Utilisation of Acacia Catechu Spent Chips For Production of Kraft Pulp For Paper

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ABSTRACT

Kraft pulps from sap wood, spent heart wood, whole wood and heart wood of *Acacia catechu* were prepared under identical conditions of pulping using 17% as active alkali as Na_2O at 25% sulphidity. It was found that the screened pulp yield followed the order sapwood (47.75%)> spent heartwood (46.03)> whole wood (45.73)> heartwood (36.94%). The kappa number was between 24.96 to 28.84 for sap wood, spent heartwood and whole wood pulps whereas for heartwood pulp the value was 52.23. The strength properties of bleached kraft pulps (72.0 to 77.4% Brightness Elrepho) obtained by CEHH sequence at about 250 ml. C.S.F. were as follows :—Breaking length 4.35 (whole wood) to 4.89 km. (spent heartwood), starch 1.88% (heartwood) to 2.3% (whole wood), Burst index 2.08 (spent heartwood) to 2.54 (sapwood). However, the tear index varied to a greater extent. The order being sapwood (7.00)> whole wood (6.17)> hearwood (4.51) = spent neartwood (4.21).

Blending of bleached kraft pulps from sapwood, heartwood, whole wood and spent heartwood with bleached kraft pulps of Bamboo *(Dendrocalamus stritus)* and soda pulp of Bhabher grass *(Eulaliopsis binata)* improved the strength properties in all categories, but the improvement was more in case of sapwood/spent heartwood. A blend containing 25 to 50% Bamboo pulp/ Bhabher grass pulp gave satisfactory strength properties.

INTRODUCTION

Acacia catechu, commonly known as khair, is one of the most important commercial species of all the Acacias found in India and is a valuable tree mainly for astringent products, cutch and katha,. Only the heartwood is used for extraction, whereas the sapwood which forms about 35% of total is wasted. Even the chips of the heartwood after katha extraction is used only as fuel. Therefore, an attempt was made to study the suitability of khair wood especially sapwood and spent heartwood i.e., wood obtained after extracting katha for pulp and paper making either alone or in blends with Bamboo or Bhabher grass.

EXPERIMENTAL

The logs of *Acacia catechu* were debarked manually. Sapwood and heartwood was separated and chipped to the chip size $2.5 \times 1 \times 0.3$ cm. Bhabher grass was chopped manually to a size approximately 2 5 cm to 3 cm length. Bamboo culms were chipped to the desired size. The chipped materials were air dried and stored in polythene bags for pulping experiments.

Proximate chemical analysis—For proximate chemical analysis of sapwood and heartwood, the chips were disintegrated into wood meal. The wood meal passing through 40 mesh and retained on 60 mesh wash used for proximate chemical analysis as per TAPPI Standard methods.

Pulping—Kraft pulping was .carried out under identical conditions for whole wood, sapwood, heartwood and spent heartwood respectively in a series digester of 2.5 litres capacity rotating in an electrically regulated thermostatic polyethylene glycol bath. The following conditions were employed for kraft pulping :—

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— Chip charge	:	400 grams O.D.
— Active alkali as Na_2O	:	17%
— Sulphidity	:	25%
— Wood liquor Ratio (including chip moisture)	:	1 : 3.0
— Cooking schedule		
Room temperature to 100°C	:	15 minutes
100° to 170°C	:	105 minutes
at 170°C	:	60 minutes

Bamboo chips were also cooked under the above mentloned conditions, except bath ratio which was kept as 1 : 3.5 instead of 1 : 3.0. Bhabher grass was cooked by soda process at the following conditions :

— Raw material	:	200 grams O.D.
— Active alkali as Na_2O	:	12%
— Bath ratio	:	1 : 3.0
Cooking schedule		
Room temperature to 100°C	:	90 minutes
at 160°C	:	90 minutes

After the stipulated time of cooking the material was washed with hot water (70 — 75°C) on terylene cloth, disintegrated and screened on laboratory screen to remove knots and shives, if any. The yields of screened pulp and rejects were determined. The kappa number of each pulp was determined using TAPPI standard method.

Bleaching—The unbleached pulps were bleachcd using CEH and CEHH sequences to abtain pulps of brightness over 70%. The conditions of bleaching and the properties of bleached pulps are given in Table 3 and 4.

Bleaching Studies—The beaten pulps (Freeness 250 ml CSF approximately) of all categories of khair wood, except pulp obtained from heartwood, were blended with beaten pulps of bamboo and bhabher grass in different proportions as given below :

I. BLENDING OF KHAIR WITH BAMBOO

1. Whole wood (75%) + Bamboo 25%)
2. Whole wood 50%) + Bamboo (50%)
3. Sapwood (75%) + Bamboo (25%)
4. Sapwood (50%) + Bamboo (50%)
5. Spent heartwood (75%) + Bamboo (25%)
6. Spent heartwood (50%) + Bamboo (50%)

II. BLENDING OF KHAIR WITH BHABHER GRASS

1. Whole wood (75%) + Bhabher grass (25%)
2. Whole wood (50%) + Bhabher grass (50%)
3. Sapwood (75%) + Bnabher grass (25%)
4. Sapwood (50%) + Bhabher grass (50%)
5. Spent heartwood 75%) + Bhabher grass (25%)
6. Spent heartwood (50%) + Bhabher grass (50%)

Standard sheets of 60 gsm were prepared and tested for physical strength properties using standard procedure.

RESULTS AND DISCUSSION

The results of proximate chemical analysis are recorded in Table 1. A perusal of data reveals that all the solubilities in the heartwood were higher as compared with sapwood which indicates that exractives, polyphenols etc., are higher in the heartwood. Further high solubilities of heartwood in cold and hot water indicates that it will be harder to cook as compared with sapwood.

The lignin content (24.12%) was lower in the sapwood than heartwood (28.63%). The proportion of holocellulose in sapwood (72.66%) was higher than heartwood (64.42%) which indicates the possibility of higher pulp yield in the sap wood by using the same charge of chemicals.

The yield of unbleached pulp from different categories of khair wood, cooked under identical conditions as recorded in Table 2 did not vary much, except in the heartwood, where it was very low (36 94%) The high pulp yield from sapwood (47.75%) was in conformity wiih the results of proximate chemical analysis as sapwood contained high holocellulose and low extractives. These results also correspond to the findings of Karnik *et al.* (1971, 1973).

Table 1.
PROXIMATE CHEMICAL ANALYSIS

Sr. No.	Partieulars	Sapwood	Heartwood
1.	Cold water solubility %	5.12	9 85
2.	Hot water solubility %	6.45	16 48
3.	1% NaoH solubility %	19.91	26.52
4.	Alcohol–Benzene solubility %	3.90	13.18
5.	Klason Lignin	24.12	28 63
6.	Holocellulose %	72.66	64 42
N.B	All results are based on o.d. wood dust.		

Table 2.
PULPING STUDIES

Sr. No.	Particulars	Whole wood	Sap wood	Spent heart-wood	heart-wood	Bamboo (D. Strictus)
1.	Active alkali as Na_2O %	17	17	17	17	17
2.	Sulphidity %	25	25	25	25	25
3.	Wood Liquor Ratio	1 : 3	1 : 3	1 : 3	1 : 3	1 : 3.5
4.	Time schedule in (min)					
	(i) Room temp to 100°C	15	15	15	15	15
	(ii) 100°C to 170°C	105	105	105	105	105
	(iii) At 170°C	60	60	60	60	60
5.	Screened Pulp yield %	45.73	47.75	46.03	36.94	44.36
6.	Rejects %	1.25	0.12	0.62	4.75	0 44
7.	Kappa number	25.43	24.96	28.84	52 23	23.03
N.B.	Percentages are based on O.D. wood chips.					

The kappa number of pulp was lowest in sapwood (24.96) closely followed by whole wood and spent heartwood but it was exceptionally high in the heart-wood (52.23). The high kappa number of beartwood indieates that it must be subjected to high alkali charge during cooking as well as for bleaching.

Table 3 reveals that yield of bleached pulp was maximum in sapwood (44.19%) followed by spent heartwood (41.62%). The bleached pulp yield in heartwood was lowest (32.87%). The higher bleached pulp yield in sapwood with lowest chemical demand for bleaching showed that there is minimum degradation and loss of pulp. The spent heartwood with little higher chemical demand for bleaching gave comparable bleaehed pulp yield.

The strength properties of bleached pulp, summarized in Table 4 shows that breaking length was highest in spent heartwood (4.89) closely followed by that of sapwood (4.85 km). Similarly, other properties such as stretch, tear index and burst index

Table 3.
BLEACHING STUDIES

Sr. No.	Particulars	Whole wood	Sap wood	Spent heart-wood	Heart wood
1.	Kappa number	25.43	24.96	28.84	52 23
2.	**Chlorination Stage**				
	Available chlorine, % applied on O.D. pulp	5.6	5.5	6.3	8.0*
	Consistency, %	3	3	3	3
	Temperature in °C	26	26	26	26
	Time in minutes	60	60	60	60
3.	**Alkali Extraction**				
	Alkali dose given as NaOH %	2	2	2	2
	Consistency, %	8	8	8	8
	Temperature in °C	70	70	70	70
	Time in minutes	60	60	60	60
4.	**Hypo Stage—I**				
	Available chlorine, % applied on O.D. Pulp	2	2	2	2
	Consistency, %	8	8	8	8
	Temerature in °C	40	40	40	40
	Time in minutes	120	120	120	120
	pH during bleaching	>10	>10	>10	>10
5.	**Hypo Stage—II**				
	Available chlorine, % applied on O.D. pulp	—	—	2	2
	Consistency, %	—	—	8	8
	Temperature in °C	—	—	40	40
	Time in minutes	—	—	120	120
	pH during bleaching	—	—	>10	>10
6.	Bleached pulp yield** %	87.47	92.55	90.42	88.99
7.	Bleached pulp yield*** %	40.00	44.19	41.62	32.87
8.	Brightness (mgo = 100)	72.0	72.3	77.4	75.7

* = Kappa number was high, but chlorine charge was kept at 8%
** = Yield on basis of unbleached pulp (100 g O.D.)
*** = Yield on basis of chips (100 g O.D.)

Table 4.
PHYSICAL STRENGTH PROPERTIES OF BLEACHED PULPS

Sr. No.	Particulars	Breaking length (km)	Stretch %	Tear index (mN m²/g)	Burst index (KPam²/g)
1.	Whole wood	4.35	2.30	6.17	2.48
2.	Sapwood	4.85	2.10	7.00	2.54
3.	Spent heartwood	4.89	2.10	4.21	2.08
4.	Heartwood	4.59	1.88	4.51	2.21

Table 5

PHYSICAL STRENGTH PROPERTIES OF BLENDED PULP OF KHAIR (*ACASIA CATECHU*) AND BAMBOO (*DENDROCALAMUS STRICTUS*)

Sr. No.	Particulars		Breaking length (km)	Stretch (%)	Tear index (mN m²/g	Burst index (KPam²/g
1.	Whole wood (75%)	+ Bamboo (25%)	5.16	2.65	8 20	2 68
2.	Whole wood (50%)	+ Bamboo (50%)	5.25	3.20	10.17	2.46
3.	Sapwood (75%)	+ Bamboo (25%)	5.17	3.05	8.23	2 69
4.	Sapwood (50%)	+ Bamboo (50%)	5.82	3.26	9.97	2.04
5.	Spent heartwood (75%)	+ Bamboo (25%)	5.18	2.61	6.70	2.28
6.	Spent heartwood (50%)	+ Bamboo (50%)	5.55	3.46	9.23	1.88

Table 6

PHYSICAL STRENGTH PROPERTIES OF BLENDED PULP OF KHAIR (*ACACIA CATECHU*) AND BHABHER GRASS (*EULALIOPSIS BINATA*)

Sr. No.	Particulars		Breaking length (km)	Stretch (%)	Tear index (mN m²/g)	Burst index (KPam²/g)
1.	Whole wood (75%)	+ grass (25%)	5.87	2 93	7.88	3.34
2.	Whole wood (50%)	+ grass (50%)	5.43	3.16	9 23	2 49
3.	Sapwood (75%)	+ grass (25%)	5.83	3.08	8.65	3 02
4.	Sapwood (50%)	+ grass (50%)	5 69	3.25	9.21	3 84
5.	Spent heartwood (75%)	+ grass (25%)	5.62	3.20	6 68	2 99
6.	Spent heartwood (50%)	+ grass (50%)	5.54	3.60	8.25	3.58

were highest in sapwood than other categories. All the strength properties of paper obtained from sapwood were beter. These results are in conformity to the findings of Bihani (1978).

The strength properties of paper obtained from blended pulps of khair and bamboo, as rccorded in Table 5, reveal that breaking length, stretch, tear index in all categories increased with increasing proportion of bamboo. There was a little increase in burst index in all cases on blending with 25% bamboo of total furnish but on increasing the proportion to 50% the value of burst index decreased a ltle.

The influence of blending of Bhabher grass pulp with pulps of khair wood on strength properties is summarized in Table 6 The breaking length of all categories of khair pulp increased on blending with 25% Bhabher grass of total furnish but increasing the proportion of Bhabher grass to 50% was of little use. The stretch, tear index and burst index in all pulps increased on blending with 25%. Blending with 50% Bhabher grass was of little advantage.

The strength properties of all categories of khair wood pulp in pure form especially from sapwood and spent heartwood fulfil the requirements for writing and printing paper. These strength properties have been further found to improve on blending with 25% bamboo kraft pulp and Bhabher grass soda pulp.

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