Evaluation of Spent Citronella Grass (Cymbopogon Winterianus Jowitt) For Making Paper Board

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ABSTRACT

The paper highlights the laboratory scale investigations carried out at Regional Research Laboratory, Jorhat, Assam on utilization of spent citronella grass for producing paper boards either alone or in blending with secondary fibres. The results of the chemical constitutional analysis of the spent grass show the cellulose content 50.2%, lignin 13.5% and pentosan 26.8%. The optimum yield of pulp recorded was 44.7% with 8% cooking chemical. The fibres showed average length of 1.15mm and diameter 11.21 μm. The physical strength properties of the paper boards prepared from the pulp of spent grass alone show the tensile index 39.9 and 40.8 Nm $^{g-1}$, Burst index 1.86 and 2.06 kg pa^{g-1}, stiffness factor 24 and 30 respectively for 260 and 480 GSM broad samples.

North eastern region of India produces citronella oil to the tune of 450 tons annually and 40,000 ton of spent grass come out as by product. As most of the boilers have been switched over to electrical ones, a huge quantity of spent grass causes a disposal problem.

Studies conducted at laboratory have indicated that the deoiled waste grass is suitable for making paper boards either alone or in blending with secondary fibres under ideal pulping conditions. The requirement of cooking chemical is less as the grass has already undergone prehydrolysis during distillation.

Key words : Citronella, pulp, fibre dimensions, strength properties, paper-board, stiffness.

INTRODUCTION

Java citronella (Cymbopogon winterianus Jowitt) belonging to the family Poaceae is a potential source of citronella oil rich in citronellal, citronellol and geraniol. Oil of Java citronella is widely used in perfumery, soaps, cosmetics and pharmaceutical industries (Ganguly and Thyagaran, 1972). The agroclimatic condition of North Eastern Region of India is found to be suitable for its luxurient growth. Therefore, cultivation of citronella grass and extraction of citronellal in this region have gained extensive popularity.

The spent grass is generally used as a fuel during distillation of oil. However, due to gradual replacement of conventional boilers by electrically heated ones large quantities of de-oiled citronella grass remain as waste at the distillation site. Thus

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Table-I	
Analysis of spent Citronella grass (Cymbopogon winterionus Jewitt)	
Particulars	**Percent OD basis**
Ash	2.81
Cold water solubility	7.68
Hot water solubility	9.52
1% NaOH solubility	34.85
Alcohol-benzene solubility	2.87
Pentoson	26.82
Lignin	13.45
Cellulose (Cross and Bevan)	50.20

disposal of the huge quantities of spent grass so accumulated has become a problem to the oil industry. As most of the Citronella oil industries are located in rural areas, the board making units based on spent citronella grass will be an attractive proposition for the development of rural industries.

It has been estimated that the yield of pulp from Citronella grass for paper and board making is 45.8%. It would therefore be possible to obtain one ton of pulp from one acre of plantation which produces about 10 ton of green grass **(Fig.A).** This green grass after extraction of oil may be a potential source of raw material for paper and board industry. Although the utilization of certain grass other than citronella for making paper has been reported by some workers[1,2] the paper board properties from spent citronella grass have not been investigated in detail so far. Therefore the characteristics of paper boards made out of spent citronella grass alone and in combination with other fibres have been studied and presented in this communication.

MATERIALS AND METHODS :

Spent Citronella grass was collected from oil distillation units situated within Jorhat district, Assam, India. The grass after extraction of oil was used for this present investigation. Recycled fibres in the form of waste paper mostly kraft paper cuttingts were used.

Table-II

Cooking conditions and pulp yield of spent Citronella grass.

Sl. No.	Cooking chemicals %	Temperature °C	Period of cooking (Hrs.)	Pulp yield (Unbleached)
A	4	150	3	Under cooked
		160	3	-
		170	3	-
B	6	150	3	Under cooked
		160	3	-
		170	3	-
C	8	150	3	45.6
		160	3	44.7*
		170	3	43.5
D	10	150	3	45.3
		160	3	42.5*
		170	3	40.6
E	12	150	3	40.8
		160	3	39.2
		170	3	36.3
F	14	150	3	35.8
		160	3	32.7
		170	3	31.2

* Represents optimum cooking condition.

Table-III

Morphological properties of spent Citronella grass fibres

Sl.No.	Particulars	Results
1.	Fibre length L (mm)	1.15
2.	Fibre diameter D (um)	10.2
3.	Cellwell thickness W (um)	5.16
4.	Lumen diameter (d) (um)	11.27
5.	Slenderness ratio	53.18
6.	Runkle ratio (2k/d)	0.91
7.	Flexibility co-efficient	51.92

Sl. No.	Layers	Basic weight (gsm)	Thickness (mm)	Stiffness factor	Tensile index (Nmg-1)	Burst index $KPa.m^2g^{-1}$
A	-	-	-	-	-	-
B	1	60	0.11	-	24.73	1.47
	3	180	0.20	-	27.45	1.67
	6	360	0.40	10	24.25	1.86
	8	480	0.54	15	25.09	1.96
C	1	60	0.11	-	29.23	1.57
	3	180	0.20	-	32.36	1.76
	6	360	0.40	24	39.91	1.06
	8	480	0.54	30	40.01	2.06
D	1	60	0.11	-	28.55	1.47
	3	180	0.20	-	28.44	1.67
	6	360	0.40	22	34.45	1.77
	8	480	0.54	30	39.36	1.96
E	1	60	0.11	-	28.76	1.57
	3	180	0.20	-	29.81	1.67
	6	360	0.40	22	33.99	1.77
	8	480	0.54	34	32.36	1.98
F	1	60	0.11	-	33.45	1.05
	3	180	0.20	-	36.09	2.0
	6	360	0.40	20	31.45	2.15
	8	480	0.54	35	32.36	2.35

FIBRE MORPHOLOTY :

The morphological properties of Citronella fibres such as fibre length, diameter, cellwall thickness, lumen diameter etc. were measured with the help of Dokuvel photomicroscope JBOL, Japan, at lower and higher magnifications. Bleached defibred pulps were taken for studying the fibre morphology and the results obtained are recorded in **Table-III.**

ANALYSIS OF SPENT GRASS :

The chemical constituents of the plant material were analysed as per Tappi Test method (Tappi 1992-93).

PULPING AND BOARD MAKING :

Spent grass after extraction of oil was digested with sodium hydroxide in an electrically heated rotary

Table-IV

Physical strength properties of paper boards blends with recycled fibre at different ratio

Sl. No.	Stock Composition spent grass pulp	Waste paper pulp	Basis weight (gsm)	Moisture %	Thick-ness (mm)	Stiff-ness factor	Tensile index (Nmg^{-1})	Burst index $K.Pa.m^2g^{-1}$
1	80	20	400	8.5	0.55	22	33.83	0.98
2	60	40	480	8.2	0.87	25	35.16	1.18
3	50	50	480	8.0	0.96	36	37.76	1.39
4	40	60	480	7.5	1.10	38	41.70	1.55
5	20	80	480	7.2	1.20	40	44.33	1.63

autoclave of 5 litre capacity maintaining bath ratio at 1:5 with 5-10 x concentration of cooking chemicals, at varying temperature from 160-170°C.The pulp yield and the cooking parameters used have been presented in **Table-II.** The pulp obtained after the digestion was washed thoroughly with fresh water and then beated at 40 °SR. Multilayered boards, each layer having basis at of 60 ± 5^{gsm} were made in British standard laboratory hand sheet making machine. The various strength properties of paper board were tested adopting standard test methods. Simultaneously, a study was also carried out to observe the effect of different strength properties of paper board made of waste paper pulp beaten at 50 °SR and blended with spent citronella grass pulp (40 °SR) at various ratios like 20:80, 40:60 and 50:60, 60:40 and 80:20.

TESTING OF BOARDS

The dried paper boards were conditioned at 65% RH and $27\pm°C$ for 2 hrs. and then tested for different physical strength properties as per standard test methods.

RESULTS AND DISCUSSION

The analysis of the spent citronella grass has been shown in **Table-I.** It is revealed that the different chemical constituents of the grass mainly cellulose, lignin, pentosan etc. are comparable to that of conventional cellulosic material used for paper and board making. The morphological properties of the fibre are presented in **Table-II.** The length of the fibre recorded 1.15 mm, while diameter recorded as 18.2 um which are comparable to that of agrowaste and other short fibred material. The pulp yield at different chemical concentration and temperature suitable for making paper boards are recorded in Table-II. It shows that although at lower chemical concentration (upto 8%), pulp yield is found to be more, yet the optimum of pulp recorded at 10% chemical concentration at 160°C producing paper and boards of higher physical strength properties. It has been observed that with 8% chemical concentration the pulp yield is higher but the strength properties of the paper boards has been recorded comparatively lower. At 10% and above concentration the pulp yield is low as well as there is high consumption of cooking chemicals during digestion.

The various physical strength properties of the board made from the pulp cooked at different conditions are shown in **Table-IV.** It is observed that the paper boards made from spent citronella grass shows adequate strength, comparable to that of commercially manufactured mill board and grey boards. From the Table-IV, it has been found that in the batch No. D and E, 480 gsm boards are comparable to mill board and grey boards items (IS 1967). The physical strength properties of paper boards made out of the pulp blended with recycled fibre **(Table-V)** also shows superior physical strength properties at the ratio 60:40, 50:50 and 40:60. These boards meet all the specifications for mill board and grey board specified by Bureau of Indian Standard Institution (BIS).

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