Chemical-grade Pulp From Some More Hardwoods From Andhra Pradesh

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The authors have tested three more hardwood species from Adilabad/ Asifabad region of Andhra Pradesh, in continuation of their work reported earlier (1). *Pterocarpus marsupium* or Bija sal, was found to yield a normal bleachable-grade pulp, comparable with that of bamboo (2), but with little fibre retained over 40 mesh sieve.

Butea frondosa or Palas, is a very light wood. Its low bulk density would effect production in hatch digestors. This wood gives very low yield, and unless its cost is suitably compensated, it would prove uneconomical in making cultural papers. *Eucalyptus hybrid*, grown in Kaghaznagar area, gave fairly good quality of bleachable grade pulp, with satisfactory yield & alkali demand economy. Its fibre are shorter and practically none could be retained on 40 mesh sieve in fibre-classification tests. Fibre passing through 80 mesh sieve was also very high, showing that Eucalyptus pulp can not be used economically over coarse wires or in thin papers.

In an earlier communication (1), some 17 species of hardwoods from this region were reported. Further three species were tested for their pulping and paper making properties, particularly for their suitability for manufacture of cultural paper and board, *Pterocarpus marsupium* (Bijasal), Butea Frondosa (Palas) and Eucalyptus Hybrid have been tested and reported here.

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Experimental :

Unbarked logs of all the three species of wood were obtained and debarked by hand in the laboratory, and subsequently chipped in plant chipper. Physical characteristics of each wood are described in table No. 1 below.

These woods were cooked in open-steam-heated rotary digestor of 200 L. capacity, with different quantity of total Active Alkali (T. A. A.), as mentioned in table No. 3, by inpregnation method (or 4-stage steaming process), having a total cooking cycle of 4½ hrs. in each case, as follows:

(i) From room Temp. to 110°c (10 psi) ½ hr.

(ii) At 110°c (2°) or 10 psi 1½ hr.

(iii) From 110°c to 170° c (100 psi) 1 hr.

Table No. 1
Physical characteristics of woods

S. No.	Name of wood Botanical	Local	Appearance of wood & bark	Chipping quality	Bulk density (of chips) Kg/m³(b.d. basis)
1.	*Butea frondosa*	Palas	Bark thin & of light colour. Heartwood portion very little. Wood is of light yellow ish colour.	Soft in chipping	163.57
2.	*Eucalyptus hybrid*	—	Thin light coloured bark, no heart wood (age about 8½ yrs)	Soft in chipping	255.5
3.	*Pterocarpus marsupium*	Bijasal	Light brown coloured thin bark tenaciously adhering. Heart-wood portion very small	Easily Chipping	211.8

(iv) At 170°c (±2°) or 98-100 psi $1\frac{1}{2}$ hr.

Total : $4\frac{1}{2}$ hr.

Dilution ratio, including condensed steam, was maintained around 1:3.5 during cooking. Sulphidity in white-liquor was kept at 16% (±1). After cooking, washing and screening, the fibre characteristics of accepted pulp was tested as given in table No. 2 below.

Table No. 2

Fibre Characteristics of woods tested

S. No.	Name of hard wood	Quality of pulp	Fibre classification			
			% fibre +40 mesh	% fibre —40+60 mesh	% fibre —60+80 mesh	% fibre —80 mesh
1.	Butea Fondosa (Palas)	a) Unbleached	63.4	7.6	1.6	27.4
		b) Bleached	58.5	9.9	2.6	29.6
		Fibre Dimension :	**Max.**	**Ave.**	**Min.**	
		Length (mm)	3.9	1.5	0.45	
		Diameter (microns)	20.0	12.0	4.0	
		Slenderness Ratio :	125.0			
2. a.	Eucalyptus Hybrid (P.No. 13.6)	a) Unbleached	Nil	30.6	7.6	61.8
		b) Bleached	Nil	21.6	11.4	67.0
		Fibre Dimension :	**Max.**	**Ave.**	**Min.**	
		Length (mm)	1.55	0.66	0.40	
		Diameter (microns)	20.0	13.6	12.0	
		Slenderness Ratio :	48.5			
b.	—do— (P.No.18.1)	a) Unbleached	8.6	21.8	19.2	50.4
		b) Bleached	Nil	26.2	19.6	54.2
		Fibre Dimension :	**Max.**	**Ave.**	**Min.**	
		Length (mm)	1.05	0.73	0.375	
		Diameter (microns)	18.7	16.0	12.5	
		Slenderness Ratio :	45.6			
3.	Pterocarpus Marsupium (Bijasal)	a) Unbleached	Nil	48.0	13.2	38.8
		b) Bleached	Nil	43.0	13.8	43.2
		Fibre Dimension :	**Max.**	**Min**	**Ave.**	
		Length (mm)	1.3	0.4	0.812	
		Diameter (microns)	36.0	24.0	20.0	
		Slenderness Ratio :	33.8			

Table No. 3

Cooking conditions Adopted in test cooks.

S. Test No.	Name of wood	Alkali taken % TAA as Na_2O	Total Effec Alkali %as Na_2O	Blow liquor after cooking T°w	°c Temp	Res. Alk. Na_2O gpl	P. No.	Kappa No.	% Unbld yield (on B.D. chips)	% Rej-ects	Visc. in cp (0.5% CED) at 20° c	Cu. No.	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Butea Frondosa (Palas)	18.0	16.5	13.5	72.0	19.2	19.0	32.1	34.3	0.4	19.7	0.95	Pulp is of darker brown colour
2. a.	Eucalyptus Hybrid	16.0	15.0	16	86	22.3	13.6	18.9	44.0	Nil	17.7	0-51	Pulp is of very light brown colour
b.	—do—	14.0	12.8	14.5	89	17.3	18.1	26.3	47.8	0.6	19.7	0.77	Pulp slightly darker than of 2 (a)
3.	Pterocarpus Marsupium (Bijasal)	18.0	16.5	11	79	18.6	19.5	32.5	45.4	0.6	25.3	0.73	Pulp is of very light brown colour

Notes:—(1) All data given above are on b. d. wt. of chips.
(2) Average chip size was 1/4"—2"

Resulting washed and screened unbleached pulp from each test-cook was subsequently bleached by C. E. H. H. system of hypo-bleaching, as given in table No. 4 below.

Table No. 4

Conditions of Bleaching of Hardwoods

S. Test cook No.	Name of wood	Bleaching Stage	Total Cl_2cons. (% on unbld. pulp)	Total Retention time (mts.)	pH maint	% of NaOH taken for extract. on unbled. pulp	Brightness achieved °GE	Bleached yield %(on b. d chips)	Viscosity in cp. at 20°c (0.5% CED)	Cu.No.
1.	*Butea frondosa* (Palas)	i. Chlorination	8.8	30	2–3	—	—	—	—	—
		ii. Extraction	—	60	11.0	2.0	—	—	—	—
		iii. I–Hypo	4.0	180	9–10	0.8	—	—	—	—
		iv. II–Hypo	1.0	180	9–9.5	0.5	78°	26.0	4.8	1.98
		Total :	**13.8**	**7½ hrs.**		**3.3**				
2. (a)	*Eucalyptus hybrid* (P. No. 13.6)	i. Chlorination	7.0	30	2–3	—	—	—	—	—
		ii. Extraction	—	60	11.0	2.0	—	—	—	—
		iii. Hypo	2.0	180	9–10	0.8	84°	38.3	4.2	0.86
		Total :	**9.0**	**4½ hrs**		**2.8**				
(b)	—do—(P. No.) 18.1)	i. Chlorination	8.3	30	2–3	—	—	—	—	—
		ii. Extraction	—	60	11.0	2.0	—	—	—	—
		iii. Hypo	4.5	180	9–10	1.0	84°	44.4	5.6	1.0
		Total :	**12.8**	**4½ hrs**		**3.0**				
3.	*Pterocarpus marsupium* (Bijasal)	i. Chlorination	8.5	20	2–3	—	—	—	—	—
		ii. Extraction	—	60	11.0	2.0	—	—	—	—
		iii. I–Hypo	4.4	180	9–10	1.0	—	—	—	—
		iv II-Hypo	1.5	60	9–9 5	0.5	81°	39.5	3.1	2.45
		Total :	**14.4**	**5 hrs. 20 mts.**		**3.5**				

Remarks:—1. Consistency maintained during bleaching stages was as follows:

a Chlorination stage ... 2–2.5%

b Extraction & Hypo stages 8–9%

2 During bleaching temperature maintained during chlorination & Hypo stages was at room temperature (30°—32° c), and during extraction stage at 70°–75°c

3. Chlorine gas taken for chlorination-stage was nearly 60% of the total chlorine demand.

Standard hand-sheets, as per Tappi specifications, were made from both unbleached and bleached pulps of each wood. Their strength properties were found to be as follows:

Table No. 5

Strength properties of standard Hand-Sheets

T. Test cook No	Name of wood	Quality of pulp	Substance gm/m²	Caliper (mm)	Burst Factor	Tear Factor	Breaking Length (m)	No of Double Folds
1.	*Butea frondosa* (Palas)	(a) Unbleached	65	0.13	24.6	73.8	4103	12.0
		(b) Bleached	63	0.12	15.9	50.8	3704	4.0
2. a.	*Eucalyptus hybrid* (P. No 13.6)	(a) Unbleached	63	0.1	47.6	69.8	7619	98
		(b) Bleached	60	0.1	33.3	46.7	5333	17
b.	—do— (P. No 18.1)	(a) Unbleached	62	0.1	43.5	77.4	5699	56
		(b) Bleached	65	0.1	37.0	64.6	4718	40
3.	*Pterocarpus marsupium* (Bijasal)	(a) Unbleached	64.5	0.11	32.5	55.8	5581	31.5
		(b) Bleached	62	0.125	17.7	41.9	3871	4

Observations and discussions :

1. Butea Frondosa or Palas is a soft variety of hardwood, having nearly 25% to 30% less bulk-density than that of bamboo with 80% Na_2o as T. A. A. It could give a pulp of permanganate number 19.0 with easy bleachability. Unbleached and bleached pulp yield of this wood were very low, being only 24.3% and 26% of b. d. wt. of chips respectively. By C.E.H.H. system of bleaching its pulp could be bleached to a fairly satisfactory brightness of 78° GE, although in this process the pulp properties came down considerably from those of unbleached pulp.

Slenderness ratio of Palas fibre was fairly high, being 125.0, and fibre retained on 40 mesh sieve was fairly good, being 63.4% and 58.5% in case with unbleached and bleached pulps respectively. Due to low strength properties, very low yield and comparatively higher alkali demand than compared with that of bamboo, Butea Frondosa wood may be graded as second grade wood for making bleachable grade pulp and paper. In paper, its fibre can be used as filler with bamboo fibre, if economy of its pulping is suitably compensated for its low yield and alkali demand.

2. Eucalyptus Hybrid wood was found to be easily pulpable and bleachable. Yield of both unbleached and bleached pulps were fairly satisfactory, being 47.8% and 44.8% respectively on the b.d. wt. of chips. Alkali demand was found to be conspicuously low, when with 14% Na_2o as T.A.A. pulp produced possessed the P. No. of 18.1 and with 16% Na_2o it was only 13.6. Bleachability of both pulps was easy. Within 4½ hrs, and only by 3-stage CEHH system, a brightness of 84° GE could be achieved with reasonably lower amount of chlorine. Shrinkage in bleaching was also found low.

Slenderness ratio of Eucalyptus Hybrid fibre was found around 48, approaching to that of Salai wood (2). In fibre classification this wood gave very poor performance, when practically no fibre was found to be retained on 40 mesh sieve, and more than 50% fibre was found to pass through 80 mesh sieve. This showed that even though Eucalyptus Hybrid wood possesses all good properties of pulping, yet it can not be lavishly used as a major fibre furnish for making thin papers or on coarse-wire machine due to its excessive content of fibre passing through 80 mesh sieve. Its use in fibre furnish will only cause increased accumulation of fibres in white water and higher loss of fibre in production.

Eucalyptus Hybrid wood may however, be used for making disso lving-grade pulp, due to its higher pulp yield and low alkali demand characteristics, but for making white paper of lighter weight-as is generally required for cultural papers, use of this wood can be accepted only to a limited extent. This is an important matter to be taken into consideration, when its plantation, for mills producing mostly cultural papers by sulphate process, is taken into account.

3. Pterocarpus Marsupium or Bijasal wood required 18% Na_2o as T.A.A. to give a bleachable grade of pulp of P. No. 19.5. By the conventional CEHH system of bleaching, it consumed 14.4% total chlorine to give a fairly bright pulp of 81° GE. Both unbleached and bleached yield of pulp was quite satisfactory, being 45.4% and 39.5% respectively. Alkali demand of this wood is higher than that of bamboo, hence to keep up pulping economy it is advisable to cook this wood separately.

Strength properties of its pulp, both unbleached and bleached, were better than those of palas. Fibre classification showed that the fibre of this wood is all short enough to pass through 40 mesh sieve. Over 60 mesh, more than 43% fibre could be retained. Proportion of fibre passing through 80 mesh was of course not as high as that in the case of Eucalyptus Hybrid, yet it was comparatively high, being more than 39% slenderness ratio of the fibre was also found to be very low, being only 33. 8.

In view of the properties found, as above, Bijasal pulp can be useful only as a fiibre filler with normal bamboo furnish in the manufacture of cultural papers and board.

Conclusions :

Bijssal and Eucalyptus Hybrid pulps are short fibred, since their retention over 40 mesh sieve is negligible. For manufacturing cultural papers of light weight papers these woods can be used only as fibre-filler to meet raw material shortage or cost economy. In such case a judicious proportionating of these fibres in the furnish has to be made to avoid excessive build-up of fines in machine back water and higher fibre loss in paper making.

Eucalyptus Hybrid having very low alkali demand copmparable to that of bamboo can, however, be cooked and mixed with bamboo. Bijasal needs separate cooking for reasons of its having higher alkali demand.

Palas wood is bulky and very soft. It is very short fibred-pulp yield is also very low, and it is not strong in strength. Its use in paper making in India will depend on its initial pulping economy - which may be dictated by its availability to a mill at a reasonably lower cost, and use in fibre furnish for thick papers and board.

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