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Pulping of Pinus Patula

Experiments on the production of sulpnate pulps from **Pinus patula** *are describad. The unbleached pulps of high strength properties suitable for strong kraft papers could be produced. Laboratory experiments on bleaching indicated that satisfactory bleached pulp could be prepared using C.E.H. bleaching sequence. Pilot plant scale trial confirmed laboratory findings. The strength properties of kraft paper produced on pilot plant met the requirements of I. S. grade I kraft as per standard of Indian Standard Institution, I S : 1397–1960.*

Introduction

In order to meet the demand by the end of Fifth and Sixth plans fully from indigenous production, it would be necessary to create a total installed capacity of 15 lakh tonnes and 20 lakh tonnes respectively as against the present built-in capacity of 9,91,000 tonnes. To meet the increasing demand resources of short fibred pulp are available in the country. India's resources of long fibred pulp are considerably ltmited. Bamboo is being utilized to fullest extent and it is unlikely that more bamboo could be made available to industry. To overcome this field trials of several fast growing pines are being undertaken in various parts of the country. *Pinus patula* has given promising results in some areas e.g. West Bengal, Tamilnadu, Uttar Pradesh and Himachal Pradesh[1] *Pinus patula* is a native of Maxico and has been widely planted in Africa and Australia[1]. At the request of the Forest Department West Bengal, an investigation was undertaken to evaluate pulping properties of *Pinus patula* grown in Darjeeling, West Bengal. The results are recorded in this article.

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Raw Material

About three tonnes of debarked *Pinus patula* logs were received from the Forest Division (North). Darjeeling.

Proximate chemical analysis

Wood dust of *Pinus patula* passing through 60 mesh and retained on 80 mesh was used for proximate chemical analysis employing Tappi standard methods. The results of the analysis are recorded in Table I.

Table I

Proximate chemical analysis of *Pinus patula*

	%
1. Ash	0.18
2. Hot water solubility	5.9
3. 1% sodium hydroxyde solubility	14.6
4. Alcohol-benzene solubility	3.1
5. Ether solubility	0.82
6. Pentosans	11.9
7. Lignin	28.7
8. Holocellulose	71.6

Fibre Dimensions

For determination of fibre length and fibre diameter chips were digested by sulphate process (NaOH : Na_2S=3 : 1) using 20% chemicals at 170°C for 4 hours. The pulp was washed and bleached using CEH sequence. The fibre dimensions of the pulp were measured under microscope. One hundred measurements were taken in each case. Values for fibre length and fibre diameter are recorded in Table II.

Table II

Fibre dimensions of *Pinus patula*

Fibre length in mm	Max.	3.2
	Min.	1.6
	Av.	2.42
Fibre diameter in mm	Max.	.028
	Min.	.014
	Av.	.023

Laboratory pulping

200 g (O.D.) of chips were digested by sulphate process in a stationary stainless steel autoclave using material to liquor-ratio of 1:4.5. In all the experiments a sulphidity as 25% maxmum cooking temperature as

170°C, and cooking period as 4 hours, which included 1.5 hours to raise the temperature of the content to maximum temperature, was kept. After the digestion the pulps were washed and screened on a laboratory vibrating screen using a screen plate having 0.35 mm size slots. Unbleached pulp yield, screen rejects and Kappa number of pulps were determined. The screened pulps were beaten to about 250 ml (C.S.F.) freeness and standard sheets of about 60 gsm. were made and dried in air using rings and plates. The sheets were conditioned at 65%RH and 25°C temperature and tested for strength properties. The results are recorded in Table III.

(c) Temperature during treatment, °C 30
(d) Time of treatment, minutes 45
Second stage (Alkali Extraction)
(a) Caustic soda applied on o.d. pulp, % 2
(b) Consistency of pulp during treatment, % 5
(c) Temperature during treatment, °C 70
(d) Time of treatment, minutes 60
Third stage (Hypochlorite treatment)
(a) Calcium hypochlorite applied as available chlorine, % 45
(b) Consistency of pulp during treatment, % 5
(c) Temperature during treatment, °C 30
(d) Time of treatment, minutes 180

The pulp was washed after every stage. Bleached pulp yield was determined. The bleached pulp yield was 44.2% on oven-dry chips. The bleached pulp was beaten in Lampen Mill to a freeness of about 250 ml (C.S.F.) and standard sheets of about 60 gsm. were made. The sheets were dried and tested for strength properties after conditioning at 65% R.H. and 25°C. temperature. The strength properties of standard sheets are given below:—

Breaking length, Km	6.50
Burst factor,	43
Tear factor,	72
Folding endurance, double folds	over 1000
Brightness, (Mgo=100)	70

Pilot plant trial

To confirm the laboratory findings a pilot plant experiment was conducted. The screened chips was loaded in the vertical mild steel indirectly heated forced circulation type digester of 11.2 cubic metre capacity.

The digestion conditions were same as given in Sl. No. 2 of Table III. The pulp after the digestion was blown at 2.8 kg/sq cm. pressure in a blow tank. The pulp was then passed through the coarse screen, sand table and washed over a Kamyr filter. Under these conditions of cooking, the unbleached screened pulp yield was 45.1% and screen rejects were 0.17% on oven dry chips respectively The Kappa number of the pulp was 32.7 wet laps tops were made on the fourdrinier paper machine.

The unbleached pulp produced on pilot plant was beaten in labora-

Table III

Sulphate Pulping of *Pinus Patula*

Sl. No.	Total chemicals %	Temperature °C	Unbleached pulp yield %	Screen rejects %	Kappa number	Strength Properties: Breaking length (m)	Burst factor	Tear factor	Folding endurance (double folds.)
1.	18	170	50.3	1.2	34.6	8570	50.0	116.6	1470
2.	20	170	47.8	0.41	31.4	9160	54.1	127.5	1780
3.	22	170	46.1	0.13	30.7	8750	51 6	120.0	1610

Bleaching of pulp

Pulp prepared under the conditions given in serial no. 2 of table III was bleached by multi-stage bleaching process. The conditions of bleaching are given below:—

First stage (Chlorination)
(a) Chlorine applied as available chlorine on o.d. pulp % 8.5
(b) Consistency of pulp during treatment, % 3

tory according to TAPPI standard T–200 t 61, standarnd sheets of about 60 g.s.m. basis weight were made from the pulp at different freeness and tested. The results are given in table No. IV.

7. Consistency of stock at head box, % 0.4
8. pH of tray water 5.0
9. Machine speed, m.p.m. 55
10. Basis weight, g s.m. 82.4
11. Burst factor 31.7

3. It could be seen from table III that *P. patula* yields pulp in good yield and high strength properties using sulphate process. The pulp could be used as long fibrous component in the furnish.

Table IV

Beating evaluation of Unbleached Pulp produced in Pilot Plant from *Pinus Patula*.

Sl. No.	Beating time minutes	Freeness of pulp ml (C.S.F.)	Breaking length metres	Burst factor	Tear factor	Folding endurance double folds
1.	0	710	4630	21.8	87.5	130
2.	15	680	5470	32.2	96.8	640
3.	30	640	6530	34.9	103.0	820
4.	45	610	6650	40.0	103.6	810
5.	60	570	7610	48.4	110.0	1210
6.	75	510	8080	50.3	107.4	1210
7.	90	450	8200	52.6	118.0	1340
8.	105	390	8561	54.8	116.0	1690
9.	120	300	9070	56.8	117.2	1780
10.	135	240	9260	59.3	133.3	1810
11.	150	190	10,910	61.6	138.9	2100

The wet laps of unbleached pulp were loaded ni wolf beater for beating. After beating rosin soap and alum were added Kraft paper was made on the pilot paper machine. Paper ran smoothly on the machine. The details of stock preparation and paper making are recorded below:—

1. Initial freeness of pulp, ml (C.S.F.) 700
2. Consistency of pulp in beater, % 5.0
3. Freeness after beating, ml (C.S.F.) 310
4. Rosin soap on oven dry pulp, % 2.0
5. Alum on oven dry pulp, % 7.0
6. Freeness after addition of chemicals, ml (C.S.F.) 300
12. Breaking length (metres)
    (a) Machine direction 7850
    (b) Cross direction 4210
13. Tear factor
    (a) Machine direction 122.1
    (b) Cross direction 141.4
14. Folding Endurance (Double Folds)
    (a) Machine direction 1040
    (b) Cross direction 610

Conclusions

1. It could be seen from table I that *P. patula* has low ash.

2. The fibre length of *P. patula* as could be seen from table II is high and could be compared with the fibre length of conifers grown in India.

4. The pulps produced could be bleached to satisfactory brightness using C.E.H. sequence.

5. Pilot plant scale trial confirmed the laboratory findings. The Kraft paper produced on pilot plant had high strength properties The strength properties of paper produced on the pilot plant met the requirements of I.S. Grade I Kraft as per Indian Standard 1397-1960.

References

1. Singh, R.P. "Pinus Patula-A Prospective choice for pulp wood Plantations", *Ippta*, Vol. IX, No. 3, 1972.