Pulping Studies On Eucalyptus Hybrid twigs.

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ABSTRACT

Eucalyptus twigs from locally grown Eucalyptus hybrid were studied alone, mixed with Eucalyptus hybrid (bole wood) 10 : 90 and compared with Eucalyptus hybrid (bole wood) for its pulp and paper making characteristics. Eucalyptus twigs has non-uniform chips quality which results in lower bulk density. The solubilities in Eucalyptus tiwgs i. e 1% NaOH, hot water and alcohol Benzene are towards higher side. The twigs has comparativaly low pulp yield with higher Kappa No. so the bleach demand is towards higher side as compared to Eucalyptus hybrid (bole wood). Eucalyptus twigs pulp has lower fibre length and diameter and thereby the lower L/D ratio as compared to Eucalyptus hybrid (bole wood). The physical strength properties of bleached Eucalyptus twigs pulp i e. Tensile Index' Burst Index and Tear Index are somewhat lower then Eucalyptus hybrid (bole wood) however eucalyptus twigs mixed with Eucalyptus hybrid (bole wood) in the ratio 10 : 90 has similar pulping and bleaching behaviour and equully good physical strength properties as that of Eucalyptus hybrid (bole wood) bleached pulp.

Prediction of a world fibre shortage resulting from increasing demands on diminishing wood supplies[1] have forced the forest based industries to search for additional sources of raw material. To meet future demands for pulp production considerable interest has been shown by the pulp and paper technologists to use hard woods of short rotation and to use tree components other than merchantable bole[2–7].

Because of their high growth rates there has been particular interest in various species of genus Eucalyptus. Eucalyptus are indigenous to Australia but over the past 30 years they have been planted for pulp production in other warm-climate countries such as Brazil, South Africa, Portugal, Spain, Morocco and Argentina[8]. Eucalyptus hybird plantations were also raised in Amlai region on experimental basis during the years 1965-71 covering an area of about 240 hectares Besides using eucalyptus bole for pulp and paper making considerable amount of twigs was available which could possibly be used for pulp and paper making and was investigated in our laboratory studies.

EXPERIMENTAL :

Eucalyptus twigs with bark having girth 8.0—18.5 cms were chipped in a K.M.W, Chipper. The chips were screened in a Wiliam's chips classifier. The results of chips classification alongwith bulk density and specific gravity are compared with Euclayptus hybrid (bole wood) chips[9] in table-1, The proximate Chips classification, bulk density and specific gravity of Eucalyrptus Hybrid twigs and its comparision with eucalyptus hybrid.

TABLE—1

1. Chips Classification (% Retention)

S. No.	Mesh size	Eucalyptus Hybrid twigs	Eucalyptus Hybrid
i.	+ 29	10 27	24.96
ii.	− 29+22	8.37	25.50
iii.	−22+16	18.71	31.70
iv.	−16+10	37.99	16.12
v.	−10+5	16 50	1.23
vi.	−5	12.16	0.49
2.	Accepted chips (%)	61.07	73.32
3.	Rejected chips (%)	38.93	26 68
4.	Bulk density (Kg/m³)	212.22	233.46
5.	Specific gravity (g/cc)	0.51	0.54

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chemical analysis of the twig's dust (—40+60 mesh) was carried out as per Tappi Standard except holocellulose which was determined by Sodium chlorite method and the results are tabulated in table-2. Fibre dimensional studies were carried out under a Projection Microscope and the findings are given in table-3.

TABLE—2

Proximate chemical analysis of Eucalyptus twigs and its comparision with Eucalyptus hybrid.

S. No.	Particulars	Eucalyptus twigs.	Eucalyptus hybrid.
1.	Cold water solubility (%)	2.42	1.40
2.	Hot water solubility (%)	5.06	4.84
3.	1% NaOH solubility (%)	16.92	14.54
4.	Alc/Benzene solubility (%)	2.21	1.80
5.	Pentosan content (%)	13.50	12.40
6.	Lignin (%)*	22.80	23.50
7.	Holocellulose (%)*	73.28	72.50
8.	Ash (%)	0.74	0.50

* Ash corrected.

TABLE—3

Fiber Morphology of Eucalyptus hybrid twigs and Eucalyptus hybrid.

S. No.	Particulars	Eucalyptus hybrid twigs.	Eucalyptus hybrid
1.	Fiber length (mm)		
(i)	Minimum	0.45	0.54
(ii)	Maximum	1.30	1.42
(iii)	Average	0 70	0.84
2.	Fiber diameter (mm)		
(i)	Minimum	0 007	0.008
(ii)	Maximum	0.024	0.027
(iii)	Average	0 013	0.050
3.	L/D Ratio	53.85	05.6

Kraft pulping studies on screened chips of Eucalyptus twigs, were carried out in a 30 litre electrically heated digester having indirect forced circulation using 17% and 18% chemicals (Sulphidity 20.0%) with a cooking cycle of $4\frac{1}{2}$ hours (as per the conditions given in table-4. Eucalyptus hybird (bole)+eucalyptus twigs (90±10) and eucalyptus hybird (bole) were also digested with 18% alkali as per the cooking conditions reported in table-4. The resulting pulps were analysed for a Kappa No. unbleached puip yield and rejects (%)

TABLE—4

Kraft pulping of Eucalyptus twigs chips separately and in admixture with Eucalyptus hybrid and its comparision with Eucalyptus hybrid.

S. No.	Particulars	Eucalyptus twigs Cook No. 1	Eucalyptus twigs Cook No.2	Eucalyptus twigs + E. Hybrids (10:90) Cook No. 3	Eucalyptus hybrid Cook No. 4
1.	Chips taken on O.D. basis (kgs)	2.5	2.5	2.5	2.5
2.	Alkali used % as Na_2O	17.0	18.0	18.0	18.0
3.	Sulphidity (%)	20.0	20.0	20.0	20.0
4.	Bath ratio	1:4	1:4	1:4	1:4
5.	Diluent	Water	Water	Water	Water
6.	Cooking schedule (Wits)				
i)	upto 135°C	120	120	120	120
ii)	From 135-164°C	60	6–	60	60
iii)	At 164°C	90	90	90	90
7. i)	Total cooking time (hrs)	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$
ii)	H factor	1068	1068	1068	1068
8.	Kappa No.	37.73	33.30	31.70	30.61
9.	Screened yield (%) on O.D.R.M.	42.99	42.02	44.05	45.80
10.	Rejects % on O.D.R.M.	2.18	1.74	1.04	0.54
11.	Black liquor analysis.				
i)	°TW at 60 °C	17.0	17 5	18.0	18.5
ii)	R.A.A. g/l as Na_2O	16.25	17.05	18.06	18.75

Black liquor was also analysed for residual alkali and Tweddle.

Eucalyptus twig pulp Cook No. 2 (Kappa No. 33.3), eucalyptus twig+eucalyptus hybird (Cook No. 3 Kappa No. 31.70) and eucalyptus hybird (Cook No. 4, Kappa No. 30.61) were bleached under C/E/H Sequence as per their chlorine demand. The bleaching conditions and results are given in table-5. The fibre classifications of the bleached pulps was carried out in Bauer Mcnett classifier and results are given in table-6.

These bleached pulps of Cook No. 2, 3 and 4 were beaten in a P.F.I. mill for 10,000 revolutions at 10% consistency to attain a freeness of about 47°SR. Standard hand sheets were prepared and tested as per Tappi Standards. The physical strtength properties are recorded in table-7.

TABLE—5

Bleaching of Eucalyptus twigs pulp Eucalyptus twigs + E. hybrid (10:90) pulp and E. hybrid pulp.

S. No.	Particulars	E. twigs pulp (Cook No. 2)	E. twigs + E. hybrid pulp (10:90) (Cook No. 3)	E. hybrid pulp (Cook No. 4)
1.	**Chlorination stage**			
i)	Chlorine applied (%) as available chlorine on O. D. pulp.	7.50	7.50	7.50
ii)	Chlorine consumed (%) on O.D. pulp	7.30	7.15	7.12
iii)	End pH	1.8	1.8	1.8
2.	**Caustic extraction stage**			
i)	Caustic applied (%)	2.5	2.5	2.5
ii)	End pH	10.6	10.5	10.5
3.	**Calcium hypochlorite stage**			
i)	Hypochlorite applied (%) as available chlorine	2.5	2.5	2.5
ii)	Hypochlorite consumed (%)	2.15	1.85	1.85
iii)	pH during bleaching	8.5–9.0	8.5–9.0	8.5–9.0
iv)	End pH	7.7	7.8	7.8
4.	**Final results**			
i)	Total chlorine applied (%)	10.0	10.0	10.0
ii)	Total chlorine consumed (%)	9.45	9.00	8.97
iii)	Brightness of pulp (%) P. V.	78.0	78.0	78.5
iv)	Bleaceed pulp yield on O.D. chips. (%)	39.06	40.08	41.66
v)	Copper No.	1.50	1.45	1.40
vi)	Viscosity (0.5% C E D, Cps)	6.03	6.15	6.20

Constant bleaching conditions :

Stage	Consistency (%)	Temperature°C	Retention time (Mts)
C	3	Room	60
E	5	55±1	60
H	5	40±1	120

TABLE—6

Bauer Mcnett fiber classification of bleached pulps of Eucalyptus tiwgs, E. twigs+E. hybrid (10:90) and comparision with E. hybrid.

S. No.	Mesh size	E. twigs bld. pulp (Cook No. 2)	E. twigs + E. hybrid bld. pulp (10:90) (Cook No. 3)	Eucalyptus hybrid bld. pulp (Cook No. 4)
1.	+20	1.50	1.85	1.96
2.	−20+40	21.62	45.20	65.02
3.	−40+70	52.56	31.50	17.78
4.	−70+100	17.70	13.65	8.00
5.	−100+140	3.65	2.85	1.02
6.	−140	2.97	4.95	6.22

TABLE—7

Physical strength properties of bleached pulps of Eucalyptus twigs, E. twigs+E. hybrid, (10:90) and comparision with E. hybrid bleached pulp.

S. No.	Particulars	E. twigs bld. pulp from Cook No. 2	E. twigs + E. hybrid (10:90) bld. pulp Cook No. 3	E. hybrid bld. pulp Cook No. 4.
1.	Freeness of beaten pulp (°SR)	49	47	47
2.	Bulk (cc/g)	1.38	1.30	1.28
3.	Tensile Index (mN/g)	55.24	56.17	56.76
4.	Burst Index ($KpaM^2/g$)	3.00	3.08	3.14
5.	Tear Index (mNm^2/g)	4.47	4.76	4 96
6.	Double fold (Nos)	70	205	216
7.	Strength Index	1370	1523	1568

DISCUSSION :

A perusal of table—1 shows that the acceptable chips percentage in eucalyptus twigs was lower than eucalyptus hybrid (bole wood) due to the shorter diameter of the twigs and its non uniform chipping. The bulk density of eucalyptus twigs chips was also lower as compared to eucalyptus hybrid (bole wood) as expected due to size variation of the chips.

Proximate chemical analysis of eucalyptus twigs and eucalyptus hybrid detailed in table—2 indicates that the Cold water, Hot water, 1% NaOH and Alcohol/Benzene solubilities in eucalyptus twigs were higher than eucalyptus hybrid (bole wood) which suggest that during Kraft pulping the pulp yield may be lower in eucalyptus twigs. The high extractives u twigs may contribute to higher alkali and bleach consumption during cooking and bleaching respectively[10,11]. The pentosan and lignin content in E. twigs E. hybrid (bole wood) were more or less same. The ash content in eucalyptus twigs was higher than E. hybrid (bole wood).

The fibre dimensional studies reported in table-3 shows that the fibre length and diameter in E. twigs was lower than E. hybrid (bole wood) pulp, and so was the Slenderness ratio of E. twigs fibre.

Kraft pulping studies of eucalyptus twigs and E. hybrid (bole wood) as reported in table-4 shows that the screened yield of E.hybrid (bole wood) was 45.80%,

rejects 0.54% at Kappa No. 30.61 as compared to E. twigs pulp (Kappa No. 33.30), screen yield 42.02%, rejects 1.74, under the same cooking conditions. It was also found that when E. hybrid (bole wood) chips were mixed with E. twigs in 90:10 ratio and digested as per the condition reported in table-4, the screened unbleached pulp yield and rejects percentage were 44.05% and 1.04% respectively at Kappa No. 31.70. The lower unbleached yield in E. twigs may be explained in part by the larger proportion of Non-fibrous cells and higher extractives of branch wood and branch bark[12]. The high Kappa No. in the twigs pulps is indicative of less complete delignification may be the result of the dense branch wood being less readily penetrated by the pulping liquor. Black liquor studies reveals that higher chemical consumption in E. twigs results in lower R. A. A. and Tweddle of the black liquor.

Bleaching studies of E. twigs and E. hybrid (bole wood) reported in table-5 shows that the twig's pulp has higher bleached chemical consumption, lower pulp viscosity than E. hybrid (bole wood) for attaining nearly the same brightness (78% P.V.). The bleached pulp yield of E. twigs (39.06%) was lower as compared to E. hybrid (bole wood) 41.66%. A perusal of table-6 reveals that in twigs pulp the fibre retention was maximum on + 70 mesh whereas in E. hybrid (bole wood) pulp. maximum fibre retention was found on+40 mesh which supports that the fibre length of E. hybrid (bole wood) is higher than E. twigs pulp.

The physical strength properties of E. twigs (cook No. 2). E. hybrid+E. twigs (90:10) and E. hybrid (bole wood) bleached pulps as reported in table-7 shows that E. twigs pulps has higher bulk and some-what lower physical strength properties like tensile index, burst index and tear index than E. hybrid (bole wood) pulp as expected due to variation in Slenderness ratio. The lower physical strength properties of E. twigs pulp are also supported by strength index.

CONCLUSION :

It can be concluded from the present studies that the bulk density of E. twigs chips is lower than E. hybrid (bole wood) due to non-uniform size of the chips which will ultimately affect the packing of the digester. The E. twigs has higher 1% NaOH and Alcohol/Benzene solubilities than E. hybrid. The E. twigs with same alkali dosage results in lower pulp yield, higher rejects percentage than eucalyptus hybrid. The bleach consumption was also on higher side in eucalyptus twigs pulp. The physical strength properties were comparatively lower in eucalyptus twigs pulp than E. hybrid (bole wood) pulp. When eucalyptus twigs were mixed with E. hybrid (bole wood) in 10:90 ratio and digested together it gives comparable, pulp yield, with nearly same bleach consumption and equally good physical strength properties as compared to eucalyptus hybrids(bole wood).

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