

# Production of Kraft Paper From Elephant Grass

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## SUMMARY

The paper describes the pulping of Elephant grass (*Imperata cylindrica*) by mechano-chemical process and pulping of waste hessian and gutter cotton by normal soda process. Kraft paper was produced from 100% mechano-chemical pulp of Elephant grass, and from a furnish containing 75% Elephant grass pulp 12.5% waste hessian pulp and 12.5% gutter cotton pulp, on a fourdrinier machine. The results show that, from a mixture of these three pulps, Kraft paper produced conforms the I.S.I. specification (IS : 1397-1967) for Grade - II kraft paper.

## INTRODUCTION

Under the present situation, when the entire paper industry is facing acute shortage of fibrous raw material, the ideal raw materials for a small or medium scale paper mill are, the local available grasses and industrial wastes beside agriculture residues. The process technology should be so oriented so as to get higher and higher yields of pulps. High yield pulping processes can give pulps can be which used for the production of industrial and cultural papers.

In this context Elephant grass, *Imperata cylindrica* which is available in Karnataka state forests have been pulped by the mechano-chemical process. These type of high yield pulps require some long fibered pulps to be admixed in furnishes for smooth production of paper. The long fibered raw materials selected for this investigation were waste hessian and gutter cotton.

This investigation was taken up to determine the feasibility of using Elephant grass for the production of kraft paper by itself or alongwith some long-fibered component. The processes selected for these trials were mechano-chemical process of pulping using caustic soda for Elephant grass and normal soda process for waste hessian and gutter cotton.

## RAW MATERIAL

About 4 tonne of Elephant grass was supplied

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by the Karnataka State Forest Department for these experiments. The grass was identified as *Imperata cylindrica*. The waste hessian and gutter cotton were purchased locally. Elephant grass was cut in a chaff cutter to pieces of approximately 4-5 cm. length. The cut grass was screened and used in experiments.

Waste hessian was cut to pieces of about 2-3cm. width before pulping. Gutter cotton was opened and dusted manually and used as such,

## LABORATORY PULPING OF WASTE HESSIAN AND GUTTER COTTON

The waste hessian and gutter cotton were separately cooked in laboratory by the soda process using the following three conditions. Pulp yield was determined. The three pulps were beaten in valley beater and pulps at different freeness were evaluated for their strength properties. The results for both the raw materials are recorded below -

### I. WASTE HESSIAN

	Expt.1	Expt.2	Expt.3
(a) Caustic soda on oven-dry weight of hessian, %	4.0	6.0	8.0
(b) Cooking pressure, kg/cm <sup>2</sup>	5.6	5.6	5.6
(c) Cooking time including 1 hr. to reach max. pressure hr.	6	6	6
(d) Batch ratio	1:4	1:4	1:4

(e)	Pulp yield on o. d. weight of raw material, %	90.0	85.7	83.2
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(f) Pulp evaluation

Beating Time min.	Freeness (CSF)ml.	Breaking length m.	Burst factor	Tear factor
<b>Expt. 1</b>				
0	660	1528	12.0	143
20	640	1779	17.0	178
40	605	2437	22.0	185
60	521	4902	30.0	169
80	433	5509	36.0	153
100	341	6735	47.0	147
120	233	7415	53.0	119

(f) Pulp evaluation (Contd.)

Beating Time min.	Freeness (CSF)ml	Breaking length m.	Burst factor	Tear factor
<b>Expt. 2</b>				
0	599	3217	22	163
20	492	4380	30	186
40	407	5313	39	171
60	301	6623	50	153
80	172	6364	55	142
100	140	6464	63	126

**Expt. 3**

0	635	2030	14	123
20	550	2586	16	171
40	388	5009	33	163
60	277	6244	43	142
80	200	6354	47	140

Out of the three cooking conditions, pulp obtained under Expt. 2 has the optimum strength properties.

**II. GUTTER COTTON:**

	Expt.1	Expt.2	Expt.3
(a) Caustic soda on oven-dry weight of gutter cotton, %	4.0	6.0	8.0
(b) Cooking pressure, kg/cm <sup>2</sup>	3.5	3.5	3.5
(c) Cooking time, including 1 hr. to reach max. pressure, hr.	5	5	5
(d) Bath ratio	1:4	1:4	1:4
(e) Yield, %	88.7	86.2	83.4
(f) Pulp evaluation			

Beating Time min.	Freeness (CSF)ml.	Breaking length m	Burst factor	Tear factor
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**Expt. 1**

0	636	1282	11	143
20	566	1376	11	156
40	502	1449	13	178
60	408	2688	19	171
80	358	3071	19	164
100	281	4197	29	142

(f) Pulp evaluation (Contd.)

Beating Time min.	Freeness (CSF)ml.	Breaking length m.	Burst factor	Tear factor
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**Expt. 2**

0	647	1488	10	224
20	591	197	13	205
40	433	3057	17	221
60	348	3194	20	216
80	257	3857	23	204

**Expt. 3**

0	610	1411	6.0	136.0
20	597	1482	8.0	210.0
40	539	2477	14.0	199.7
60	473	2822	16.0	187.6
80	412	3965	25.6	174.7

Out of the three cooking conditions pulp obtained under Expt. No. 2 has the optimum strength properties.

**LABORATORY PULPING OF ELEPHANT GRASS**

Laboratory experiments on pulping of Elephant grass by mechano-chemical process were conducted at the Institute of Paper Technology. The optimum conditions of pulping, supplied to this laboratory were caustic soda on o. d. grass - 8%, cooking period - 90min.; consistency - 10%; temperature - 95°C.

**PRODUCTION OF PULPS IN PILOT PLANT**

**I. MECHANO-CHEMICAL PULP FROM ELEPHANT GRASS—**

The equipment used for mechano-chemical pulping of the grass was a 5.4. cu. m. capacity hydropulper (Black clawson) of 183 cm. diameter with a workable height of 152 cm. This hydropulper is equipped with a 60 H.P. motor and rotor speed is 600 R.P.M. Heating is by direct steam through a connection near the base of the hydropulper, just

above the perforated false bottom. The conditions for pulping were, caustic soda on o. d. weight of grass-8%, cooking time 90 min., consistency-10%, temperature of treatment 95-98°C.

The hydropulper was filled with water and was boiled. The requisite amount of water for 10 percent consistency with an allowance for steam condensate was left in the hydropulper and the rest was drained. Solid caustic soda was added and simultaneously the cut grass was also added. Temperature was then brought to boiling (95-98°C) with hydropulper in action within 15 min. From the time the contents reached the boiling temperature the treatment was continued for 90 min.

After the treatment the pulp was diluted and pumped to a chest. Pulp was then refined through a conical Jones Refiner with 75 H.P. motor. After refining the pulp was converted into wet laps on a Fourdrinier machine. Yield was determined on the basis of wet laps. The washed pulp yield was 66% on o. d. weight of grass.

The above pulp was beaten in valley beater and evaluated for strength properties. The results are recorded below in TABLE I.

TABLE-I EVALUATION OF ELEPHANT GRASS PULP FROM PILOT PLANT

Beating Time min	Freeness (CSF) ml.	Breaking length m.	Burst factor	Tear factor
0	310	4245	17.7	72.5
10	255	5375	26.9	65.0
20	210	6190	31.7	55.0
30	180	6240	34.1	47.6
40	140	6380	35.3	45.1
50	110	6755	36.5	38.0

## II. SODA PULPING OF WASTE HESSIAN :

Soda pulping of waste hessian was done in rotary digester under the following conditions :—

- (a) Caustic soda on o.d. weight of hessian, % — 6
- (b) Cooking pressure, kg/cm<sup>2</sup> — 5.6
- (c) Cooking period, hr, — 6
- (d) Bath ratio — 1:1.5

After cooking, the hessian pulp was washed in the digester with fresh water and then dumped into a pit. The washed pulp was then loaded into the Banning Beater and beaten for 2½ hrs. at 5% consistency. The beaten pulp was then converted into wet laps on the Fourdrinier wire. The pulp yield was 77% on o.d. weight of hessian.

The conditions for stock preparation of the hessian pulp are given below:—

- (a) Initial freeness, (CSF), ml. — 580
- (b) Consistency of the pulp in beater, % — 5.0
- (c) Freeness after beating, (CSF), ml.— 480

The hessian pulp was evaluated for strength properties in the laboratory. The pulp was beaten in the Lampen Mill to about 250 ml. freeness (CSF) and standard sheets of about 60 gsm. were made. The sheets were tested for their strength properties. The results are given in TABLE-II.

TABLE—II EVALUATION OF HESSIAN PULP FROM PILOT PLANT

Freeness after beating, (CSF) ml	— 255
Breaking length, m.	— 6705
Burst factor	— 45.0
Tear factor	— 168.3

## III. SODA PULPING OF GUTTER COTTON :

Cleaned gutter cotton was loaded in the rotary digster and cooked. The conditions of cooking were :

- (a) Caustic soda on o.d. weight of gutter cotton, % — 6
- (b) Cooking pressure, kg/cm<sup>2</sup> — 3.5
- (c) Bath ratio — 1:1.5
- (d) Cooking time, hr, — 5

After cooking the pulp was washed with fresh water in the digester and then dumped in a pit. The washed pulp was then loaded into the Banning Beater and beaten for 2½ hrs. at 5% consistency. The beaten pulp was then converted into wet lap on the Fourdrinier wire. Pulp yield was 88.8% on o.d. weight of gutter cotton.

The conditions for stock preparation of the gutter cotton pulp are given below :

- (a) Initial freeness, (CSF), ml. — 630
- (b) Consistency of the pulp in beater, % — 5
- (c) Freeness after beating (CSF), ml — 560

The gutter cotton pulp was evaluated for strength properties in the laboratory. The pulp was beaten in the Lampen Mill to about 250 ml. freeness (CSF) and standard sheets of about 60 gsm. were

made. The sheets were tested for their strength properties. The results are given in TABLE-III.

**TABLE-III EVALUATION OF GUTTER COTTON PULP FROM PILOT PLANT**

Freeness after beating, (CSF), ml. —	255
Breaking length, m., —	4284
Burst factor, —	20
Tear factor, —	153.3

#### PRODUCTION OF KRAFT PAPER

Kraft paper was produced from two furnishes, one containing 100% mechanochemical pulp from Elephant grass and another furnish containing 75% Elephant grass pulp, 12.5% waste hessian pulp and 12.5% gutter cotton pulp. The hessian pulp and the gutter cotton pulp have already been partially beaten and they were further treated as given below :

#### IV PRODUCTION OF KRAFT PAPER FROM 100% MECHANOCHEMICAL PULP :—

Part of the wet lapped grass pulp was loaded in Hallender beater with lava and beaten for 1 hr. 45 mins. and then pumped to the machine chest where dye, rosin soap and alum were added and mixed into the pulp. 0.5% I.C.I. Bismarck Brown Basic dye was used.

The conditions for stock preparation of the grass pulp are listed below:

(a) Initial freeness, (CSF), ml. —	320
(b) Consistency of the pulp in beater, % —	5.5
(c) Freeness after beating, (CSF), ml. —	160
(d) Rosin soap, % —	2
(e) Alum, % —	6
(f) Freeness after addition of chemicals, (CSF), ml —	130

The above furnish was separately ran on the paper machine. The strength properties of paper made are given in TABLE-IV.

#### II. PRODUCTION OF KRAFT PAPER FROM FURNISH CONTAINING, ELEPHANT GRASS PULP, WASTE HESSIAN PULP AND GUTTER COTTON PULP :

The wet laps of hessian and gutter cotton were loaded in the Banning Beater at a consistency of 4.4% and beaten for 2 hrs. 40 mins. till the freeness was reduced to 245 ml. (CSF) of the mixed pulps. The remaining portion of the beaten grass pulp not

used in the 100% grass run and the above beaten long fibered stock were taken in the Lava beater and beaten for 1 hr. 30 mins. till the freeness of the mixed stock was 155 ml. (CSF). The beaten stock was pumped to the machine chest where it was mixed with 2% Rosin soap and 6% Alum.

The condition for stock preparation for the beaten stock were :

(a) Initial freeness of mixed long-fibered (CSF) ml. —	245
(b) Initial freeness of grass pulp, (CSF), ml. —	160
(c) Consistency of grass and long-fibered stock in beater, % —	4.6
(d) Freeness of blended stock after beating (CSF), ml. —	155
(e) Rosin soap, % —	2
(f) Alum, % —	6

The stock from the machine chest was pumped through the refiner to the centricleaners and then to the screen (Outward flow-type Leith-Walk Screen-cut size 0.28 in.) where the coarse fibres were eliminated. The screened pulp was taken through the flow-box to the paper machine of 100 cm. deckle.

**TABLE-IV**

Particulars	100 % Elephant grass	75% Grass + 12.5% Hessian + 12.5% cotton	Kraft paper Grade II (IS:1397-1967)
Basis weight, gsm.	63.0	65.0	—
Burst factor,	15.6	24.6	20
Breaking length, metres	MD 3400 CD 2880	4650 3000	4500 2500
Tear factor, MD	122	142	75
CD	131	160	75
pH of paper	6.0	6.0	5.5 to 7.5

#### CONCLUSION

The results of this investigations show that Elephant grass is suitable for pulping by mechanochemical process, waste hessian and gutter cotton are suitable for pulping by soda process.

The kraft paper produced from 100% mechanochemical pulp from Elephant grass does not conform even to the specification of kraft paper Grade-II and hence cannot be used alone. The kraft paper produced from a furnish containing 75% Elephant grass and 12.5% hessian and 12.5% gutter cotton pulps conforms to the specifications of kraft paper Grade-II.