Investigation on the Possibility of Making Sulphate Pulp from Rubber wood (*Hevea Brasiliensis*)

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An investigation was made to determine the possibility of making sulphate pulp from rubber wood (*Hevea brasiliensis*). The pulp obtained was low in yield and the permanganate number was very high ranging from 12.35 to 24.44 predicting a high bleach requirement. The physical strength properties of the pulps were moderate. Rubber wood pulp showed promise to be used for making moderate quality wrapping, bag and average quality printing papers.

রবার গাছের কাঠ হইতে সালফেট মণ্ড তৈয়ারীর সম্ভাবনার উপর নিরীক্ষা চালানো হইয়াছে। এইভাবে প্রস্তুত মণ্ডের উৎপাদন কম এবং ইহার পারমাঙ্গানেট নম্বর খুব বেশী—১২.৩৫ হইতে ২৪.৪৪ যার অর্থ বিরঞ্জনের মাত্রাও খুব বেশি করিতে হইবে। মণ্ডের বিভিন্ন শক্তি মাঝামাঝি মানের। রবার কাঠের মণ্ড হইতে মাঝারি মানের মোড়ক কাগজ, থলি এবং মধ্যম মানের মুদ্রণ কাগজ তৈয়ারীর সম্ভাবনা আছে।

INTRODUCTION

Rubber wood (*Hevea brasiliensis*) grows in dense moist forest on deep rich soil at low elevations, often inundated lands under high atmospheric humidity and great uniformity of temperature. The rainfall needed is 80 inches or above. It has glabrous trifoliate leaves on long petioles. In 1873 seeds were procured from the Amazon and planted successfully in three regions : Southern India, Burma and the Andamans (Troup 1921).

Usually, in the beginning the yield of latex is comparatively low but gradually towards the age of 25-30 years the yield becomes maximum. At the age of about 50-60 years the yield of latex becomes too low and it does not seem to be economic to continue any further tapping.

Rubber plantations have been conducted on an experimental basis in the Chittagong Hill Tracts and Cox's Bazar of Bangladesh. They grow there successfully and tapping has been started at seven years of age.

The present investigation was undertaken with a view to establishing the source of cellulose from rubber wood after the tapping is over, for the manufacture of paper pulp.

MATERIALS AND METHOD

The rubber wood log used in this experiment was freshly cut in Hazarikhil, Chittagong and was received in the laboratory with bark on. The log was 19.5″ in girth at the butt end, 45.5″ in length and the tree was reported tobe 14 years old. It was hand peeled and converted into 5/8″ chips in the laboratory chipper. Before pulping the oversized and undersized chips were removed. The moisture content of the chips was determined.

Samples were collected from the chips by way of random selection. The chips were macerated in a maceration solution (1 : 3 nitric acid and 10% chromic acid). Temporary slides were made from the macerated fibres after thoroughly washing them with distilled water. Of the morphological properties, fibre diameter, cell wall thickness and lumen diameter were measured by means of a microscope from the slides. Runkel ratio, flexibility coefficient and relative fibre length were then calculated (Razzaque and Siddique 1968). The results are shown in Table 1.

Table 1 Fibre dimensions and other morphological properties of rubber wood

Fibre length (av) mm	Fibre dia. (av) mm	Cell wall thick-nsss(av) mm.	Lumen dia. mm	Runkel ratio	Flexibility coefficient	Relative fibre length
1.375	0.0221	0.004507	0.0131	0.69	0.592	62.21

All the sulphate pulping experiments were carried out in steam jacketed cylindrical, tumbling digesters of 0.8 cubic foot capacity indirectly heated with steam. Air dry chips equivalent to 1500 gms oven-dry chips were used for all digestions. After cooking for the predetermined time, the pulps were washed and screened in a Johnson vibratory screen. Then the yield and permanganate number were determined for each pulp.

All the digestions were conducted for 120 minutes at 170°C temperature with cooking chemicals containing 15.3% to 24.5% active alkali at 17.5% to 25.5% sulfidity. The time spent to reach the temperature in all cooks was 60 minutes. The liquor to wood ratio was 4 : 1 in all cooks. The cooking conditions and results are shown in Table 2.

Table 2 The cooking conditions and results of sulphate pulping of rubber wood

Serial No.	Active alkali*	Sulphidity.	Weight of chips.	Total vol. of liquor.	Time to temp.	Time at temp.	Chemical consumption.	Yield: Screened.	Yield: Screenings.	KMn04 No.
	%	%	gm	ml	min	min	%	%	%	
162K	19.1	24.8	1500	6000	60	120	77.52	41.07	0.60	20.51
163K	19.5	20.4	1500	6000	60	120	85.22	39.12	0.73	22.16
164K	15.3	19.5	1500	6000	60	120	95.63	45.60	1.30	24.44
165K	24.5	25.5	1500	6000	60	120	75.44	36.44	0.26	12.35
166K	17.5	20.0	1500	6000	60	120	87.70	44.26	0.84	22.88
167K	17.5	17.5	1500	6000	60	120	85.66	43.42	1.00	23.40

*—Moisture free wood basis.

The strength properties of the pulps were determined on test sheets prepared after beating the pulp in a valley beater machine for different durations. The hand sheets made were kept for 24 hours in a testing room at 72+1°F and 50±1% relative humidity. All the sheets were tested according to TAPPI standards. Results are shown in the tables 3 and 4.

Table 3 Strength properties of sulphate pulp of rubber wood at 450 C. S. F.

Sl. No.	Active alkali.	Sulphidity	Density	Tear Factor	Burst Facrtor	Breaking length	Folding end.	Beating time
	%	%	gm/cc			metre	df	min
162K	19.1	24.8	0.63	72.0	56.1	81.03	433	20.0
163K	19.5	20.4	0.68	78.0	62.3	8800	1500	18.5
164K	15.3	19.5	0.72	66.0	63.0	9200	770	23.0
165K	24.5	25.5	0.59	66.0	36.3	5800	225	20.5
166K	17.5	20.0	0.60	92.0	57.1	7620	1430	25.0
167K	17.5	17.5	0.63	84.0	54.2	7890	2430	23.0

Table 4. Strength properties of sulphate pulp of rubber wood at 250 C. S. F.

Sl. No.	Active alkali	Sulphidity	Density	Tear factor	Burst factor	Breaking length.	Folding end.	Beating time.
	%	%	gm/cc			meter	df	min.
162K	19.1	24.8	0.74	57.0	62.0	8990	760	37.5
163K	19.5	20.4	0.74	69.0	76.0	10150	650	30.3
164K	15.3	19.5	0.75	71.0	62.0	10680	974	33.6
165K	24.5	25.5	0.71	65.5	47.5	6750	860	37.0
166K	17.5	20.0	0.64	90.5	75.0	9280	4070	42.0
167K	17.5	17.5	0.72	79.0	66.3	8830	4800	37.0

DISCUSSIONS

From the morphological data, it is seen that the Runkel ratio is less than unity which indicates that the pulp may be suitable for paper making industries. The flexibility co-efficient does not predict better tensile strength for the paper as the value is less than the standard value. Relative fibre length indicates that the pulp should have good tearing resistance.

The amount of chemical required to produce pulp from rubber wood was about the same as that for other hard woods previously tried in this

Table 5. Comparison of strength properties of sulphate pulp of rubber wood and other hard wood sulphate pulps prepared in Forest Research Institute

Sl. No.	Species	Active alkali	Sulphi dity	Yield of pulp	KMnO 4 No.	C. S. F.	Beating time	Burst ractor.	Tear factor	Break-ing length	Density
		%	%	%		min.	min'			meter	gm/cc.
1.	Civit	14.95	15.10	52.50	13.53	450	23	36.00	84	55780	2.33
						250	43	64.03	95	8390	1.67
2.	*Albizzia Moluccana*	15.06	17.24	49.38	9.02	450	20	88.80	85.0	10400	0.74
						250	47	103.00	72.3	12700	0.81
3.	Simul	15.00	20.23	46.70	22.50	450	20	40.83	103.0	6410	0.40
						250	32	50.66	100.0	7710	0.63
4.	Minjiri	20.00	20.00	43.40	36.1	450	20	24.43	9.5	4500	4.76
					(kappa)	250	40	40.05	84.1	7000	5.54
5.	Rubber	17.50	20.00	45.10	22.88	450	25	57.10	92.0	7620	0.60
						250	42	75.00	90.5	9280	0.64

Institute (Table 5). It appears from tables 3 and 4 that the yields of fully cooked sulphate pulp are less than 46%. The amount of screening reject is satisfactorily low ranging from 0.26% to 1.3%. The pulps produced by sulphate process are very dark in colour. Probably the pulps have high lignin content and their high permanganate numbers indicate their high bleach requirement. The chemical consumption of the chips is satisfactory. The use of less chemical in pulping seems to be the best way of increasing the pulp yield to 45.6%. The use of high chemical concentration (Active alkali 24.5% at sulphidity 25.5%) results in low yield of pulp (36.44%).

The strength properties of the pulp are moderate (Tables 3 and 4). The increase of chemical upto 24.5% results in decrease of paper strength. The burst factor falls rapidly at 24.5% resulting in decrease of paper strength. Some trend is also observed in the burst factor at 24.5% active alkali in comparison with other cooks. Tear factor and breaking length are not so encouraging at higher chemical concentrations. There is an improvement of strength properties at 19.5% active alkali at 20.4% sulphidity but the yield obtained at this concentration is not satisfactory. In consideration of yield and strength properties cook No. 166K is more promising than cook No. 163K and other cooks.

CONCLUSIONS

1. Rubber wood (*Hevea brasiliensis*) can be converted into pulp by the sulphate process. The optimum cooking chemical concentration has been evaluated to be 17.5% active alkali at 20.0% sulphidity.

2. The permanganate number of the pulps is very high which indicates a high bleach requirement.

3. Moderate quality wrapping and corrugated board can be manufactured with the rubber wood sulphate pulp.

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