S.R.D. Guha
Y.K. Sharma
Om Bahadur

Utilization of *Acacia Planifrons* for Paper Making

Laboratory scale experimunts on production of sulphate pulp from **Acacia planifrons** *are described. Strength properties of standard sheets at 46.2 percent yield were 6.3 km. breaking length, 31.6 burst factor and 105.0 tear factor. The pulp could be bleached using C.E.H. sequence to a brightness of 75 by using 12.5 pereent as total available chlorine. Pilot plant scale trial on production of wrapping paper further confirmed the suitability of* **Acacia planifrons.**

Introduction

The increasing demand for paper year after year has compelled pulp and paper industry to investigate the possibility of utilization of new raw materials available in the nature. In India, available hardwoods can be a potential source of raw material. The main fibrous raw material for pulp and paper industry at present is bamboo. The available surplus resources of bamboo are limited. For the growth of pulp and paper industry it may be essential to not only conserve bamboo but using more and more hardwoods in the furnish by the existing units but also planning new units in such a way that higher percentage of hardwoods form the main furnish. For this the pulping and papermaking qualities of the available hardwoods should be known. Extensive work has been done by the Forest Research Institute & Colleges in establishing suitability of various hardwoods available in India.

In this paper results on investigation on *Acacia Planifrons* for suitability as paper making raw material are recorded.

S.R.D. Guha, Y.K. Sharma and Om Bahadur
Cellulose and Paper Branch, Forest Research Institute, Dehra Dun.

Raw Material

About 2 tonnes of *Acacia planifrons* debarked logs were received from Tirunelveli Range, Tirunelveli, Tamil Nadu State. The logs were chipped in four knife chipper. The moisture content of chips was 12 percent.

Proximate Chemical Analysis

The wood dust passing through 60 mesh and retained on 80 mesh was used for the proximate chemical analysis employing the *TAPPI* standards methods. The results of the analysis are recorded in Table I. For comparision proximate chemical analysis of *Eucalyptus* Hybrid (mostly *E. tereticornis*)[1] is also recorded.

Fibre dimensions

For the determinations, of fibre dimensions, pulp was prepared by digesting chips by the sulphate process ($NaOH : Na_2S :: 3 : 1$) using 14 percent chemicals at 162°C for a period of 4 hours. The pulp was bleached with calcium hypochlorite. The fibre dimensions were measured under microscope by the usual procedures followed in this laboratory. Two hundred measurements were made in each case. Values of the fibre length and diameter are given in Table II. For comparision values of the fibre length and diamenter of *E. hybrid* (mostly *E. tereticornis*)[1] obtained earlier are recorded.

Table–1
Proximate chemical analysis of *Acacia planifrons*

	Acacia planifrons	Eucalyptus
1. Ash	1.26	0.51
2. One percent Caustic Soda Solubility	14.90	16.45
3. Alcohol Benzene Solubility	2.70	1.11
4. Pentosans	15.26	15.75
5. Hollo cellulose	74.25	—
6. Lignin	22.3	28.26

Figures expressed on 100g. oven-dry material

Table II
Fibre dimensions

	Fibre length		Fibre diameter	
	A. planifrons	Eucalyptus	A. planifrons	Eucalyptus
	mm	mm	mm	mm
Minimum	0.602	0.59	0.007	0.007
Maximum	1.638	1.16	0.021	0.021
Average	1.120	0.83	0.014	0.016

Production of pulp

The chips (200 g) were digested by sulphate process (NaOH : Na_2S : : 3 : 1) in a 3 litre stationary autoclave using a material to liquor ratio of 1 : 4. The quantity of chemicals for cooking was varried from 12 to 16 percent on oven-dry chips. The temperature of cooking was kept at 162°C and 170°C. All the digestions were carried out for a period of 4 hours, which included 1.5 hours to raise the temperature of the contents to the maximum temperature. After the digestion, the pulp was washed and screened. Unbleached pulp yield and kappa number of pulps were determined.

The unbleached pulp was beaten in Lampen Mill to about 250 ml (CSF) freeness. Standard pulp sheets of approximately 60 gsm. basis weight were made on the sheet making machine and dried using rings and plates. The air dry sheets were conditioned at 65% RH and 25°C temperature and tested for strength properties. The digestion conditions, unbleached pulp yield, screen rejects, kappa number and strength properties of standard sheets are recorded in Table III.

Bleaching of pulp

Pulp obtained under serial No. 3 of Table III was used for bleaching. Multistage bleaching process using chlorination, alkali extraction and hypochlorite treatment was used. The pulp was washed with water after every stage. The conditions of bleaching are recorded below :

Chlorination stage

(i) Chlorine applied on oven-dry pulp as available chlorine, %	8.5
(ii) Consistency of pulp during treatment, %	3
(iii) pH of pulp during treatment,	2.0
(iv) Period of treatment, minutes,	60
(v) Temperature during treatment, °C	15

Alkali extraction

(i) Caustic soda applied on oven-dry pulp, %	2
(ii) Consistency of pulp during treatment, %	5
(iii) Period of treatment, minutes,	60
(iv) Temperature during treatment, °C	70

Calcium Hypochlorite stage

(i) Calcium hypochlroite applied on oven-dry pulp as available chlorine, %	4
(ii) Consistency of pulp during treatment, %	3
(iii) Period of treatment, minutes	180
(iv) Temperature during treatment, °C	30
(v) pH during treatment,	8-9

The bleached pulp yield was 40.6 percent on oven-dry chips. The bleached pulp was beaten in Lampen Mill to about 250 ml (C.S.F.) and standard sheets of 60 g.s.m. were made. The sheets were air-dried using rings and plates. The air-dried sheets were conditioned at 65% RH and 25°C temperature and tested for strength properties. The results are recorded below :

1. Breaking length, Km = 4.60
2. Burst factor, = 24.1
3. Tear factor, = 48.3
4. Brightness, (MgO=100) = 75

Pilot plant trial

One experiment was conducted on pilot plant to eonfirm the laboratory results. Screened chips were loaded in a vertical stationary, mild steel digester of indirectly heated forced circulation type of 11.2 cubic meter capacity. The condition of pulping was same as given in serial No. 3 of Table III. After digestion the pulp was blown at 2.8 kg/cm² pressure into a blow tank. The pulp was passed over a fiat screen, sand table and washed on a kamyr filter. Wet laps were made on a Fourdrinier paper machine. The unbleached screened yield of pulp was 45.6 percent on oven-dry chips. The rejects were 3.3% on oven-dry chips.

The wet laps were loaded in Banning beater fitted with phosphorbronze tackle on roll and bed plate. The pulp was beaten and rosin soap and alum were added.

Table-III

Pulping of Acacia Planifrons by Sulphate Processes

Sl. No.	Total Chemical as Na_2O	Maximum Temperature	Unbleached pnlp yield on O.D. Chips	Rejects on oven dry material	Kappa number	Breaking length	Burst factor	Tear factor	Folding endurance
	%	°C	%	%		metres			Double folds
1.	12	162	50.4	3.0	41.4	6930	47.6	104.6	376
2.	12	170	49.5	2.7	35.8	6450	38.2	100.0	299
3.	14	162	46.2	0.4	30.2	6300	31.6	105.0	271
4.	14	170	45.4	0.3	29.3	6200	30.0	88.5	120
5.	16	162	44.4	—	28.2	6150	28.3	86 6	95

Unbleached wrapping paper was made on the Fourdrinier paper machine. The details of stock preparation, paper making and strength properties of paper made are given below :

Laboratory evaluation of pulp produced on pilot plant

The unbleached pulp produced on pilot plant was beaten in laboratory valley beater according to *TAPPI* standard T. 200 t-61. Standard sheets of about 60 g.s.m. basis weight were made from the pulps of different freenesses and tested for strength properties. The results are recorded in Table IV.

Blending of pulp

Unbleached pulp produced under the conditions given in serial No. 3 of Table III was used for blending with unbleached bamboo *(Dendrocalamus strictus)* pulp.

The conditions of pulping of bamboo are given below :—

1. Total chemicals as Na_2O, % on oven-dry chips 14
2. Sulphidity, % 25
3. Digestion temperature,°C 162
4. Period of cooking (this includes 1.5 hours to raise the temperature), hours 4
5. Material to liquor ratio 1:4

The unbleached bamboo pulp yield was 46.3 percent on oven-dry chips. The kappa number of pulp was 34.3.

Pulps of *A. planifrons* and bamboo were mixed in different proportion and were beaten in Jokro Mill for same time. The freeness of pulps was arranged 220 ml (C.S.F.). Strength properties of

1. Freeness of unbeaten pulp, ml (C.S.F.)	625
2. Freeness of beaten pulp before addition of chemicals, ml (C S F.)	250
3. Power consumption during beating, KWH/tonne of pulp	700
4. Rosin soap on oven-dry pulp, % as rasin	0.8
5. Alum—on oven-dry pulp, %	6
6. Freeness of pulp after addition of chemicals, ml (C.S.F.)	240
7. pH of pulp after addition of chemicals,	4.5
8. pH of stock in head box,	5.5
9. pH of tray water,	6.0
10. Machine speed, m.p.m.	70
11. Basis weight, g.s.m.	60
12. Breaking length, km.	
a. Machine Direction	4.1
b. Cross Direction	2.0
13. Burst factor,	13.3
14. Tear factor	
a. Machine Direction	66
b. Cross Direction	80

Table–IV

Pulp Evaluation of Unbleached Pulp of Acacia planifrons made on pilot plant

Sl. No.	Time of Beating (minutes)	Freeness of pulp ml (C.S.F.)	Breaking length metres	Burst factor	Tear factor
1.	0	650	1790	7.4	37.0
2.	15	620	2530	10.4	62.7
3.	30	580	2740	12.7	70.0
4.	45	525	3260	17.1	71.8
5.	60	475	3450	18.7	73.4
6.	90	430	4110	25.0	100.0
7.	75	380	4020	23.4	90.4
8.	105	340	4250	27.0	100.0
9.	120	250	4940	33.8	108.4
10.	135	190	4940	36.3	111.0

blends are given in Table V. Strength properties of 100% *A. planifrons* pulp and 100% bamboo pulp beaten for same time are also recorded in the table.

Discussion and Conclusions

1. It could be seen from Table I that *Acacia planifrons* has higher ash content and lower lignin content than *Eucalyptus*.

2. The fibre length of *Acacia planifrons*, as given in Table II, is higher and fibre diameter is lower than Eucalyptus.

3. It could be seen from Table III that unbleached pulps in higher yield and satisfactory strength properties could be prepared from *A. planifrons* under the conditions studied. Condition reported in Sl. No. 2 of Table III are optimum.

4. The pulp prepared under optimum condition could be bleached to satisfactory brightness using multistage bleaching process.

5. Pilot plant scale trial confirmed the suitability of *Acacia planifrons* for paper making. Under the conditions tried on pilot plant unbleached wrapping paper could be made. The paper ran smoothly. However, on wider machines running at higher speed some admixture of long fibred pulp may be necessary for smooth operation of the paper machine.

6. Pulp evaluation in valley-beater as given in Table IV, indicates that the strength of standard pulp sheet increases with increased beating.

7. It could be seen from Table V that the strength development of *Acacia planifrons* pulp is more in Jokro Mill than valley-beater when compared with the results recorded in Table IV. When the pulp is blended with bamboo pulp the tear factor of the pulp increases.

Table–V

Strength Properties of Bamboo pulp–A. planifrons pulp blends

Sl. No.	Proportion of pulps	Breaking length km.	Burst Factor	Tear Factor
1.	100% Bamboo	7.43	40.6	101.7
2.	80% Bamboo & 20% A. planifrons	7.31	40.0	100.0
3.	60% Bamboo & 40% A. planifrons	—	40.5	82.0
4.	40% Bamboo & 60% A. planifrons	7.50	39.7	81.2
5.	20% Bamboo & 80% A. planifrons	7.95	38.8	80.0
6.	100% A. planifrons	8.04	37.1	68.2

References

1. Guha, S.R.D., Man Mohan Singh, Mathur, G.M., Sharma, Y.K., Krishan Kumar and Thapliyal, R.C. Proceeding of the "Symposium on utilization of Hardwoods for Pulp & Paper" held at the Forest Research Institute Dehra Dun, on 1st, 2nd & 3rd August, 1968, pp. 103–112.