1.5% consistency. The disintegrated pulp was tested for freeness. In all the experiments hand sheets (60+1 gsm) were made and tested for physical properties after conditioning as per TAPPI Standard Test Methods. To find out Wet Web Strength of bleached pulps, strips from 100 gsm hand sheet were taken at 25% O.D. using Wet Web tensile tester of L&W, SWEDEN (as per SCAN Method-M11/C31 and SCAN-M12/C35. The experimental data is presented in Tables 1-7.

RESULTS & DISCUSSIONS

Freeness (°SR):

The freeness (°SR) trend with the increase of Broke at different PFI revolutions is given in Table-1. Refined pulp freeness (°SR) increased with increasing proportion of Broke pulp for same number of revolutions indicating more fines generation.

HAND SHEET BULK

No definite trend in Bulk is observed with increasing Broke percentage.

TABLE -1

EFFECT OF FREENESS (DEG SR) WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT : PFI MILL REVOLUTIONS				
BROKE :	500 :	1000 :	2000 :	3000 :
0 :	20 :	28 :	35 :	47 :
10 :	22 :	28 :	36 :	47 :
30 :	24 :	31 :	38 :	50 :
50 :	27 :	30 :	39 :	56 :
70 :	29 :	33 :	45 :	56 :

TABLE -2

EFFECT OF BULK (cc/gm) WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT : PFI MILL REVOLUTIONS				
BROKE :	500 :	1000 :	2000 :	3000 :
0 :	1.715 :	1.523 :	1.489 :	1.404 :
10 :	1.625 :	1.496 :	1.42 :	1.315 :
30 :	1.62 :	1.469 :	1.437 :	1.412 :
50 :	1.628 :	1.524 :	1.379 :	1.294 :
70 :	1.67 :	1.578 :	1.515 :	1.437 :

Burst Factor and Breaking Length

There is a gradual decrease in both properties

TABLE -3

EFFECT OF BURST FACTOR WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT BROKE	PFI MILL REVOLUTIONS 500	1000	2000	3000
0	24.8	34.4	41	47.2
10	24.6	30.1	37.6	41.1
30	23.8	30.9	35.6	41.4
50	20.3	27.3	33.8	38.4
70	19.8	24.8	31.2	33.5

TABLE -4

EFFECT OF BREAKING LENGTH (meters) WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT BROKE	PFI MILL REVOLUTIONS 500	1000	2000	3000
0	4460	4980	6120	6370
10	4320	4820	5680	6240
30	4030	4800	5630	6170
50	3860	4490	5060	5600
70	3800	4290	4580	4920

with increase of Broke upto 30% level. The decrease is more when the Broke level is 50% and 70%. This may be due to increase of fines content with higher Broke addition and increased refining.

Tear Factor

Increasing of addition of Broke pulp there is marginal decrease of Tear factor upto 30% Broke level. However, at higher levels of Broke viz, 50% and 70% the decrease is considerable indicating maximum amount of fines generation due to fiber cutting in refining.

Wet Web Strength

There is no much change in Wet Web strength with increasing Broke contents. This indicates higher percentage of Broke (70% level) addition may not effect the runnability on paper machine.

Bleanding Unrefined Broke with Refined Virgin pulp

The strength properties of blended pulps with combined refining are more compared to blending Broke pulp without refining to refined Virgin pulp. The results indicate that the addition of higher Broke content without refining affects the runnability on paper machine as indicated by reduced Wet Web strength and strength properties compared to those of combined pulp Refining.

TABLE -5

EFFECT OF TEAR FACTOR WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT BROKE	PFI MILL REVOLUTIONS 500	1000	2000	3000
0	67	72	68	65
10	67	73	68	61
30	64	67	66	62
50	60	62	61	59
70	57	60	60	59

TABLE -6

EFFECT OF WET WEB STRENGTH (N) WITH INCREASE OF BROKE AT DIFFERENT REVOLUTIONS

PERCENT BROKE	PFI MILL REVOLUTIONS 500	1000	2000	3000
0	1.15	1.64	1.7	2.06
10	1.32	1.42	1.65	1.98
30	1.28	140	1.59	1.95
50	1.30	1.39	1.76	2.00
70	1.33	15.3	1.76	1.86

TABLE -7

EFFECT OF PROPERTIES ON COMBINED REFINING Vs UNREFINED BROKE BLENDED WITH REFINED VIRGIN PULP

PARTICULARS	REFINING OF BLENDED VIRGIN PULP & BROKE AT 2000 PFI REVOLUTONS				BLENDING OF UNREFINED BROKE TO REFINED VIRGIN PULP (2000 REV)		
	0% BROKE	30% BROKE	50% BROKE	70% BROKE	30% BROKE	50% BROKE	70% BROKE
BURST FACTOR	41.0	35.6	33.8	31.2	31.6	23.4	17.6
BREAKING LENGTH, mtrs	6120	5630	5060	4580	4870	3450	2930
TEAR FACTOR	68	66	61	61	68	65	60
WET WEB STRENGTH, N	1.70	1.59	1.76	1.76	1.66	1.54	1.41

CONCLUSIONS

* By blending before refining the recycled fiber will not have much adverse effect on physical properties of final paper upto 30% level of Broke pulp addition. At higher levels (50% & 70% levels) the strength properties are adversely affected.

* Addition of unrefined Broke to the refined Virgin pulp will adversely effect the strength properties and runnability.

Mills facing runnability problem and lower strength properties with the addition of higher Broke content can adopt refining of mixed pulp. However, the study results are to be considered with caution as the Broke handling systems and quality of recycled fiber varies for individual mills.

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