Pulping and Papermaking Potentials of Local Mixed Hardwoods With Barks

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The effect of barks in the pulping of woods was studied by carrying out the pulping of nine local hardwoods considered pulpable. These nine hardwoods taken for the study were (i) Adina cordifolia (Heddi), (ii) Mitragyna parviflora (Kalam), (iii) Dillenia pentagyna (Karmal), (iv) Lagerstroemia lanceolata (Nandi), (v) Terminalia belerica (Ghoting), (vi) Grewia tiliaefolia (Dhaman), (vii) Anogeissus latifolia (Dindal), (viii) Kydia calycina (Bhendi) and (ix) Eucalyptus hybrid (Nilgiri). The pulping experiments of the individual barks of these woods and the woods after removal of the bark were carried out. Acceptable quality pulp was obtained with the barks of six of the nine hardwoods studied viz. Adina cordifolia (Heddi), Mitragyna parviflora (Kalam), Lagerstroemia lanceolata (Nandi), Grewia tiliaefolia (Dhaman), Kydia calycina (Bhendi) and Eucalyptus hybrid (Nilgiri).

The pulp yields were slightly less (0.5-1.0%) when barks were used along with the woods. Under the identical conditions of pulping, the increase in the amount of barks content increased the Kappa Number of the unbleached pulp. There was no significant drop in the strength properties when barks were used along with the woods to the extent, they were present with the woods.

The dirt and speck count was, however, significantly increased when the pulp was made with the mixture of nine hardwoods along with their barks. But when the barks of three of these nine hardwoods viz. Dillenia pentagyna (Karmal). Terminalia belerica (Ghoting) and Anogeissus latifolia (Dindal) were excluded, the dirt count had reduced by about 50% as against 27% when barks of all nine hardwoods were removed. With the conventional screening arrangement, it should be possible to remove the dirt from the pulp.

It is therefore considered feasible to pulp six of the above mentioned woods with barks and the remaining three after removal of barks to obtain an acceptable grade of pulp suitable for pulping and papermaking.

Introduction

It has now become common practice to use hardwoods for pulping and papermaking to overcome the shortage of bamboo as a fibrous raw material. In India, next to Bamboo, Eucalyptus is being used for pulping and papermaking. Recently the use of other hardwoods also has been started. Before the woods are chipped for pulping, they are debarked as per the common practice. The debarking of hardwoods in forests produces large quantities of wastes, which need commercial exploitation, taking into account the environmental care. Pulping of woods with the barks of acceptable quality is one of the ways of solving the problem of pollution caused by these forestry wastes. Besides that, the cost of debarking and bark disposal etc. would also be eliminated.

The effect of bark on the kraft pulp quality using southern pine (1), Douglas fir (2) and several European hardwoods (3) has lead to the conclusion that the considerable amount of bark could be utilised for pulping and papermaking.

The proximate chemical analysis of the barks of different Eucalyptus species (4) and other hardwoods (5) show higher solubility in 1% NaOH, cold water and hot water which indicate the lower pulp yield from pulping of barks.

In the light of these, this paper

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deals with the pulping and papermaking study of the mixture of some of the local hardwoods with and without addition of barks.

Experimental :

Nine species of local hardwoods consisting of eight billets each were supplied by our Forest Department. These hardwoods are commonly used in The West Coast Paper Mills Ltd. for pulping after debarking. The names of these hardwoods are as follows :

i) Adina cordifolia—Heddi
ii) Mitragyna parviflora—Kalam
iii) Dellenia pentagyna—Karmal
iv) Lagerstroemia lanceolata—Nandi
v) Terminalia belerica—Ghoting
vi) Grewia tiliaefolia—Dhaman
vii) Anogeissus latifolia—Dindal
viii) Kydia calycina—Bhendi

ix) Eucalyptus hybrid—Nilgiri

The circumference of the billets of all the species with bark was measured. The logs were then debarked and the circumference of the debarked billets was measured. The weight percent of the bark was determined in each case. The thickness of the bark was calculated from the circumference. Table No. I gives the botanical and local names of the hardwoods, Average bark content, bark thickness and the nature of the barks.

Debarked logs of these hardwoods were chipped separately in the mill chipper. The barks were reduced to chip size by handchipping. The green volume density of the chips from wood and bark was determined by water displacement method. These results are recorded in Table No. I.

Pulping experiments were carried out separately on wood chips and those on barks in autoclave digesters. The capacity of these digesters being two litres for cooking of 300-350 g. chips. After connecting these digesters to rotating couplings, they are heated in glycol bath.

Same amount of chemicals and cooking condition were applied to the wood and its bark. Fig. 1 gives the pulp yield and Kappa Number of these hardwoods and their bark.

The wood chips from all nine hardwood species were mixed in equal proportion (by weight) and the lot was named mixed hardwood chips (MHW). To get the mixture of barks, hand chipped barks of all nine hardwoods were mixed in the same proportion as those present with wood i.e. on the weight percentage of barks as in Table No. I. This lot was named bark mixture 9B. Those barks which were considered suitable, after preliminary experiments were mixed in the proportion present with wood. This lot was named 6B. The pulping experiments were then planned in the following manner.

1. Cook - A ... Pulping of nine mixed hardwood (MHW) chips
2. Cook - B ... 90% of MHW chips + 10% of mixture of barks from 9 B (all barks)
3. Cook - C ... 93.5% of MHW chips + 6.5% of mixture of barks from 6B (acceptable barks)

The capacity of the rotary digester is 14 litres and is used for cooking 2 - 3 Kg chips. Chips and liquor are fed in the digester. The digester is electrically heated and rotated round its axis to get uniform mixing and heating of the cooking liquor and chips. The pulping data, pulp yield etc. are recorded in Table No. II.

The bleaching of the pulps (obtained from cooks A, B and C) was carried out separately using CEHH sequence to get about 80% brightness (Elrepho). The dirt and shive count was done by Tappi standard method. The bleaching data, shrinkage, dirt count etc. are recorded in Table No. III.

The Bauer McNett classification of the bleached pulps was done and the data are given in Table No. IV.

The bleached pulps were then beaten in the laboratory valley beater to four different slowness levels. Standard handsheets of 60 gsm were prepared on the British Sheetmaking machine. The strength properties of the handsheets were determined. Table No. V gives the strength properties of these pulps at 30°SR for comparison.

Results and Discussion :

It can be observed from the Table No. I that the bark content in different hardwood species varied from 5—16% by weight with an average of 10% by weight of bark content.

The pulping study of all the nine hardwoods and their barks separately (Fig. 1) in common, reveal higher Kappa Number and lower pulp yield in case of pulps obtained from barks as compared with respective wood pulps without bark.

The pulps from the barks of Dillenia pentagyna (Karmal) and Anogeissus latifolia (Dindal) were pithy and mostly non-fibrous and hence these barks were found useless for pulping. The pulp from the bark of Terminalia belerica (Ghoting) was hard and shivy and hence found unsuitable for pulping to minimise the dirt and shive problem.

The pulps from barks of rest hardwoods viz. Adina cordifolia (Heddi), Mitragyna parviflora (Kalam), Lagerstroemia lanceolata (Nandi), Grewia tiliaefolia (Dhaman), Kydia calycina (Bhendi) and Eucalyptus hybird (Nilgiri) were clean, fibrous and hence suitable for the pulping.

It can be seen from Table No. II that at same chemicals and cooking conditions, there is little difference (0.5—1.0%) in the unbleached pulp yields. As the bark percentage was increased, the Kappa Number of the unbleached pulp increased by about two units. When barks were used along with the woods the pulp yield was reduced by 0.5 to 1.0%. The unbleached pulp brightness was reduced by about four units when barks from all nine hardwoods were used and by about two units when acceptable bark were used with all nine hardwoods.

TABLE NO. I

Characteristics of barks of local hardwoods

Botanical Name	*Local Name*	*Green volume density, g/cc.*		*Av. content of bark, % w/w*	*Ax. Bark thickness mm*	*Nature of the bark*
		Wood	*Bark*			
Adina cordifolia	Heddi	0.517	0.447	16.0	11.2	Thick, fibrous, dark shade
Mitragyna perviflora	Kalam	0.507	0.386	12.0	6.5	Thin, fibrous, dark shade.
Dillenia pentagyna	Karmal	0.565	4.490	9.0	9.5	Thick, pithy, brittle, dark purple shade.
Lagerstroemia lanceolata	Nandi	0.493	0.399	5.0	5.0	Thin, fibrous, light shade.
Terminalia belerica	Ghoting	0.539	0.394	9.0	8.0	Medium thick, brittle, light, shade.
Grewia tiliaefolia	Dhaman	0.548	0.418	9.0	8.0	Medium thick, fibrous, dark shade.
Anogeissus latifolia	Dindal	0.613	0.472	10.5	8.7	Medium thick, pithy, brittle, light shade.
Kydia calycina	Bhendi	0.348	0.286	13.5	7.2	Medium thick, fibrous, light shade.
Eucalyptus hybrid	Nilgiri	0.513	0.345	11.0	6.3	Thin, fibrous, light shade.

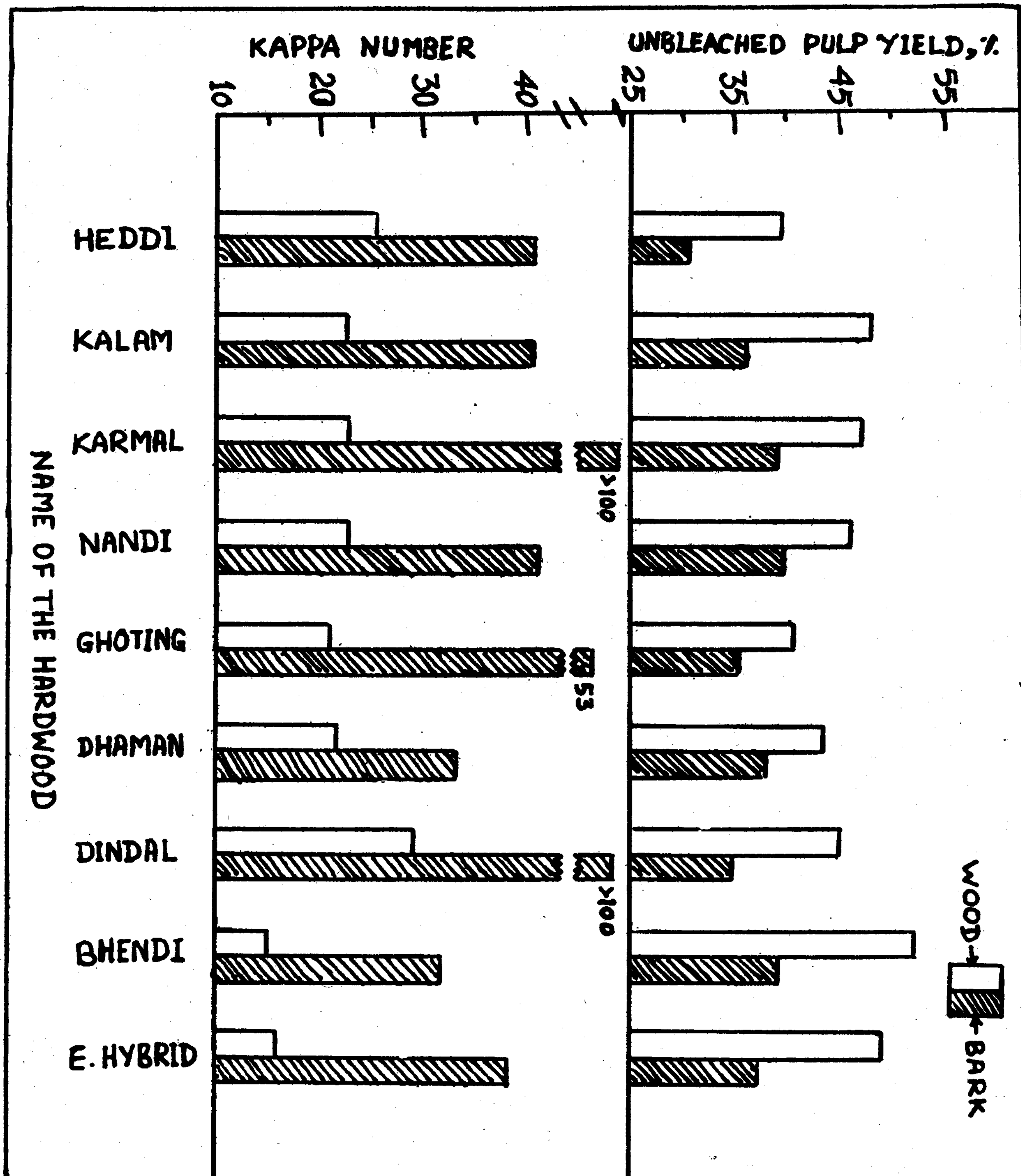
KAPPA NUMBER
10
20
30
40
UNBLEACHED PULP YIELD, %
25
35
45
55
NAME OF THE HARDWOOD
HEDDI
KALAM
KARMAL
NANDI
GHOTING
DHAMAN
DINDAL
BHENDI
E. HYBRID
>100
53
>100
WOOD
BARK

Fig. 1

By using mild hypochlorite treatment (6) to those unbleached pulps when barks were used, the shade can be improved to the level of that pulp, obtained by using hardwoods without bark. Thus, the difficulty of variation in shade of the kraft paper can be overcome. These pulps, then, can be used for manufacturing papers.

No marked difference was found in the bleachability, shrinkage and bleached pulp viscosity when barks were used along with woods (Table No. III).

The Bauer McNett fibre classification data (Table No. IV) show the increase in the fines fraction when barks were present with wood for pulping. There was practically no difference in the classification of pulps from Cook-B and Cook-C. Table No. V of the strength properties of the bleached pulps at 30°SR indicate that almost all properties are comparable in these three cases i.e. 100% mixed hardwoods (Cook-A); 90% mixed hardwoods with 10% barks from all hardwoods (Cook-B) and 93.5% mixed hardwoods with 6.5% acceptable barks.

As observed from Table No. III, the main difference amongst these pulps is shive count. By removing the objectionable barks, the dirt and shive could be reduced to about 50% to get an acceptable pulp. The efficient screening arrangement should further reduce the shives.

Conclusion :

The barks of Dillenia pentagyna (Karmal), Terminalia belerica

TABLE NO. II

Data on pulping of local hardwoods with and without barks

Particulars	*Chips from*		
	Mixed hard-woods	*Mixed hardwoods with acceptable barks (6B)*	*Mixed hard-woods with barks of all 9 species (9B)*
	Cook-A	*Cook-B*	*Cook-C*
Barks on total chips, %	..	6.5	10.0
Chemicals as Na_2O, %	17.0	17.0	17.0
Chips : Liquor	1:3	1:3	1:3
Cooking temp., °C.	170	170	170
Time schedule :			
70-120°C., Min.	45	45	45
At 120°C., "	60	60	60
120-170°C., "	90	90	90
At 170°C., "	90	90	90
'H' Factor	1770	1770	1770
Unbleached screened pulp yield, %	44.5	44.0	43.8
Rejects, %	0.9	1.0	1.1
Kappa Number	26.7	28.0	28.6
Unbleached pulp brightness, % (Elrepho)	24.3	24.4	20.9

TABLE NO. III

Data on bleaching of different pulps

Particulars	*Unbleached pulp from*		
	Cook-A	*Cook-B*	*Cook-C*
Chlorination :			
Cl_2 added on pulp, %	4.7	5.0	5.0
Cl_2 consumed on pulp, %	4.7	5.0	5.0
Alkali Extraction :			
NaOH added on pulp, %	1.3	1.3	1.3
Final pH	9.2	9.1	9.2
Hypo—I :			
Hypo as av. Cl_2 added on pulp, %	2.5	2.5	2.5
" " " consumed " %	2.05	2.05	2.05
Final pH	6.8	6.8	6.9
Hypo—II :			
Hypo as av. Cl_2 added on pulp, %	1.0	1.0	1.0
" " consumed " %	0.55	0.55	0.55
Final pH	7.2	7.3	7.2
Total Cl_2 added on pulp, %	8.2	8.5	8.5
Total Cl_2 consumed on pulp, %	7.3	7.6	7.6
Shrinkage during bleaching	6.7	7.2	7.3
Bleached pulp yield, % on O.D. chips	41.7	40.9	40.7
Bleached pulp brightness, % (Elrepho)	80.1	79.7	79.3
Bleached pulp viscosity, (CED), cp.	12.0	11.8	11.9
Dirt count, ppm	15	28	55

(Ghoting) and Anogeissus latifolia (Dindal) were found unsuitable for pulping, while Adina cordifolia (Heddi), Mitragyna parviflora (Kalam), Lagerstroemia lanceolata (Nandi), Grewia tiliaefolia (Ghoting), Kydia calycina (Bhendi) and Eucalyptus hybrid (Nilgiri) possess pulpable barks. The laboratory study showed that Dillenia pentagyna (Karmal), Terminalia belerica (Ghoting), and Anogeissus latifolia (Dindal) should be used only after debarking. The rest six hardwoods studied can be used along with their barks. This will save the time and labour in debarking the acceptable wood species. Kydia calycina (Bhendi) and Eucalyptus hybrid (Nilgiri) wood species with bark are being used in our mills for pulping and papermaking. The plant trials of pulping remaining hardwoods with barks are yet to be conducted.

Tee utilisation of above mentioned hardwoods with bark gives about 2.5% of extra pulp.

Constant Conditions :

	Consistency, %	*Temp., °C.*	*Sulphamic acid on hypo, %*	*Time, hr.*
Chlorination	3	30	..	1.0
Alkali Extraction	5	55	..	1.0
Hypo—I	5	45	2	1.0
Hypo—II	5	45	5	1.5

TABLE NO. IV

Bauer McNett fibre classification of bleached pulps

Mesh used		*Fibres retained, % for the pulp from*		
		Cook-A	*Cook-B*	*Cook-C*
	+ 35	35.5	30.8	27.3
— 35	+ 50	24.0	22.4	25.7
— 50	+ 100	10.6	11.5	12.7
— 100	+ 150	6.9	7.4	6.7
— 150	+	23.0	27.9	27.6

TABLE NO. V

Strength properties of the bleached pulps

Particulars	*Bleached pulp from*		
	Cook-A	*Cook-B*	*Cook-C*
Slowness, °SR	30.0	30.0	30.0
Drainage time, Sec. (Sheet mould)	6.0	6.1	6.3
Bulk, cm³/g.	1.56	1.59	1.57
Breaking length, km	5.68	5.58	5.68
Stretch, %	2.7	2.7	3.1
Tear factor	86.3	82.8	81.8
Burst factor	39.8	36.6	37.9
Double folds	35	38	45

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