Utilisation of a Mixture of Xylia xylocarpa, Terminalia tomentosa and Terminalia paniculata for Pulping

SARAF, G.P.,* PAI, N.M.,** MESHRAMKAR, P.M.,*** DEB, U.K.,**** JASPAL, N.S.*****

SUMMARY

The West Coast Paper Mills is facing acute shortage of bamboo and pulpable mixed hardwoods, the main raw materials for pulping. Though the local forests are abundant in hardwoods like Jamba, Matti and Kindal (JMK), these were hitherto considered as not pulpable, as they are dense, highly lignified and coloured requiring severe pulping and also bleaching conditions, and producing pulp of sub-standard quality. This paper describes the innovative approach to overcome the difficulties in the commercial exploitation of these hardwood species by reducing the size and thickness of the chips. A series of experiments were carried out using JMK chips of different chip sizes, and maintaining the Kappa Number of unbleached pulps between 27 and 29 by adjusting the pulping conditions. It was found that along with the reduction in chip size and thickness and maintaining the same pulping chemicals (i.e. 22% as Na_2O) the 'H' factor could be reduced. Because of the reduced 'H' factor, the pulp quality was not deteriorated. The strength properties of unbleached and bleached pulps of JMK of different chip sizes were determined and compared with those of eucalyptus hybrid and mixed hardwoods with normal chip sizes. The studies on blending of bleached pulps of bamboo, mixed hardwood, eucalyptus hybrid and JMK in different proportions have shown that 20% JMK bleached pulp would have good runnability on the paper machine in combination with 65% bleached bamboo and remaining mixed hardwoods bleached pulp, as indicated by the wet web strengths of the blends.

INTRODUCTION

Indian pulp and paper industry was depending entirely on bamboo as a raw material upto the late sixties. The increased production of pulp for making paper and also rayon proportionately showed increased demand for this raw material. Gregorious flowering and insufficient measures adopted in replanting this specie were responsilube for the short supply of bamboo to the paper industry. Laboratory experiments in utilising the various hardwoods available in the country were successful and paved a way for commercial utilisation of these species with bamboo. Bhargava et al (1) emphasized the need for utilising our wood resources to the fullest extent in meeting growing shortage of bamboo.

*Senior Chemist, Research Centre, **Asst. Research Officer, ***Research Officer, ****Senior Research Officer, *****Works Manager, The West Coast Paper Mills Limited, Dandeli—581 362, Karnataka.

As a result of extensive research work on hardwood utilisation for pulping in supplementing bamboo, The West Coast Paper Mills started commercial utilisation of eucalyptus hybrid and a mixture of other acceptable hardwoods many years ago. Wood pulp upto 40% is being mixed today with bamboo pulp to obtain satisfactory quality of paper with good runnability on paper machines. However, the sudden shortage of bamboo and even eucalyptus hybrid in recent years necessitated efforts in procuring bamboo, reeds and eucalyptus hybrid from distant places like Assam, Tamil Nadu, Kerala and Goa, to keep up the paper production.

Considering the economics of bringing these cellulosic raw materials from distant states, it seemed imperative to give top priority to develop suitable technology for the use of highly lignified and dense species like *Xylia xylocarpa*, (*Jamba*), *Terminalia tomentosa*, (Matti) and *Terminalia paniculata* (Kindal) for commercial utilisation in our mills. These species available in abundance in local forests have been

hitherto considered unpulpable. A good deal of work on these species carried out in Research Centre earlier indicated that these species required higher amount of chemicals and drastic conditions for getting acceptable pulps [2]. However, very little control on chip size and thickness was exercised in these experiments. It is the general experience that the amount of rejects in kraft pulping increases with chip thickness. In kraft pulping it is well known that thickness is the critical dimension of the chips [3]. The chip geometry influences the penetration of chemicals in the chips during pulping and also affects cooking temperature and time or 'H' factor [4]. Hence, a systematic study on the effect of gradual reduction in chips size was found essential in order to study the potentials of these species for pulping and papermaking.

EXPERIMENTAL

The required number of billets of Jamba, Matti and Kindal were collected from the lime kiln yard. Care was taken in collecting straight billets without branches and knots for minimum trouble during chipping. Also, it was noticed that the billets were of nature wood. They were slit in the saw mill of the yard and pieces of 3″—4″ width were debarked manually. The split pieces of each species were then chipped separately in the voith chipper no. 7.

The knife settings in the chipper were specially adjusted in order to obtain small and thin chips from these woods. In order to control/minimise the oversize chips during chipping, the chips obtained from the chipper were screened through 25 mm screen opening and the oversize chips were separated and fed to the rechipper and afterwards mixed with the accepted chips. The chips were air dried to the moisture level of 17 percent. The air dried chips of Jamba, Matti and Kindal were then mixed in equal proportions and mixed uniformly. The JMK chips were further classified in William's Chip Classifier and the results are shown in Table–I. Chip density of any raw material is a notable parameter in cooking as it affects penetration of liquor in the chips. Hence chip density of JMK mixture was determined and it is recorded in Table–II. For comparison, the chip densities of Eucalyptus hybrid and mixed hardwoods. (MHW) are also recorded. The results of proximate chemical analysis of JMK are shown in Table–III along with those of Eucalyptus hybrid and MHW.

In order to study the effect of chip size of Jamba, Matti and Kindal mixture on pulping six different lots of mixed chips as shown in Table–IV were prepared. To have an idea of thickness of the chips, the chips were classified according to thickness and the results are given in Table–V.

TABLE–I. SIZE CLASSIFICATION OF JMK* CHIP MIXTURE

JMK chips were mixed in equal proportions. The oversize chips were rechipped and mixed with the accepted chips.

Fraction retained on screen, mm		Percent
32	..	1.2
25	..	3.4
22	..	3.6
19	..	7.5
16	..	17.2
13	..	20.6
6	..	38.5
3	..	6.3
–3 (Dust)	..	1.7

*JMK = Jamba + Matti + Kindal chips mixed as stated above.

TABLE–II. CHIP BULK DENSITY OF DIFFERENT WOODS

Kg/m³	JMK	MHW	Eucalyptus hybrid	Bamboo
At 10% moisture	280	275	240	230
O.D.	254	250	220	210

PULPING

Rotary digester cooks were carried out by using JMK chips of different sizes. The objective was to cook the chips to the same degree of delignification measured by kappa number, by adjusting the 'H' factor of different lots. The cooking conditions of these pulping experiments are recorded in Table–VI (a). An extract of this is given in Table–VI (b), where the pulping characteristics of Jamba, Matti and Kindal mixtures are compared to those of Eucalyptus hybrid and mixed hardwoods.

On the basis of the results on cooking and unbleached strength characteristics of the different lots of JMK mixture, the chip lot –16 to +3 mm was chosen as the optimum. It produced pulps similar to the pulp from the normal chip lot - 32 to +3 mm in strength properties. Hence to have further comparison bleaching and bleached pulp strength properties, only these two chip lots were taken.

BLEACHING

The unbleached pulps of JMK from the chip lots –32 to +3 mm and –16 to +3 mm were bleached by using CEHH bleaching sequence, to a brightness

level around 80% (Elrepho). The bleaching data with results of JMK pulps of these two lots were compared with those of Eucalyptus hybrid and MHW, and are recorded in Table–VII (a). As the viscosity of bleached pulp of the chip lot –16 to +3 mm was low, it was found necessary to bleach the pulp from this lot to lower brightness levels (70% and 75% Elrepho) in order to investigate whether any improvement in viscosity was possible. The pulps were bleached in two separate lots using CEH and CEHH bleaching sequences depending on the desired final brightness of bleached pulps. The conditions and results of these bleaching experiments are shown in Table–VII (b) along with the results of bleaching to 80% brightness level for comparsion.

TABLE–III. PROXIMATE CHEMICALS ANALYSIS OF DIFFERENT WOODS

Particulars	JMK	MHW*	Eucalyptus hybrid	Bamboo
Cold water solubility, %	5.3	3.3	0.8	2.4
Hot water solubility, %	7.2	5.1	3.0	4.4
1% NaOH solubility, %	21.2	15.5	11.4	18.1
Alcohol-benzene solubility, %	6.6	3.0	1.8	2.3
Pentosans, %	11.6	14.1	12.3	17.4
Lignin, %	29.5	28.5	23.3	25.6
Holocellulose (by difference), %	56.3	64.0	70.7	65.3
Alpha-cellulose, %	37.1	43.2	44.2	49.2
Ash, %	1.0	0.9	0.60	3.6

*MHW = accepted mixed hardwoods, which consist of the following—

(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.

TABLE–IV. CHIP SIZE CLASSIFICATION OF DIFFERENT LOTS OF JMK TAKEN FOR PULPING

Fraction retained on screen, mm	–32 to +3 (As such) %	–22 to +3 %	–19 to +3 %	–16 to +3 %	–13 to +3 %	–6 or +3 %
25	3.5	..	..	..	..	..
22	3.6	..	..	..	..	..
19	7.7	7.2	..	..	..	..
16	17.7	19.4	18.2	..	..	..
13	21.2	24.3	25.4	33.3	..	..
6	39.8	42.5	48.0	57.2	53.5	..
3	6.5	6.6	8.4	9.5	46.5	100.0

TABLE–V. THICKNESS ANALYSIS OF JMK CHIPS

Thickness, mm	%
+ 9	4.0
+ 7	4.0
+ 5	34.9
+ 3	25.4
– 3	31.7

Note :—For thickness determination, JMK chips from the chip lot –32 to +3 mm were taken.

TABLE–VI (a). PULPING DATA OF JMK CHIPS

Particulars	—32 to + 3 mm (As such)	—22 to + 3 mm	—19 to + 3 mm	—16 to + 3 mm	—13 to + 3 mm	— 6 to + 3 mm	— 6 to + 3 mm
Active alkali as Na_2O, %	22.0	22.0	22.0	22.0	22.0	22.0	21.0
Time at maximum temp., min.	120	120	105	105	90	90	75
'H' factor	2040	2040	1785	1785	1555	1555	1350
Results :							
Screened unbleached pulp yield, %	40.0	40.0	41.0	40.5	41.0	40.3	42.0
Rejects, %	0.4	0.1	0.07	0.06	nil	nil	nil
Total unbleached pulp yield, %	40.2	40.1	41.0	40.5	41.0	40.3	42.0
Kappa Number	28.2	26.8	28.2	27.6	28.1	23.2	29.0
Residual active alkali, gpl (18 °Tw at 80 °C.)	8.7	9.8	10.2	11.3	10.9	11.4	10.8

Constant Conditions during pulping :
Material to liquor ratio : = 1 : 2.
Maximum temperature, °C: = 170
Cooking schedule : 70° C–120° C = 45 min; At 120° C = 45 min; 120° C.–170° C = 45 min.

TABLE–VI (b). PULPING OF JMK CHIPS IN COMPARISON WITH EUCALYPTUS HYBRID AND ACCEPTED MIXED HARDWOODS (MHW)

Particulars	JMK —32 to + 3 mm	JMK —16 to + 3 mm	E. hybrid —32 to + 3 mm	MHW —32 to + 3 mm
Active Alkali as Na_2O, %	22.0	22.0	15.0	18.5
Material to liquor ratio	1:2.7	1:2.7	1:3	1:3
Maximum temp., °C	170	170	165	170
Time at maximum temp., min.	120	105	75	75
Cooking schedule :				
70° C–120 °C, min.	45	45	45	45
At 120 °C, min	45	45	45	40
120 °C—Max. temp., min.	45	45	60	80
'H' factor	2040	1785	900	1445
Results :				
Unbleached pulp yield, %	40.0	40.5	46.9	41.0
(Screened) Rejects, %	0.4	0.06	1.0	1.3
Unbleached pulp yield (total), %	40.2	40.5	47.4	41.7
Kappa Number	28.2	27.6	26.8	30.0
Residual active alkali in spent liquor, gpl	8.7	10.9	5.0	7.2

TABLE-VII (a). BLEACHING OF JMK PULPS TO 80% (ELREPHO) BRIGHTNESS IN COMPARISON WITH THOSE OF EUCALYPTUS HYBRID AND MIXED HARDWOODS (MHW)

Particulars	JMK unbleached pulp		Eucalyptus hybrid	MHW
	—32 to +3 mm	—16 to +3 mm	—32 to +3 mm	—32 to +3 mm
Kappa No. of unbleached pulp	28.2	27.6	27.2	30.0
Chlorination :				
Chlorine applied, %	6.0	6.0	4.5	6.0
Chlorine consumed, %	5.5	5.6	4.5	6.0
pH	1.8	1.8	1.8	1.8
Alkali Extraction :				
NaOH applied, %	1.5	1.5	1.2	1.0
pH	10.2	10.2	8.5	9.0
Alkali extracted pulp K. No.	6.5	6.4	7.2	6.8
Hypo Stage I :				
Chlorine applied, %	2.0	2.0	1.4	2.0
Chlorine consumed, %	1.7	1.8	1.36	1.52
pH	7.4	7.4	7.0	7.1
Hypo Stage II :				
Chlorine applied, %	1.0	1.0	0.8	0.75
Chlorine consumed, %	0.8	0.8	0.54	0.34
pH	7.5	7.6	7.3	7.9
Total chlorine applied, %	9.0	9.0	6.7	8.75
Total chlorine consumed, %	8.0	8.2	6.4	7.86
Brightness, % (Elrepho)	79.5	80.0	80.3	78.3
Viscosity, cp. (0.5% CED)	5.6	6.2	13.4	7.9
Shrinkage, %	6.5	6.0	9.0	8.0
Bleached pulp yield, % (on O.D. chips basis)	37.4	37.8	42.2	37.7

Constant conditions :

	Chlorination	Alkali Extraction	Hypo I	Hypo II
Consistency, %	3.5	5.0	10.0	10.0
Temperature, °C.	30	50	45	45
Time, min.	30	60	60	90
Sulphamic acid, % (on pulp)	..	..	0.07	0.03

BLENDING STUDIES

A study on blending of JMK pulp with bamboo and MHW pulps was carried out using the following steps:

(i) Cooking the different species to desired kappa no. level, i.e., kappa no. of bamboo unbleached pulp=22.5 and kappa nos. of Eucalyptus hybrid, MHW and JMK unbleached pulps=31.32.

(ii) Mixing of the different unbleached pulps in varying proportions to make the following blends:
(a) 65% Bamboo+35% MHW
(b) 65% Bamboo+35% JMK
(c) 65% Bamboo+15% MHW+20% JMK
(Note :—The MHW pulp was a mixture of 70% conventional mixed hardwoods and 30% Eucalyptus hybrid).

(iii) Bleaching of these blends by using CEHH bleaching sequence to brightness around 80% (Elrepho).

TABLE-VII(b). BLEACHING OF JMK PULPS TO DIFFERENT BRIGHTNESS LEVELS

Kappa No. of unbleached pulp = 27.6
Unbleached pulp viscosity, CED, cp. = 11.9

Particulars	I	II	III
Chlorination :			
Chlorine added, %	6.0	6.0	6.0
Chlorine consumed, %	5.56	5.47	5.6
pH	1.9	1.9	1.8
Alkali Extraction :			
Alkali added, %	1.5	1.5	1.5
pH	10.0	10.2	10.2
Hypo Stage I :			
Chlorine added, %	1.8	1.5	2.0
Chlorine consumed	1.64	1.34	1.7
pH	7.5	7.5	7.4
Hypo Stage II :			
Chlorine added, %	..	0.5	1.0
Chlorine consumed, %	..	0.34	0.8
pH	..	7.5	7.6
Total chlorine added, %	7.8	8.0	9.0
Total chlorine consumed, %	7.2	7.15	8.2
Shrinkage, %	5.0	6.0	6.0
Brightness, % (Elrepho)	71.0	76.0	80.0
Viscosity, cp. (CED)	7.0	6.7	6.2

Constant Conditions :

	Chlorination	Alkali Extraction	Hypo I	Hypo II
Consistency, %	3.5	5.0	10.0	10.0
Temperature, °C	30	55	45	45
Time, min.	30	60	60	90
Sulphamic acid on pulp, %	..	..	0.07	0.03

For the bleaching of all the unbleached pulps, wet pulps equivalent to 500 gm. O.D. were taken. The data and results of bleaching of the blends are recorded in Table-VII (c).

BEATING AND PULP EVALUATION

In order to evaluate the JMK pulps of different lots as mentioned in Table-IV, the unbleached pulps of all the six lots were beaten in laboratory Valley beater. The bleached pulps of chip lots –32 to +3mm and –16 to +3mm and the bleached blended pulps of bamboo, MHW and JMK were also beaten in the Valley beater. All the pulps were beaten to three different slowness levels, i.e., 20, 30 and 40°SR.

TABLE-VII (c). BLEACHING DATA OF PULP BLENDS

Kappa Number of unbleached pulps :
Bamboo = 22.5; Eucalyptus hybrid = 31.4 ;
MHW = 31.0, JMK = 32.3.

Particulars	65 B + 35 MHW*	65B + 35 JMK	65B+15 MHW* 20 JMK
Kappa No. of unbleached pulp	25.6	26.0	25.8
Chlorination :			
Chlorine applied, %	5.7	5.7	5.7
Chlorine consumed, %	4.7	4.95	5.0
pH	1.8	1.8	1.8
Alkali Extraction :			
NaOH	1.5	1.5	1.5
pH	8.7	8.8	8.8
Hypo Stage I :			
Chlorine applied, %	2.0	2.0	2.0
Chlorine consumed, %	1.8	1.8	1.8
pH	7.0	7.0	6.9
Hypo Stage II :			
Chlorine applied, %	0.5	0.5	0.5
Chlorine consumed, %	0.4	0.36	0.36
pH	7.5	7.4	7.5
Total chlorine applied, %	8.2	8.2	8.2
Total chlorine consumed, %	6.9	7.1	7.2
Brightness, % (Elrepho)	80.0	80.0	79.8
Viscosity, cp. (0.5% CED)	14.8	12.9	14.4
Shrinkage, %	7.2	6.5	6.6

*MHW = 70% Mixed hardwoods
+30% Eucalyptus hybrid.

Constant Conditions :

	Chlorination	Alkali Extraction	Hypo I	Hypo II
Consistency, %	3.5	5.0	10.0	10.0
Temperature, °C	30	50	45	45
Retention time min.	30	60	60	90
Sulphamic acid, % (on pulp)	..	..	0.07	0.03

Standard handsheets having basis weight 60 g/m² of virgin and blended pulps were prepared on the British sheetmaking machine. The sheets were air dried and tested for their strength characteristics. The strength properties of all the pulps were computed to only two slowness levels i.e. 30 and 40°SR for comparison. The results of strength properties of unbleached pulps from JMK of different lots, along with those of Eucalyptus hybrid and MHW are indi-

TABLE–VIII (a). STRENGTH PROPERTIES OF UNBLEACHED PULP OF JMK, EUCALYPTUS HYBRID AND MHW

Cook No.	1		2		3		4		5		6					
	JMK–32 to +3 mm (As such)		JMK–22 to +3mm		JMK–19 to +3 mm		JMK–16 to +3 mm		JMK–13 to +3 mm		JMK –6 +3 mm		Eucalyptus hybrid		MHW	
Slowness, °SR	30	40	30	40	30	40	30	40	30	40	30	40	30	40	30	40
Beating time, Min.	19.0	24.0	21.0	25.5	21.0	26.0	20.5	25.5	19.5	23.5	18.0	23.0	8.0	14.0	16.0	25.5
Drainage time (mould), Sec.	5.0	6.0	5.4	6.6	5.3	7.5	5.3	7.4	5.6	7.0	5.5	7.3	5.5	6.8	5.3	6.5
Drainage time (700 ml), Sec.	19.4	32.7	19.4	33.0	19.5	33.0	19.9	34.0	20.0	32.4	20.5	34.2	..	..	24.0	40.0
Basis weight, g/m²	58.3	58.3	59.1	59.0	58.2	58.7	59.7	59.4	59.2	60.0	58.0	59.1	58.9	59.5	59.7	58.6
Bulk, cc/g.	1.4	1.27	1.37	1.29	1.41	1.28	1.42	1.27	1.38	1.17	1.44	1.34	1.78	1.62	1.80	1.65
Breaking length, Metres	4250	4500	4000	4500	3800	4400	3600	4600	3900	4340	3560	4070	5630	6750	5100	5950
Stretch, %	3.9	4.4	3.8	4.1	3.7	4.4	3.7	4.4	3.7	4.1	3.3	3.7	2.5	3.3	2.8	3.3
Tear factor	87.0	80.0	87.0	81.5	88.0	82.5	87.2	82.0	87.0	88.6	92.0	99.2	81.2	80.9	68.2	67.0
Burst factor	28.0	33.0	27.5	32.5	27.6	33.0	27.0	34.0	28.0	33.3	29.4	35.6	36.9	48.2	30.2	33.0
Double folds (MIT)	16	31	15	25	15	29	15	38	13	28	16	37	42	125	28	52
Strength Index No.	1410	1580	1400	1560	1420	1600	1390	1640	1390	1620	1480	1770	1690	2000	1440	1560

TABLE–VIII (b). STRENGTH PROPERTIES OF BLEACHED PULPS OF JMK WITH DIFFERENT BRIGHTNESS COMPARED TO EUCALYPTUS HYBRID AND MHW PULPS

Particulars	JMK –32 to +3mm (As such)		JMK –16 to +3mm		JMK –16 to +3mm		JMK –16 to +3mm		Eucalyptus hybrid		MHW	
Brightness, % (Elrepho)	79.5		71.0		76.0		80.0		80.3		78.3	
Slowness, °SR	30	40	30	40	30	40	30	40	30	40	30	40
Beating time, Mins.	15.0	19.0	17.0	22.0	15.0	20.0	17.0	21.0	8.0	14.0	11.0	15.0
Drainage time (mould), Sec.	5.0	7.0	5.2	7.0	5.4	7.5	5.2	7.2	6.0	8.0	..	..
Drainage time (700 ml), Sec.	25.0	44.0	..	..	..	..	19.2	37.0	..	..	20.0	37.0
Basis weight, g/m²	58.3	58.1	57.7	58.1	59.6	60.0	58.5	59.8	59.6	59.1	56.9	58.0
Bulk, cc/g.	1.58	1.50	1.70	1.56	1.67	1.55	1.65	1.54	1.68	1.41	1.65	1.50
Breaking length, Metres	3900	4100	3920	4450	3840	4350	3990	4200	5250	7100	4000	4800
Stretch, %	3.8	4.1	3.8	4.3	4.0	4.5	3.9	4.2	3.1	4.1	3.7	4.0
Tear factor	82.8	79.8	83.2	81.6	81.4	79.0	84.7	81.4	81.0	83.0	85.5	82.5
Burst factor	25.0	30.5	32.1	37.9	30.2	36.7	30.0	32.9	36.9	50.8	30.0	35.5
Double folds (MIT)	9	16	14	28	14	27	15	23	47	263	17	25
Strength Index No.	1260	1430	1450	1650	1410	1590	1440	1540	1710	2170	1420	1600

TABLE--VIII(c). STRENGTH PROPERTIES OF THE HANDSHEETS OF PULP BLENDS (BLEACHED)

Particulars	65B + MHW		65B + 35 JMK		65B + 15 MHW + 20 JMK	
Slowness, °SR	30	40	30	40	30	40
Beating time, mins.	12.5	16.5	12.0	15.5	13.0	17.5
Drainage time (mould), Sec.	5.0	8.5	5.0	7.5	5.0	7.5
Basis weight, g/m²	61.0	59.0	59.7	60.0	60.3	59.8
Bulk, cc/g.	1.60	1.53	1.60	1.48	1.60	1.50
Breaking length, Metres	5500	6250	5500	6200	5400	6250
Stretch, %	3.3	3.5	3.4	3.7	3.5	3.7
Tear factor	99.5	90.3	101.5	95.8	97.5	94.5
Burst factor	45.0	49.8	43.5	48.8	45.3	48.5
Double folds (MIT)	157	254	122	205	148	245
Strength Index No.	2140	2215	2095	2200	2125	2220
Wet web strength, Metres	47.5	53.5	35.0	38.0	45.5	53.5

TABLE—IX. RESULTS OF BAUER McNETT FIBRE CLASSIFICATION OF THE BLENDS (BLEACHED)

Fibre retained on mesh no., %	65B+ 35 MHW	65B+ 35 JMK	65B+15 MHW +20 JMK
35	46.8	42.9	44.4
50	11.5	11.8	12.5
100	3.5	3.8	3.6
150	8.9	10.5	9.2
Passing through 150	29.3	31.0	30.3

cated in Table–VIII (a). Table–VIII (b) denotes the results of strength properties of JMK bleached pulps of chip lots –32 to +3mm and-16 to +3mm at different brightness levels in the range 71-80% (Elrepho) along with those of Eucalyptus hybrid and MHW. The strength properties of handsheets of pulp blends i.e. bamboo, MHW and JMK are shown in Table–VIII(c).

The different pulp blends of bamboo, MHW and JMK were subjected to Bauer McNett fibre classification under identical conditions and the results are given in Table–IX.

DISCUSSION

The chip size of the JMK mixture was maintained to have minimum oversize chips. As seen from Table-I, only 1.2% of the chips could be regarded as oversize. These smaller dimensional JMK chips were ideal for pulping.

The chip bulk density of JMK is highest compared to MHW and Eucalyptus hybrid. The results are indicated in Table—II. Bamboo possesses lowest chip bulk density. From the results of proximate chemical analysis of different species as indicated in Table—III, JMK has highest amount of extractives and lignin. It has also lower amounts of holocellulose and alpha-cellulose compared to MHW, Eucalyptus hybrid and bamboo. Because of these characteristics JMK consumes higher amounts of chemicals and also requires severe cooking conditions.

Table -- IV indicates the chip size analysis of different chip lots of JMK and Table — V shows the chip thickness of JMK mixture as such. This has helped in adjusting 'H' factor to have unbleached pulps having similar kappa number from the different lots. The reduction of chip size of JMK helped in reducing the 'H' factor during pulping. The results of cooking experiments shown in Table — VI (a) and Fig. 1 (a) indicate that smaller size chips of JMK at constant alkali charge required lower 'H' factor.

At the level of 22% active alkali, the rejects were rather low (0.4%) even for normal chip size of – 32 + 3 mm. However, the effect of reduction in chip size in reducing the amount of rejects can be clearly seen from Fig. 1 (c).

Fig. 1 (b) shows the increase in yield with reduction of rejects. The kappa numbers of the unbleached pulps obtained from the different lots were in the range 27.5 - 29.0.

A comparative study on normal and smaller size (–16 to + 3 mm) JMK chip lots with normal chip lots of Eucalyptus hybrid and MHW (Table – VI (b) showed that normal size chip lot of JMK

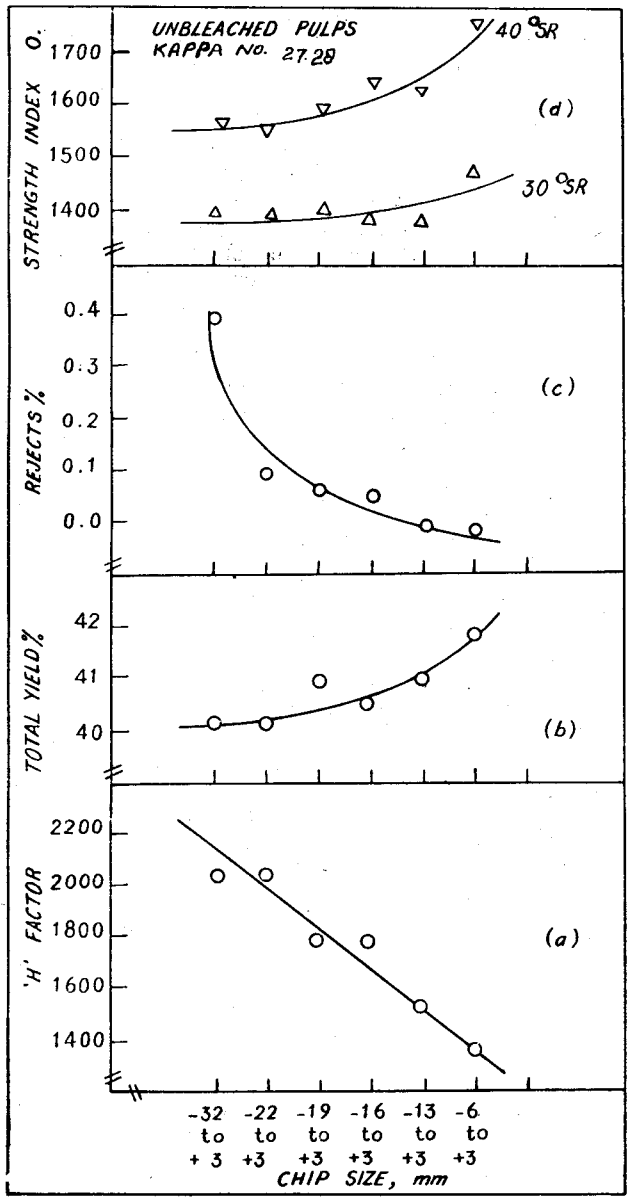

Fig. 1 (a,b,c,d). Influence of Chip Size of JMK Mixture on 'H' Factor, Total Unbleached Pulp Yield, Rejects and Strength Index No. of unbleached Pulps at Constant Kappa Number.

required most drastic conditions as compared to that of smaller size (i.e. — 16 to + 3 mm). But, this chip lot (— 16 to + 3 mm) required higher 'H' factor i.e. 1785 as compared to MHW and Eucalyptus hybrid which was 1445 and 900 respectively. The unbleached pulp yield of smaller size JMK chips was more by 0.5% as compared to the normal chip lot of the same species. But normal chip lot of Eucalyptus hybrid was found to give higher unbleached pulp yield compared to both MHW and JMK.

The bleaching of JMK normal and smaller dimensional chips) is summarised in Table — VII (a). The results are compared with normal chip lots of MHW and Eucalyptus hybrid. From the results it could be observed that the unbleached pulps of JMK and MHW having kappa numbers in the range 27.0 - 30.0 required about 9% chlorine to give bleached pulps of 80% brightness (Elrepho). But Eucalyptus unbleached pulps of identical kappa numbers required about 7% chlorine to give the same brightness. The CED viscosity of bleached JMK pulp was only 6.0 cp. compared to 13.4 of Eucalyptus hybrid. The bleached pulp yield also was less for JMK and MHW compared to Eucalyptus hybrid.

Bleaching of JMK unbleached pulps of chip lot — 16 to + 3 mm has been carried out to three different brightness levels ranging from 71.0 - 80.0% (Elrepho). The results are shown in Table-VII (b). The objective of bleaching these pulps to lower brightness level was to get improved viscosity of these bleached pulps. However, no appreciable change in viscosity of bleached pulps at lower brightness level was noticed.

The mixed bleaching of bamboo and MHW in the ratio 65:35 is being practised in our mill since a few years. In order to find out the possibility of replacing MHW pulps by JMK to a reasonable extent, mixed bleaching of bamboo and JMK (65:35) and bamboo, MHW and JMK (65:15:20) was carried out. The results shown in Table — VII (c) indicated distinct possibility of mixing JMK pulps upto 20% in a mixture of bamboo and MHW (65:15).

The strength properties of unbleached JMK pulps of different chip lots are given in Table — VIII (a), in comparison with those of Eucalyptus hybrid and MHW of normal size. It was observed that the reduction in chip size of JMK mixture did not affect the major strength properties. This could be attributed to the milder cooking conditions i.e. lower 'H' factor employed for pulping smaller size chips of JMK. However, a slight reduction in breaking length was observed when the size of the JMK chips was reduced. Fig. 1 (d) shows that the strength index values of unbleached pulps from chip lots of different sizes were almost unaffected with reduction in chip size except for the very smallest chips of — 6 + 3 mm size, for which a slight increase of the index was observed. The unbleached pulp strength characteristics of JMK normal size chips were, however, slightly inferior to those of MHW chips. Eucalyptus hybrid was proved to be superior in strength compared to both JMK and MHW pulps from normal size chips.

Bleached pulp strength properties of JMK mixture of normal and reduced size chips at three different brightness levels, i.e., 71%, 76% and 80% respectively are given in Table — VIII (b) in comparison with those from Eucalyptus hybrid and MHW at brightness around 80% (Elrepho). For pulps of this brightness,

reduction in chip size from – 32 + 3 mm to – 16 + 3 mm produced a marginal increase in strength properties. The trend was thus similar to that observed for unbleached pulps. With increase in brightness the strength of the bleached JMK pulps deteriorated. The MHW bleached pulps were similar in strength properties to JMK bleached pulps of chip lot – 16 to + 3 mm at identical brightness level. But Eucalyptus bleached pulps have once again shown their superiority over JMK and MHW bleached pulps.

The results on blending experiments of bamboo, hardwoods and JMK are recorded in Table–VIII (c). It was observed that the strength properties of the blend 65% Bamboo + 15% MHW + 20% JMK were comparable to those of the blend 65% Bamboo 35% MHW. From the results of wet web strength of the blends it was observed that addition of 20% JMK pulp to a mixture of bamboo and MHW (65 + 15%) would give satisfactory runnability on the paper machines.

The results of Bauer McNett fibre classification of the blends as recorded in Table — IX confirmed that addition of JMK pulps reduced the amount of long fibre fractions in the blends.

CONCLUSIONS

1. In view of the shortage of both bamboo and accepted mixed hardwoods the so-called not pulpable species like Xylia xylocarpa (Jamba), Terminalia tomentosa (Matti) and Terminalia paniculata (Kindal) can prove useful as raw materials for pulping.

2. This will be possible by utilising JMK chips of reduced size and thickness. The pulp quality will not be deteriorated as the severely of cooking (H-factor) can also be reduced with reduction in chip size.

3. JMK pulps did not pose any problem in bleaching and bleached pulp brightness around 80% (Elrepho) was obtained when bleached by CEHH sequence.

4. The bleached pulp viscosity values of JMK pulps were towards lower side when compared to other mixed hardwood pulps. The same trend was also observed in case of strength characteristics of these pulps of normal chip lot. However, strength properties of both unbleached and bleached pulps of chip lot – 16 to + 3 mm were comparable with those of MHW.

5. Upto 20% JMK pulps can be utilised in the mixture of bamboo and mixed hardwoods and the paper machine runnability will not be affected adversely with this particular blend.

ACKNOWLEDGEMENTS

The authors are thankful to the Management of West Coast Paper Mills Ltd., Dandeli, for allowing them to present this paper in the Annual General Meeting and Seminar, of Ippta at New Delhi on 24–25 March, 79.

REFERENCES

1. Cooking of North Kanara Hardwoods, Bhargava, R.L., Bihani B.L. and Jaspal, N.S., IPPTA Souvenir 1964, p. 313.

2. Evaluation of Jamba, Matti and Kindal for pulping and papermaking, Unpublished work of Research Centre.

3. Effect of chip thickness on the delignification of hardwoods by the Kraft process. Hatton, J.V., Pulp and Paper Canada, June 1978, TR 55.

4. Effect of chip size on the kraft pulping of Canadian hardwoods. Hatton, J.V., Pulp and Paper Canada, June, 1978, TR 49.