

# Kadam - A Potential Fast Growing Fibre Source for Paper Industry

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## ABSTRACT

*Kadam is a promising hardwood species suitable to Black soil. In this article, laboratory evaluation results of Kadam of 2,3 and 4 years age from the experimental plantation are presented. Except for marginally lower yield, pulp quality of 4 years old kadam is found to be comparable to subabul and casuarina.*

## INTRODUCTION

One of the stumbling blocks for the Indian paper industry is availability of required cellulosic fibrous raw materials. Due to nonavailability of forest based raw materials, industry is left with no other option except to bank on pulp wood plantations through farm forestry. As long gestation periods are not economical for farmers, identification of fast growing short rotation wood species has become necessary for successful farm forestry programme. In this direction APPM started Farm Forestry programme in 1989 itself and some of the fast growing wood species, Casuarina (Casuarina Equisetifolia) and Subabul (Leucaena Leucocephala) were identified and propagated successfully for pulp wood plantations. Company's Farm Forestry activities as a means of ensuing abundant future supply of pulp wood and eco-friendly approach continued vigorously. Around 26.3 million Casuarina seedlings and subabul stumps were distributed during the year 2001 to the farmers in the Coastal districts of Andhra Pradesh. As a continuing effort of identification of new fast growing fibrous raw materials APPM has tried Kadam (Anthocephalous chinensis) in experimental plantation.

## EXPERIMENTAL

### Pulping

Kadam wood from the experimental plantation was harvested at the intervals of 2, 3 and 4 years age. The material was chipped in mill's chipper without debarking. Pulping of wood was carried out in laboratory digester under conditions mentioned in

Table-1. The pulp was screened in laboratory slotted screen and computed the total yield and screened yield. The kappa number of the screened unbleached pulp was determined as per T 236 method. The unbleached pulp viscosity (0.5% CED) was determined after chlorite treatment.

### Bleaching

Bleaching of unbleached pulp of Kadam of 4 years old was carried out in C/DEpDED sequence as per conditions given in Table-3.

### Pulp evaluation

Evaluation of unbleached and bleached pulps were carried out by beating in PFI Mill to get  $40 \pm 1^\circ\text{SR}$ . Hand sheets were tested for strength properties as per TAPI standard methods.

### Wood growth

In black soil and under temperate (22-42°C) climatic conditions at two years of age the average plant girth of Kadam is 28 cms with a wood density (as such) of 0.81 T/cu.m After 3 years of age the average girth was 32 cms with an increased wood density of 1.85 T/cu.m with an average tree height of 6.9 meters. The average fibre length of Kadam of 4 years age is 1.18 mm which is marginally higher than Subabul (1.05mm) and Casuarina (0.87mm).

### Observations

Laboratory evaluation results of Kadam with bark of 2, 3 and 4 years age from the experimental plantation are presented in Table.1

The bulk density of chips (B.D. basis) increased with age (157 to 196 kgs/cu.m). Though no much

Table 1. Pulping results of Kadam with bark (different ages)

Particular	Unit	2 years	3 years	4 years
Bulk density, (B.D. Basis)	Kgs/cu.m	157	166	196
Active alkali	%	15.25	15.25	17.25
Sulphidity of W.L	%	18.9	21.1	19.8
Cooking temperature	°C	165	165	160
H- Factor		1060	1060	890
Kappa number		26.8	24.7	20.5
Total yield	%	45.1	45.7	47.0
Screened yield*	%	43.6	43.4	46.8
Effective yield	%	44.3	44.4	46.9
Unbld. Pulp Viscosity	Cps	25.4	29.3	28.1
<b>Unbld. Pulp Evaluation at 40 ± 1'SR</b>				
PFI revolutions	No.	1800	2100	2500
Burst index	kPa m <sup>2</sup> /g	4.3	4.2	4.5
Tensile index	Nm/g	68.3	67.4	63.2
Tear Index	mNm <sup>2</sup> /g	5.6	6.2	6.7
* Effective yield = [Screened yield + (Rejects x Screened yield x 0.01)]				

Table 2. Pulping results of Kadam Vis-a-Vis subabul and casuarina

Particular	Unit	Kadam 4 years with bark	Earlier Data	
			Subabul 4-5 years with bark	Casuarina 4-5 years with bark
Bulk density, (B.D. Basis)	Kg/cu.m	196	191-200	196-234
Active alkali	%	17.25	15.25-16.5	15.25-16.5
Cooking temperature	°C	160	160-165	160-165
Kappa number		20.5	23.6-28.3	18.7-23.2
H- Factor		890	930-1060	930-1060
Total yield	%	47.0	49.8-51.9	47.1-51.2
Screened yield	%	46.8	47.6-50.6	46.2-50.2
Effective yield	%	46.9	48.2-51.3	46.6-51.0
Unbld. Pulp Viscosity	Cps	28.1	20.6-24.0	16.4-22.0
<b>Unbld. Pulp Evaluation at 40 ± 1'SR</b>				
Burst index	kPa m <sup>2</sup> /g	4.5	3.9-4.3	3.7-4.3
Tensile index	Nm/g	63.2	61.2-67.4	56.9-65.6
Tear Index	mNm <sup>2</sup> /g	6.7	6.4-6.9	6.1-6.4
Fibre Dimensions				
Fibre length, Avg	mm	1.18	1.05	0.87
Fibre diameter, Avg	microns	19.1	16.07	13.23
Slenderness Ratio	L/d	61.8	65.3	65.7
* Effective yield = [Screened yield + (Rejects x Screened yield x 0.01)]				

Table 3. Bleaching results of Kadam with bark (4 years age) - C/DEpDED sequence

Particular	Unit	KADAM	Earlier Data	
			Subabul	Casuarina
Kappa number		20.5	22.6	23.5
Chlorination (C/D)				
Chlorine dosage	%	3.075	4.138	5.525
Chlorine dioxide	%	0.39	0.53	0.45
<b>Extraction (E/P)</b>				
Alkali %	2.0	2.0	2.0	
Peroxide, (50%)	%	1.2	1.2	1.2
Brightness (ISO)	%	62.5	63.4	60.1
<b>Dioxide (D1)</b>				
Dioxide	%	0.6	0.5	0.6
Alkali as buffer	%	0.2	0.15	0.2
Brightness (ISO)	%	82.0	83.4	82.5
<b>Extraction (E2)</b>				
Alkali %	0.5	0.5	0.5	
<b>Dioxide (D2)</b>				
Dioxide	%	0.4	0.3	0.3
Sulphur dioxide	%	0.1	0.1	0.1
Total Chlorine	%	3.075	4.135	5.525
Total dioxide	%	1.39	1.33	1.35
<b>Final pulp optical properties</b>				
Brightness, (ISO)	%	86.7	86.0	86.8
Yellowness, ASTM	%	1.1	2.92	2.8
Whitness, Berger	%	80.2	76.2	76.2
Viscosity (0.5% CED)	cPs	14.6	14.6	13.8
<b>Pulp evaluation at 40 ± 1*SR</b>				
Burst index	kPa m <sup>2</sup> /g	4.7	5.2	3.9
Tensile index	Nm/g	71.1	78.9	61.1
Tear index	mN m <sup>2</sup> /g	5.6	7.0	5.3

Note: Bleaching conditions adopted

Chlorination	3% Cy, Ambient Temperatures, 45 minutes reaction time
Extraction (E/P)	10% Cy, 65°C, 65 minutes reaction time
Dioxide (D1)	10% Cy, 70°C, 180 minutes reaction time
Extraction (E2)	10% Cy, 65°C, 60 minutes reaction time
Dioxide (D2)	10% Cy, 70°C, 180 minutes reaction time

improvement in unbleached total pulp yield from 2 years to 3 years age (45.1 % to 45.7%), about 1.3% yield improvement (47%) was observed in case of 4 years wood. Unbleached pulp strength properties, especially tear index increased with age (5.6 to 6.7

mNm<sup>2</sup>/g).

#### Pulping of Kadam Wood with bark (4 years age)

The pulping results were compared with established wood species viz., Subabul with bark and Casuarina

with bark of 4-5 years age.

The chip bulk density (on BD basis) of Kadam wood (196 kgs/cu.m) is on par with Subabul wood (191-200 kgs/cu.m) but slightly less than Casuarina wood (196-234 kgs/cu.m).

The slightly higher chemical and lower H- factor tried indicat that the pulpability of Kadam will be more or less onpar with Subabul and Casuarina at nearly equal kappa number.

The total yield of Kadam wood is low (47.0%) compared to both Subabul and Casuarina yield of about 49-50%. The unbleached pulp strength properties are comparable to those of Subabul and Casuarina.

The total chlorine requirement for bleaching is less compared to Subabul and Casuarina for achieving same level of pulp brightness. The bleached pulp strength properties are marginally lower than Subabul and higher than Casuarina.

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## CONCLUSION

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Black soil and temperate climatic conditions suit to Kadam wood. Compared to both Subabul and Casuarina pulp yield of Kadam wood is less by 2-3%. However, final evaluation is to be carried out after 5th years. Over all pulp strength properties are marginally better than Casuarina and comparable to Subabul. Kadam appears to be one of the potential short rotation fibrous raw materials, which the Indian Pulp and Paper Industry can seriously consider to meet it's ever growing fibrous raw material demand.

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