Utilisation of Eucalyptus Hybrid (Mysore Gum) Grown in U. P. for the production of Wrapping Paper, Writing Paper and Rayon Grade Pulp.

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Proximate chemical analysis and fibre dimensions of Eucalyptus hybrid (Mysore gum) grown in U.P. have been recorded. Sulphate pulps suitable for wrapping paper have been prepared on the laboratory scale. Laboratory as well as pilot plant experiments for the production of writing and printing papers have shown that such papers can be manufactured from Eucalyptus hybrid. Pilot plant experiments have also shown that the use of Basalt lava beater gives a higher quality of paper. Rayon grade pulps have been prepared from Eucalyptus hybrid by water prehydrolysis sulphate process followed by multistage bleaching in suitable yield and chemical properties.

Introduction :

The total installed capacity for the production of paper in the country is 7,30,000 tonnes per annum out of which in Uttar Pradesh only 34,200 tonnes per annum are produced in the two mills situated in this province. In the country the production of pulp suitable for rayon is only 60,000 tonnes per annum as compared to the present demand of 1,10,000 tonnes annually resulting in the import of this variety of pulp. To increase the production, of pulp and paper in V. Pit is essential that suitable fibrous raw materials should be available in the State at economic price. With this end in view of the forest department of Uttar Pradesh investigated the possibility of growing Eucalyptus species in the State for the production of pulp and paper. After the various trials conducted in the U.P. Silviculturist's nursery. **Eucalyptus hybrid** (Mysore gum) has been chosen for the planting over extensive area in Tarai region of the State in 1962. The area covered under Eucalyptus plantations comes to about 10,343 ha. It is estimated that with a stocking of 1200 trees/ha. an annual yield of about 95.5 tonnes of pulpwood per ha. is expected at the time of harvesting based on measurements made at Lalkua assuming a 10 years felling cycle. Euclayptus wood weighs roughly 7.3 quintals per cu. metre. It is also proposed by the department to exploit Eucalyptus on 10 years rotation. At the request of the Conservator. Research and Development Circle, U.P. investigations have been undertaken in this Institute on the utilization of this wood for the production of pulp and paper. Earlier investigation carried out on **Eucalyptus hybrid** (Mysore gum) grown in Madras State have shown that this wood could yield suitable ground wood pulp for the production of newsprint as well as chemical pulp for the production of writing and printing paper[3].

Raw material :

About 5597 Kg. of **Eucalyptus hybrid** from Lalkua were received from the Silviculturist (Sal region U.P.) for the laboratory experiments. The logs were chipped and screened after debarking. The screened chips were used for these experiments.

Proximate chemical analysis :

The wood dust 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-1. For comparison results of proximate chemical analysis of **Eucalyptus hybrid** (Mysore gum) grown in Madras determined earlier are also given:—

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TABLE—I

Proximate chemical analysis of Eucalyptus hybrid (Mysore gum)

	Grown in U.P.	Grown in Madras
1. Ash	0.51	0.32
2. Cold water solubility ...	1.80	4.70
3. Hot water solubility ...	13.80	13.40
4. One per cent caustic soda solubility	16.45	37.00
5. Alcohol benzene solubility	1.11	1.80
6. Pentosans ...	15.75	14.12
7. Lignin	28.26	24.70
8. Cellulose (Cross and Bevan)	53.41	50.58

It is seen from Table-I that **Eucalyptus hybrid** grown in U.P. has higher ash cellulose content, lignin content and pentosans than the hybrid grown in Madras though 1% caustic soda solubility is less in case of U.P. grown hybrid than the Madras grown hybrid.

Fibre dimensions :

For the determination of the fibre dimensions pulp was prepared by digesting the chips by the sulphate process (NaOH :Na_2S : 3 : 1) using 20 per cent chemicals on the oven-dry basis at 162°C for a total period of 4 hours including 1 hour to raise the temperature from room temperature to the maximum temperature. The bath ratio was kept as 1 : 4. The pulp was bleached by bleaching powder in two stages with intermediate alkali wash. 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 firbre length and diameter are given in Table—II. For comparison the fibre dimension of Eucalyptus hybrid grown in Madras are also given :—

TABLE—II

Fibre dimensions of Eucalyptus hybrid

	Length		Diameter	
	Grown In U. P. mm.	Grown In Madras mm.	Grown In U. P. mm.	Grown In Madras mm.
Minimum	0.59	0.56	.007	.007
Maximum	1.16	1.19	.021	.021
Average	0.83	0.73	.016	.012

The ratio of the average fibre length to diameter is 52 : 1 in case of U.P. and 61 : 1 in case of Madras.

Production of unbleached chemical pulps in the laboratory for wrapping papers :

300 gm. of chips were digested by the sulphate process (NaOH : Na_2S : 3 : 1) in a 5 litre electrically heated rotary digester of Dutch Neumann make, using bath ratio of 1 : 4. The quantity of chemicals were varied from 18 to 24 per cent on the oven-dry weight of the chips and the digestions were carried out at 162°C for 4 hours including 1 hour to raise the temperature of the digester contents to maximum temperature from the room temperature. After digestion the pulp was washed. After determining the yield of the pulp it was beaten in Lampen mill to about 250 ml. (C.S.F.) freeness. Standard pulp sheets of approximately 60 g.s.m. basis weight were prepared on the sheet making machine, dired in air using rings and plates and tested for strength properties after conditioning to 65% R.H. and 25°C. The digestion conditions, pulp yield and strength properties of sheets are recorded in Table—III. The results recorded in Table—III show that under suitable condition of cooking a good quality wrapping paper can be obtained in good yield and high strength properties from **Eucalyptus hybrid.** Under the conditions studied the best results were obtained under serial No. 1.

Production of bleached chemical pulp in the laboratory :

The pulps obtained under the conditions detailed in Table—III were bleached after washing by multi-stage bleaching. The first stage of bleaching was carried out using bleaching powder at 20°C for 1 hour at 3 per cent consistency. The amount of bleaching powder calculated as available chlorine in this stage was 10%. After the first stage of bleaching the pulp was washed and treated with 2 per cent caustic soda on the basis of oven-dry pulp at 70°C for 1 hour at 5% consistency. The pulp was then bleached with bleaching powder at 20°C and 3% consistency for 3 hours, to a brightness of about 70. Pulp was washed and bleach consumption and bleach yield were determined. The bleached pulp was beaten in the Lampen Mill to about 250 ml. (C.S.F.) freeness. Standard sheets of 60 g.s.m. basis weight were made from this pulp on the sheet-making machine and dried in air using

rings and plates. The sheets were conditioned at 65% R.H. and 25°C and tested for their strength properties. The sheets were also tested for their brightness using 610 Photovolt meter and taking MgO = 100. Bleach consumption, bleach yield, strength properties and brightness are recorded in Table—IV. For comparison the optimum results on the **Eucalyptus hybrid** grown in Madras are also recorded. It is seen that the yield and strength properties are better from **Eucalyptus hybrid** grown in U.P. than from **Eucalyptus hybrid** grown in Madras.

Pilot plant trials for production of writing and printing papers :

To confirm the laboratory results pilot plant experiments were conducted. About 1200 Kg. of screened chips of Eucalyptus hybrid were loaded in a vertical stationary mild steel digester of indirect forced circulation type of 11.2 cubic metres capacity. The digestion conditions were the same as serial No. 2 Table—IV. The pulp after digestion was blown at 2.8 Kg./sq. cm. pressure in a blow tank. The pulp was then processed through a coarse flat screen and washed over a Kamyr filter. The pulp was then again processed through the same coarse screen, riffler, a fine drum screen and then thickened over the same Kamyr filler. Under these conditions the unbleached screened yield was 42.6 per cent on the oven-dry chips. The permanganate number of the pulp was 19.5. The pulp was bleached under the following conditions :

First stage (Calcium Hypochlorite)			
(1) Available chlorine applied on O.D. pulp	...	%	6
(2) Consistency of pulp	...	%	3.3
(3) Period of treatment	...	hours	1
(4) Temperature of treatment		°C	23
(5) pH	... ...	%	9.5
Second stage (Caustic extraction)			
(1) Caustic soda on O.D. pulp	...	%	2
(2) Consistency of the pulp		%	3
(3) Period of treatment	...	hours	1
(4) Temperature of treatment		°C	70
Third stage (Calcium hypochlorite)			
(1) Available chlorine applied on O.D. pulp	...	%	3
(2) Consistency of pulp	...	%	3.0
(3) Period of treatment	...	hours	3
(4) Temperature of treatment		°C	23
(5) pH	... ...	%	9.5

The bleached pulp yield was 39.7 per cent. Wet laps of the bleached pulp were prepared.

A portion of the bleached pulp was taken in the conventional Banning beater with conventional bronze bars while another portion was beaten in the Banning beater with Basalt lava bed plate and roll. White printing paper was made from the furnish on a fourdrinier machine of 100 cm. deckle. The details of stock preparation, paper-making and strength properties are recorded below. For comparison the results of the stock preparation of paper-making and strength properties of paper from **Eucalyptus hybrid** grown in Madras are also recorded :

		Grown in U.P.	Grown in Madras	
		Conventional Banning beater	Banning beater with Basalt lava roll and bed plate	Conventional Banning beater
1. Freeness of the unbeaten pulp ...	ml (CSF)	400	440	350
2. Freeness of the beaten pulp, addition of chemicals	ml (CSF)	230	215	160
3. Rosin soap on O. D. pulp	%	4	4	3
4. Alum on O. D. pulp ...	%	12	12	9
5. Soap stone on O. D. pulp	%	7	7	5
6. pH of the stock in head box ...	%	5	—	4
7. Beating time ...	hours	11	6	—
8. Power consumed KH per tonne ...	—	1350	580	—
9. Final Freeness after the addition of chemicals ..	ml (CSF)	226	195	130
10. Basis weight ...	g. s. m.	52	52	59.6
11. Machine speed, metres/minute ...	—	46	61	12
12. Breaking length ...	metres			
(a) Machine direction ...		4470	4860	4260
(b) Cross direction ...		2730	3260	2900
13. Burst factor ...	—	17.3	21.1	16.8
14. Tear factor ...	—			
(a) Machine direction ...		38.4	42.3	48.6
(b) Cross direction ...		63.4	65.4	52.2

It is seen from these results that the **Eucalyptus hybrid** grown in U.P. gives a better pulp and better paper than from **Eucalyptus hybrid** grown in Madras. It is also seen that by the use of Basalt lava roll and bed plates not only the beating time

and power consumption are reduced but also the quality of the paper is improved. It is also seen from pilot plant experiments that **Eucalyptus hybrid** (M.H.) grown in U.P. gives bleachable pulp in good yields with satisfactory strength properties for production of writing and printing papers.

Production of rayon grade pulp :

In order to prepare high alpha cellulose pulp or pulp suitable for rayon manufacture the wood was prehydrolysed with water under different conditions and then digested by the sulphate process using various conditions. The liquor after the water prehydrolysis was examined for pH. The yield of the unbleached pulp was determined. Optimum conditions of water prehydrolysis and sulphate digestions are given in Table-V. The pulp was bleached by multi-stage bleaching process using elemental chlorine, caustic soda extraction, sodium hypochlorite, and chlorine dioxide. In the bleaching process the quantities of chemicals used, sequence of treatment with different chemicals etc. was varied. The yield of the bleached pulp was determined. In Table-VI are recorded the conditions under which the pulp obtained as described in Table-V was bleached. The bleached pulp was analysed for alpha, beta and gamma cellulose, pentosans, ash and viscosity according to the methods described earlier. In Table-VII are given the results of chemical analysis of the bleached pulps.

It is seen that pulps of requisite chemical purity and brightness can be prepared by water-prehydrolysis sulphate process followed by multi-stage bleaching from this raw material.

References :

1. "Raw Material Resources of Uttar Pradesh for wood based industries" Lucknow. Research and Development Circle, U. P. 1967.
2. Guha, S. R. D. and Madan, R. N. Mechanical Pulp from Eucalyptus (M. H. Mysore origin). *Indian Forester, 90*, p. 179, 1964.
3. Guha, S.R.D., Bhola, P.P., Mathur, G.M. and Sharma, Y.K. Writing and Printing Paper from Eucalyptus (M.H. Mysore Origin). *Indian Forester. 91.* No. 4, P. 228-232.

TABLE—III

Sulphate diguestions of Ecalyptus hybird and strength properties of unbleached sheets.

Sl. No.	Total chemical	Digestion temperature	Cooking time	Permanganate number	Unbleached pulp yield	Breaking length	Burst factor	Tear factor	Folding endurance
—	%	°C	hours	—	%	metres	—	—	double folds
1	2	3	4	5	6	7	8	9	10
1.	18	162	4	21.8	50.5	6050	68.3	91.6	108
2.	20	162	4	21.4	46.7	5440	53.3	88.3	78
3.	22	162	4	20.0	45.0	5040	51.6	86.6	72
4.	24	162	4	18.1	43.9	4845	50.0	83.3	70
5.	20	162	4	—	44.5	—	Eucalyptus hybrid grown in Madras.		(Mysore Origin)

TABLE—IV

Bleach consumption, bleach yield and strength properties of bleached pulps.

Sl. No.	Bleach consumption as available Chlorine	Bleached pulp yield	Breaking length	Burst factor	Tear factor	Folding endurance	Brightness
—	%	%	metres	—	—	double folds	—
1	2	3	4	5	6	7	8
1.	10.6	45.9	5650	48.3	78.3	96	69
2.	10.1	41.8	5040	46.6	75.0	66	70
3.	9.4	40.3	4330	40.0	73.3	48	72
4.	8.3	38.7	3730	36.6	68.3	42	72
5.	6.3	41.5	4840	34.2	63.6	44	75

TABLE—V

Water-prehydrolysis and digestion conditions of Eucalyptus hybrid

1. **Conditions of Prehydrolysis :**

(a) Materi : Liquor	...	1 : 5
(b) Temperature °C	...	153
(c) Time, hours	...	2
(d) pH of the liquor after prehydrolysis	...	4

2. **Conditions of sulphate digestion** ($NaOH : Na_2S : 3 : 1$)

(a) Chemicals *, %	...	14.5
(b) Material : Liquar	...	1 : 4
(c) Temperature **, °C	...	153
(d) Time, hours	...	4
(e) Yield of pulp (unbleached)%		43.2
(f) Permangate Number of Pulp ...	...	10

* This includes 1.5 hrs. to raise the temperature from room temperature to the maximum temperature.

** Expressed on ever-dry weight of original material.

TABLE—VI

Conditions of bleaching, yield and brightness of pulps

1. **Ist stage :**

(a) Chemicals, %	...	2.5 *
(b) Consistency, %	...	3
(c) Temperature, °C	...	23
(d) Time, hours	...	½

2nd stage :

(a) Chemicals %	...	2
(b) Consistency, %	...	5
(c) Temperature, °C	...	50
(d) Time, hours	...	1

3rd stage :

(a) Chemicals, %	...	1 **
(b) Consistency, %	...	5
(c) Temperature, °C	...	23
(d) Time, hours	...	2½

4th stage :

(a) Chemicals, %	...	2 ***
(b) Consistency, %	...	5
(c) Temperature, °C	...	23
(d) Time, hours	...	1

5th stage :

(a) Chemicals, %	...	1 ****
(b) Consistency, %	...	5
(c) Temperature, °C	...	80
(d) Time, hours	...	2

2.	Bleached yield, %	... 32.3
3.	Brightness (Mgo = 100)	... 89

* Chlorine water (% expressed as available chlorine on oven-dry weight of the pulps).

** Caustic soda (% expressed on oven-dry weight of the pulps).

*** Sodium hynochlorite (% expressed as available chlorine on oven-dry weight on the pulp).

**** Chlorine dioxide (Sodium chlorite and acetic acid) (% expressed as available chlorine on O. D. weight of pulp.).

TABLE VII

Analysis of the Bleached Pulps

(a)	Alpha Cellulose, %	... 92.0
(b)	Beta Cellulose, %	... 5.2
(c)	Gamma Cellulose, %	... 2.8
(d)	Pentosans, %	... 2.88
(e)	Ash, %	... ... 0.10
(f)	Viscosity (Cupramorium) C.P.	... 14
(g)	Degree of Polymerization	... 682