CHEMICAL PULPS AND WRITING AND PRINTING PAPERS FROM *CHIR* (*PINUS LONGIFOLIA* ROXB.)

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SUMMARY

Laboratory experiments on the sulphate pulping of *chir* (*Pinus longifolia*) are described. One pilot plant experiment is also described. The average fibre length of the pulp was 3·60 mm. and the average fibre diameter was 0·052 mm. Easy bleaching pulps in good yields were obtained. Printing paper made on the pilot plant was characterized by good formation and satisfactory strength properties. A sample of printing paper is appended to this bulletin.

INTRODUCTION

In foreign countries coniferous woods are chiefly used for the production of paper. The paper-making value of conifers depends mainly on their long fibres, the average fibre length being 3 to 5 mm. Broadleaved woods have short fibres, 0·7 to 1·5 mm., in length and, therefore, their pulps require to be blended with long-fibred pulp in the manufacture of paper. So far methods for the economic extraction and transport of fir and spruce growing in the rugged interior terrain of the Himalayan region have not been worked out. However, one species of pine, viz., *Pinus longifolia* (*chir*) growing on the outer Himalaya and Siwalik Range and also in valleys of principal Himalayan rivers at 1,500–7,500 feet extending west to Afghanistan and east to Bhutan is more easily extractable. It is at present used for the manufacture of sleepers. Results of the investigation on the suitability of this species for the production of writing and printing papers are described in this bulletin.

THE RAW MATERIAL

For this investigation, logs of *chir* 10 to 12 feet in length and 9 to 13 inches in diameter were obtained from the Demonstration Area of this Institute. The logs were taken from trees of about 25 years age. The logs were chipped and used for the pulping experiments. Some chips were converted into dust for proximate chemical analysis.

PROXIMATE CHEMICAL ANALYSIS

The wood dust passing 60-mesh and retained on 80-mesh was used for proximate chemical analysis by the Tappi standard methods. The results of analysis are recorded in Table I. The moisture content of the dust was 7·55% (on the basis of the dust used for the analysis).

TABLE I

Proximate chemical analysis of Pinus longifolia

		% on oven-dry basis
1.	Ash	0·25
2.	Cold water solubility	1·62
3.	Hot water solubility	3·36
4.	1% NaOH solubility	13·19
5.	Ether solubility	3·41
6.	Alcohol-benzene solubility	2·15
7.	Pentosans	7·23
8.	Lignin	28·56
9.	Cellulose (Cross and Bevan)	53·46

The results recorded in Table I indicated that *Pinus longifolia* was a suitable raw material for investigating its suitability for paper pulp.

FIBRE DIMENSIONS

For the determination of fibre dimensions, pulp was prepared by digesting the chips by the sulphate process ($NaOH : Na_2S = 3 : 1$) using 26% chemicals in a concentration of 65g. per litre at 162°C., for a total period of 8 hours. The pulp was bleached with bleaching powder. The fibre dimensions were measured under the microscope by the usual procedure followed in this laboratory. Two hundred measurements were made in each case. Values for the fibre length and diameter are given in Table II. The fibre length distribution is given in Table III and the fibre diameter distribution in Table IV.

TABLE II

Fibre dimensions

	Fibre length mm.	Fibre diameter mm.
Minimum	1·06	0·031
Maximum	7·52	0·125
Average	3·60	0·052

The ratio of average fibre length to diameter = 69 : 1.

TABLE III

Fibre length distribution

Fibre length mm.	Number of fibres	% of fibres
1·00 to 2·30	52	26·0
2·31 to 3·60	71	35·5
3·61 to 4·90	42	21·0
4·91 to 6·20	24	12·0
6·21 to 7·50	11	5·5
TOTAL ...	200	100·0

TABLE IV

Fibre diameter distribution

	Number of fibres	% of fibres
0·030 to 0·040	67	33·5
0·041 to 0·060	78	39·0
0·061 to 0·080	43	21·5
0·081 to 0·100	6	3·0
0·101 to 0·130	6	3·0
TOTAL ...	200	100·0

PRODUCTION OF PULP

The chips (270g.) were digested by the sulphate process ($NaOH : Na_2S = 3 : 1$) in a 3 litre, electrically heated, vertical, rotary digester (Deutch and Neumann Make) using a material-liquor ratio of 1 : 4. The pulp was washed on a 66-mesh sieve. Permanganate number of the unbleached pulp was determined using TAPPI method. The pulp was bleached with bleaching powder in two stages. The first stage of the bleaching was carried out at 35°C. with about 75% of the total bleach requirement. After the first stage of bleaching, the pulp was washed and treated with 2% caustic soda (on the basis of oven-dry pulp) at 70°C. for 1 hour. The pulp was then washed and bleached with bleaching powder.

The bleached pulp was beaten in the Lampen Mill to about 300 c.c. (C.S.F.) freeness. Standard pulp sheets were made from this beaten pulp on the sheet making machine and dried in the air using rings and plates. The pulp sheets were conditioned at 65% R.H. and 74°F. and tested for their strength properties.

The digestion conditions, pulp yields, bleach consumption and strength properties are recorded in Table V.

PILOT PLANT TRIALS

In order to confirm that *chir is a suitable fibrous raw material for the production of writing* and printing papers, a pilot plant scale experiment was carried out. About 585 lb., chips (on the basis of the oven-dry weight) were digested in a vertical stationary mild steel digester of forced circulation indirect heating type. The cooking was carried out with 28% chemicals ($NaOH : Na_2S : 3 : 1$) at 170°C. for a total period of 5 hours. This period of cooking included 1½ hours during which the temperature of the digester was raised to 170°C. After the digestion, the pulp was washed in the potcher at 5% consistency and the yield of unbleached pulp was determined. The pulp was then bleached in the potcher with bleaching powder in two stages with an intermediate alkaline treatment. The pulp was washed and the yield of the bleached pulp was determined. The bleached pulp was beaten in the beater at 5% consistency. Rosin size, alum, china caly, ultramarine blue and titanium dioxide were added and the stock was transferred to the machine chest. Printing paper was made on the Fourdrinier machine of the pilot plant which was run at its maximum speed of 50 feet per minute. A sample of this paper is appended to this bulletin.

TABLE V.—*Sulphate digestions of chir (Pinus longifolia) and strength properties of standard pulp sheets*

Digestion Conditions and Pulp Yields									Strength Properties of Standard Sheets Conditioned at 65% R.H and 74°F.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Serial No.	Total chemicals*	Digestion temperature	Digestion period†	Consumption of chemicals*	Unbleached pulp yield*	Permanganate number	Bleach consumption as standard bleaching powder containing 35% available chlorine*	Bleached pulp yield*	Freeness of pulp	Basis weight	Breaking length (Schopper)	Stretch	Tear factor (Marx-Elmendorf)	Burst factor	Folding endurance (Schopper)
	%	°C.	hours	%	%		%	%	c.c. (C.S.F.)	g./sq. metre	metres	%			double folds
1	24	142	6	17·5	60·0	Over 35			Hard cooked.		Not processed further				
2	24	153	6	20·0	51·6	Do.			Hard cooked.		Not processed further				
3	24	170	6	23·1	45·6	..	16·8	43·5	324	61·2	6530	2·7	59·3	34·5	70
4	24	170	8	23·4	42·8	12·8	9·8	40·8	309	62·0	5690	2·6	54·0	22·3	20
5	26	162	8	21·6	42·8	13·2	9·3	41·5	314	60·8	5910	2·4	53·5	26·4	30
6	26	170	8	23·0	40·9	11·3	7·6	38·9	283	58·8	5510	2·3	55·0	21·9	20
7	26	170	5	21·0	42·7	18·9	8·7	40·8	301	62·4	5280	2·4	71·9	25·2	80
8	28	170	3½	20·1	42·3	19·1	11·1	40·0	283	56·8	5120	2·5	57·8	20·2	25
9	28	170	5	21·0	42·3	17·1	8·0	40·2	301	60·2	5500	2·4	59·2	24·8	30

*The % is expressed on the basis of the raw material (oven-dry).
†This includes 1½ hours required to raise the temperature of the autoclave contents to the cooking temperature.

The yields of unbleached and bleached pulps were 39·8% and 39·2%, respectively. The bleach consumption was 8·15%. All these percentages are expressed on the basis of the oven-dry raw material. The formation of the printing paper was good. The strength properties of the printing paper made from 100% *chir* pulp are given in Table VI.

TABLE VI

PILOT PLANT TRIALS

Strength properties of printing paper made from 100% chir. The paper was conditioned at 65% R.H. and 83°F. before test

1.	Freeness, c.c. (C.S.F.)	150
2.	Basis weight g./sq. metre	71·0
3.	Thickness, mils	3·70
4.	Breaking length, metres	
	(*a*) Machine direction	7000
	(*b*) Cross direction	3200
5.	Stretch%	
	(*a*) Machine direction	1·9
	(*b*) Cross direction	5·4
6.	Tear factor (Marx-Elmendorf)	
	(*a*) Machine direction	123
	(*b*) Cross direction	132
7.	Burst factor (Mullen)	23·1
8.	Folding endurance (Schopper), double folds	
	(*a*) Machine direction	1160
	(*b*) Cross direction	1410
9.	Brightness (Photo-volt meter), MgO = 100	68

DISCUSSION

The results recorded in Table V indicate that easy bleaching pulps are not obtainable from *chir* when only 24% chemicals are used. However, when 26% or 28% total chemicals are employed for digestion, under suitable conditions of temperature and period of digestion easy bleaching pulps with satisfactory strength properties for use in the manufacture of writing and printing papers can be prepared. Under the conditions studied, the digestion conditions given in Serial Nos. 7 and 9, Table V are suitable.

The pilot plant experiment confirmed that easy bleaching pulp with satisfactory strength properties can be manufactured from *chir*.

CONCLUSIONS

1. Bleached pulps in satisfactory yields can be prepared from *chir* (*Pinus longifolia*) by the sulphate process.

2. The average fibre length of *chir* is 3·60 mm.

3. Printing paper made on the pilot plant from 100% *chir* pulp had satisfactory formation and strength properties.

4. Since *chir* is long-fibred, its pulp will be particularly suitable for the admixture with short-fibred pulps for the manufacture of paper.

5. Although whole logs of *chir* may not be available at economic prices for paper manufacture, the utilization of *chir* waste left after extraction for sleepers for the manufacture of white writing and printing papers is worth consideration.

NEWS AND NOTES

Indian Council of Agricultural Research, New Delhi

SESBANIA AS GREEN MANURE

Can be Grown in Orissa too

New Delhi: Experiments at the Agricultural Research Station, Sambalpur, show that the popular green manure crop of Madras, *Sesbania speciosa*, can be grown with success in Orissa too.

Dhaincha is already a popular green manure crop of the State, but these experiments show that *Saspeciosa* grows more súculent and stands droughty conditions better than *dhaincha*.

State agricultural officials are now recommending to farmers that they grow *S. speciosa* on field bunds and wastelands for green manure.

They advise that the seed be first sown in nurseries, and when the plants have grown about nine inches high, they be lifted and transplanted.

Where irrigation facilities are available, they advise that the green manure be sown broadcast in the main field itself, but early enough to obtain sufficient green matter for the main crop.

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Shri N. J. Masani, B.E., A.M.I.E., Officer-in-Charge, Timber Engineering Branch, Forest Research Institute and Lecturer in Engineering and Surveying, Indian Forest College, Dehra Dun has been given a 3 months assignment as Timber Engineering Expert under Colombo Plan to advise the Government of Ceylon in the construction of modern timber buildings for the Forestry Field Training School and Double Storeyed Hostel. The designs, drawings and estimate, etc., of the buildings have been prepared in the Timber Engineering Branch, Forest Research Institute, Dehra Dun. The total cost of the buildings is estimated to Rs. 1,54,000.