Mixed Pulping of Subabul and Bamboo

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ABSTRACT: *As the bamboo availability is decreasing day by day, the paper industry may be forced to utilize other raw materials to meet their total raw material requirement. Subabul is one of the hardwood species gaining popularity as a pulping raw material and is widely considered for afforestation for its fast growth, water conservation, soil fertility, etc. In this article the results obtained with the mixed pulping of subabul and bamboo in different proportions are presented. The studies have indicated that the mixed pulping of bamboo and subabul can be carried out without any adverse effects.*

INTRODUCTION

The depleting resources of the conventional raw material, bamboo, has forced the paper industry in general to look for alternative resources. Subabul (Leucaena leucocephala) is one of the hardwood species gaining popularity as a pulping raw material and is widely considered for afforestation for its fast growth, water conservation, soil fertility etc.

In the recent years this specie has been grown in India with favourable results and it has been estimated that a hectare of plantation yields about 200 tonnes of wood in four years.

Though extensive experiments on cold soda and kraft pulping of subabul have already been published, all are related to the individual pulping of subabul only. As the mixed pulping of bamboo and casurina could be carried out at plant level without any adverse effects, in this study attemptswere made in our laboratory to find out the possibility of mixed pulping of bamboo and subabul too.

EXPERIMENTAL

Subabul wood logs of 5 years old trees were used for the experimental purpose. The logs were chipped alongwith bark. The chemical analysis was carried out as per TAPPI standard methods except for Holocellulose. Holocellose was determined by Sodium Chlorite method. The physical properties and Chemical analysis results are presented in Table-1.

Table-1.

Proximate analysis and fibre dimensions of bamboo and subabul

S.No.	Particulars		Bamboo	Subabul
I. Proximate analysis				
1.	Ash	%	3.0	1.46
2.	Alcohol-benzene extractive	%	1.73	2.3
3.	1% NaOH solubility	%	19.3	20.1
4.	Holo Cellulose	%	66.7	72.3
5.	Lignin	%	27.8	24.4
6.	Pentosans	%	16.4	16.5
II. Fibre dimensions				
1.	Average fibre length	mm	2.05	1.12
2.	Average fibre width	Microns	13.7	16.6
3.	Slenderness Ratio	(l/d)	150	67.5

Six sets of experiments were conducted. The first

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five pulping experiments were conducted. The first five pulping experiments were conducted with 100% bamboo, 75% bamboo +25% subabul, 50% bamboo +50% subabul, 25% bamboo +75% subabul and 100% subabul (Cook 1 to Cook 5) using bamboo cooking conditions and the sixth pulping experiment was conducted with 100% subabul using wood cooking conditions which are presently being followed in our mills. The cooking conditions and results are presented in Table-2. The resultant black liquors were collected and

Table-2.

Cooking conditions and unbleached pulp strength properties

S.No.	Particulars		With bamboo cooking conditions				100% Subabul with wood cooking conditions
			100% Bamboo	75% Bamboo + 25%Subabul	50% Bamboo + 50%Subabul	25% Bamboo + 75%Subabul	100% Subabul
			cook1	cook2	cook3	cook4	cook5	cook6
1.	Bulk density (A.D)	T/M	0.282	0.271	0.262	0.253	0.246	0.246
2.	Total Yield	%	48.25	48.70	49.18	49.89	52.02	50.3
3.	Screened Yield	%	47.75	48.05	48.59	49.16	51.02	49.7
4.	Effective Yield	%	48.00	48.37	48.89	49.52	51.53	50.0
5.	Screen rejects	%	0.5	0.65	0.59	0.73	1.00	0.7
6.	Black liquor							
	a) Twadell at 70xC		26	24	24.5	24.5	25.0	25.0
	b) RAA at 18xTM	gpl	10.85	11.46	12.4	13.95	15.88	7.8
	c) Total solids at precipitation point	%	81.2	51.5	45.6	43.6	41.7	41.2
7.	Permanganate Number		20.6	20.2	19.6	19.3	17.7	17.3
8.	Viscosity	cps	29.4	27.0	24.1	21.7	17.6	20.0
9.	Strength properties							
	a) Burst Factor		36.8	36.9	39.1	40.1	42.2	43.5
	b) Breaking length	mts	5725	6310	6800	7220	7620	8160
	c) Tear Factor		99	86	84	80	74	72
	d) Double folds	nos.	153	182	235	242	247	280

Note:- 1. For the cooks sulphidity of white liquor is 17.6%, steaming time is, 150 mts.
2. For cook no. 1 to 5 chemical used as Na_2O is 16.5%, cooking time is 60 mts., cooking temperature is 165°C and H-factor is 820.
3. For cook no. 6 chemical used as Na_2O is 15.75%, cooking time si 120 mts., cooking temperature is 168°C and H-factor is 1470.

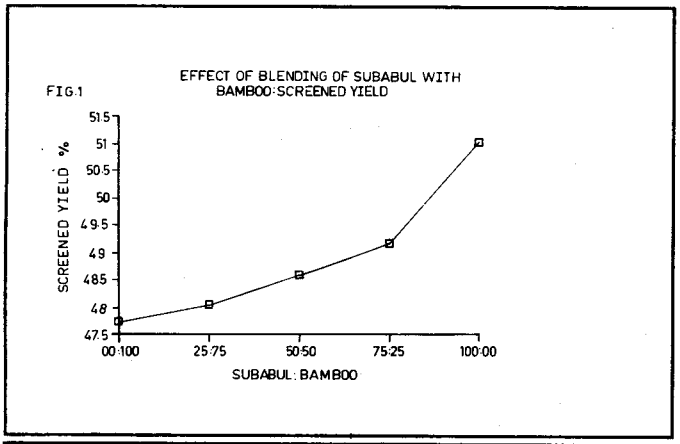
Table-3.

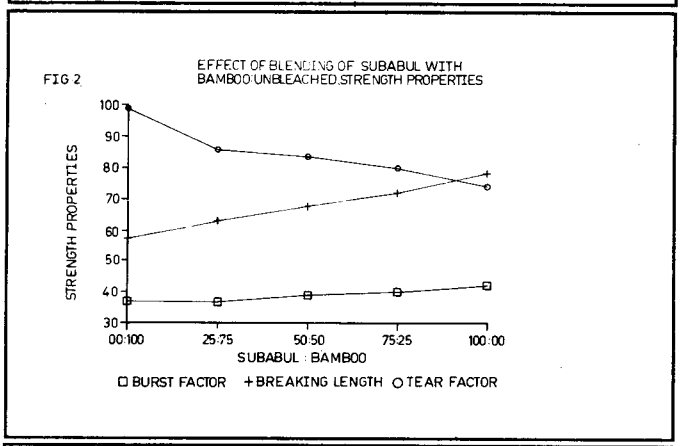
Bleaching Chemical Consumptions and Bleached pulp strength properties

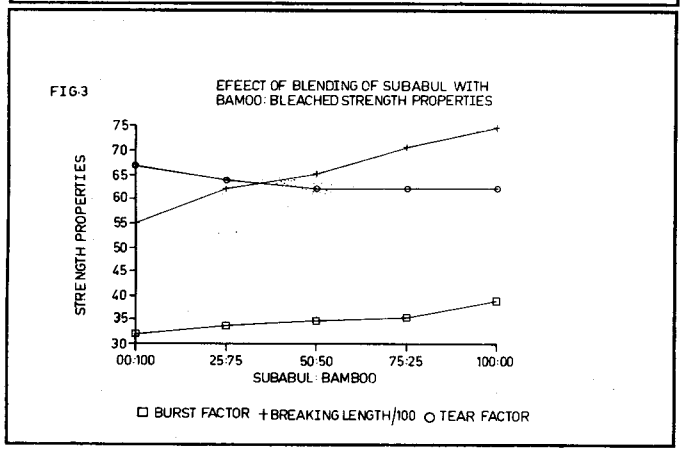
S.No.	Particulars		100% Bamboo	75% Bamboo + 25%Subabul	50% Bamboo + 50%Subabul	25% Bamboo + 75%Subabul	100% Subabul
I.	CHLORINATION STAGE						
	Chlorine consumed as Chlorine	%	6.59	6.14	6.05	6.05	5.54
II.	ALKALI EXTRACTION STAGE						
	Alkali consumed as NaOH	%	1.13	1.08	0.87	0.77	0.75
III.	HYPO STAGE						
	a) Hypo consumed as chlorine	%	2.97	2.96	2.45	2.46	2.45
	b) Buffer added as NaOH	%	1.2	1.2	1.0	1.0	1.0
	c) Brightness	%	80.0	80.0	79.0	80.5	80.0
	d) Viscosity	cps	8.3	6.9	7.2	6.6	8.2
IV.	TOTAL CHLORINE CONSUMPTION	%	9.56	9.10	8.50	8.51	7.99
V.	STRENGTH PROPERTIES						
	a) Burst Factor		32.0	33.6	34.8	35.6	38.8
	b) Breaking length	meters	5500	6200	6520	7060	7490
	c) Tear Factor		67	64	62	62	62
	d) Double folds	nos.	23	19	29	22	14

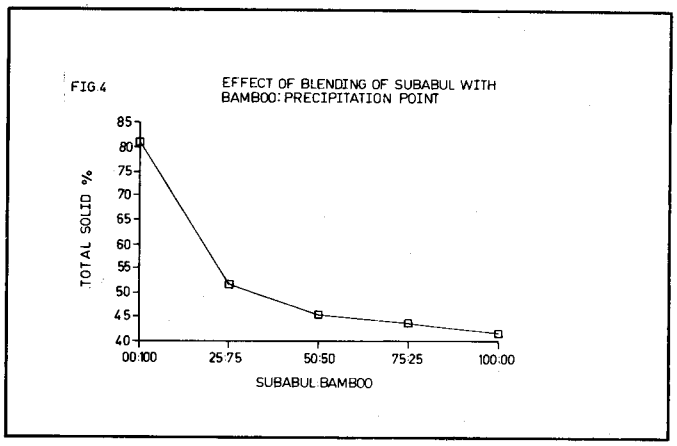
analysed for their precipitation points. The precipitation point was determined by concentrating the liquors in the vacuum flash evaporator. When the granulation started on the wall of the evaporator flask, the evaporation was stopped and the total solids were determined.

The pulps were bleached using CEH bleaching sequence and the results are presented in Table-3. The effect of subabul mixing with bamboo on yield, strength properties of unbleached and bleached pulps and black liquor precipitation point are graphically represented in Fig. 1-4.









RESULTS AND DISCUSSION

From the results, (Table-2) it is evident that there is an increase in yield and a decrease in permanganate number by increasing subabul percentage in the mixture. The total solids at precipitation point of black liquors showed a decreasing trend from cook 1 to cook 5. However, the precipitation point of the black liquors (40-50%) is within the ranges of bamboo + mixed hardwoods. Thus, the handling of bamboo + subabul mixed liquor may not pose much problem as it is similar to bamboo + mixed hardwoods (casurina + eucalyptus + seasonal woods) liquor. The unbleached pulp strength properties : burst factor, breaking length, and double folds are better than 100% bamboo pulp, while there is decreasing trend in the tear factor. However, the tear factor is better than some of the tropical hardwoods and casurina pulps.

When we compare the yield, permanganate number and strength properties of 100% subabul pulp obtained with bamboo cooking conditions and with hardwood conditions (cook 5 and cook 6) it is seen that the results are almost similar in all respects. Further, with the hard wood cooking conditions the yield is less by 1.5%. Hence, the subabul and its admixtures with bamboo can be cooked with bamboo cooking conditions and savings due to lesser energy requirement (lower H-factor) and more digester output can be realised.

The bleached pulps strength properties are also better with the increased subabul percentage except the tear factor. Because of lower permanganate number, the bleach chemical requirement for subabul blended pulps is less compared to 100% bamboo pulp. The bleached pulp strength properties have also shown the

same trend as that of unbleached pulps.

CONCLUSION

1. Mixed pulping of subabul and bamboo can be carried out without adversely effecting the yield and strength properties.
2. By adopting bamboo cooking conditions (lower H-factor) considerable energy saving can be realised. Further, the output per digester can also be increased.
3. The mixed pulping is advantageous from black liquor handling point of view as the precipitation points of mixed pulping liquors were higher than 100% subabul liquor.
4. Combined chipping of Subabul and bamboo can be carried out instead of separate chipping.

ACKNOWLEDGEMENTS

The authors are grateful to the management of The Andhra Pradesh Paper Mills Limited for permitting to publish these results.

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