Dhaincha (Sesbania Aculeata) Seeds-A Source Of Natural Additive For Paper Industry

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ABSTRACT:– Laboratory scale investigation was carried out to study the possibility of utilising the seed gum extracted from seeds of Sesbania aculeata (Dhaincha) for use as sizing material in paper making. While used as wet end additive in the range 0.5%-2.0% in paper sheet formation, the seed gum imparted satisfactory strength properties to the paper sheets.

The burst and tensile indices of the paper were found comparatively better when 2.0% of the seed gum was used as sizing material. Greaseproof properties could also be achieved at lesser beating when this gum was used as beater additive.

INTRODUCTION

It is an established fact that additives play a vital role not only in the beating process but also in improving the strength properties of paper. Unless the pulp is properly beaten, uniform sheet formation cannot be achieved. As per the end use, different types of additives are selected for imparting special properties to the paper. Now a days, a number of additives are used in stock preparation, some are synthetic and others natural[1-7]. During stock preparation besides additives, fillers are also used. Fillers are highly desirable in printing papers where they increase the opacity and improve printing properties[8]. The gum type of additives improve dry strength, by increasing the interfibre bonding in the sheet. There are several gums of natural origin presently used in paper industry[9].

Sesbania aculeata popularly known as Dhaincha is a herbaceous, annual plant of fast growing nature. It can attain a height of 6m and produce dry stem yields upto 20 ton per hectare [10,11]. The stem portion can be used as a raw material for producing writing and printing paper[12]. Improved agro-technology for cultivation of this annual plant has been carried out with successful results[13].

The yield of seeds per plant is considerably high and is a waste. It is, therefore, attempted to utilise the seeds for producing seed gums for use in paper industry.

A chemical analysis of the seed meal of Dhaincha was carried out. Gum (powdered endosperm) was obtained by mechanical grinding of the seed material and separating them from husk and kernel.

EXPERIMENTAL

Materials and Methods

The matured seeds used for preparation of gum were collected from Dhaincha plant cultivated in the experimental farm of RRL, Jorhat. The seeds were cleaned, sun dried and fed in a mechanical grinder to dehusk and then kernels were separated. The

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endosperm was then dried, powdered for producing the gum, The seed meal was analysed and the results are presented in Table 1.

Table 1.

Analysis of the Dhaincha seed meal sample

Components	Results (% o.d. basis)
Crude protein	24.55
Fats	6.5
Carbohydrates (non-fibrous)	16.5
Crude fibre	11.5
Ash content	4.18
Insoluble matter	0.65
Calcium	0.5
Phosphorous	0.9
Moisture	9.5

The endosperm powder was then dissolved in warm water and the viscosities of the gum solution at different concentration were found out and the results are recorded in Table 2.

Table 2.

Viscosities of Dhaincha seed gum solutions at different concentrations

Sample	Solution concentration (%)	Voscosity (Cp)	
		Before centrifugation	After Centrifugation
Wholeseed gum	1	100	50
	2	2000	1600
	3	15000	5000
	4	25000	12000
	5	48000	27000
Endosperm gum	1	50	50
	2	750	650
	3	3500	3000
	4	8500	8000
	5	11000	10800

It was found that the seed endosperm mainly composed of galactomanan with low protein oil.

Bleached cotton linter pulp was used for the experiments. The pulp was first soaked in water for about four hours. Initially the pulp was beaten in a laboratory valley beater to a freeness of 300 cc CSF. Then the Dhaincha seed gum was added from 0.5 to 2.0 percent on the o.d. weight of the pulp in the form of 5% solution. The gum was mixed with the beaten fibres without applying any load to the beater for 15-20 minutes. The sheets were formed in a hand sheet former to obtain dry sheet weight of 60 ± 1 g/m^2. For determination of physical strength properties, the sheets were dried in air and conditioned at $65 \pm 2\%$ R.H. at 27 ± 2^0C for 2 h and then tested for various strength properties.

RESULTS AND DISCUSSION

The results of analysis of seed meal powder and viscosities of the seed gum solutions at different concentration are given in Tables 1 & 2 respectively.

The pulp was first beaten to different degrees of freeness viz. 250, 300 & 350 c.c. CSF. To the beaten pulp, the gum was added at 0.50, 0.75, 1.00, 1.50, 2.00 and 2.50% on o.d. weight of the pulp. The mixing of the gum with the pulp was carried out without applying load to the beater for 15 minutes each. Standard paper sheets (60 ± 1 gsm) were formed in a laboratory sheet former. The paper sheets were dried in air and then conditioned as indicated above and the physical strength properties such as bursting strength, tear and tensile strength etc were determined. Fig. 1 (a,b,c) shows the rela-

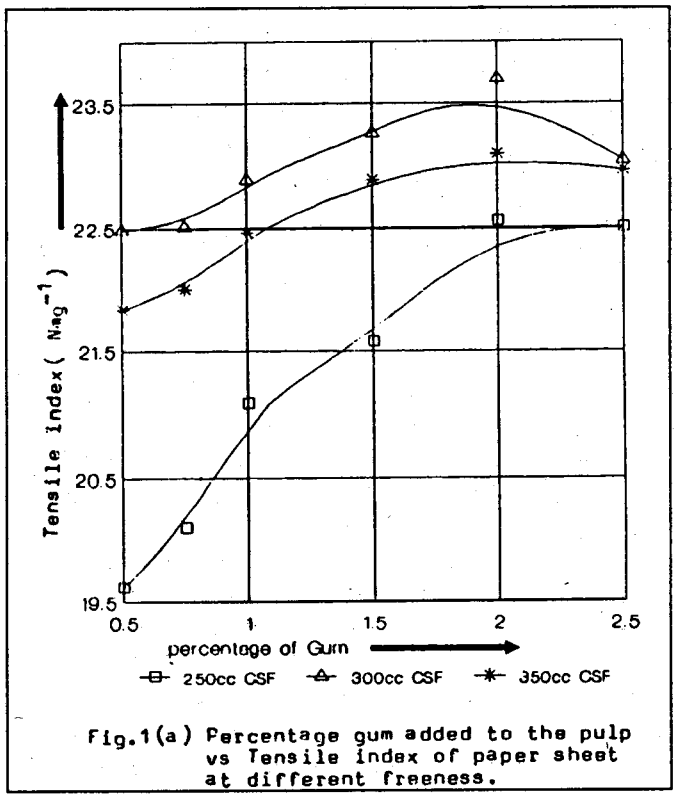

Fig.1(a) Percentage gum added to the pulp vs Tensile index of paper sheet at different freeness.

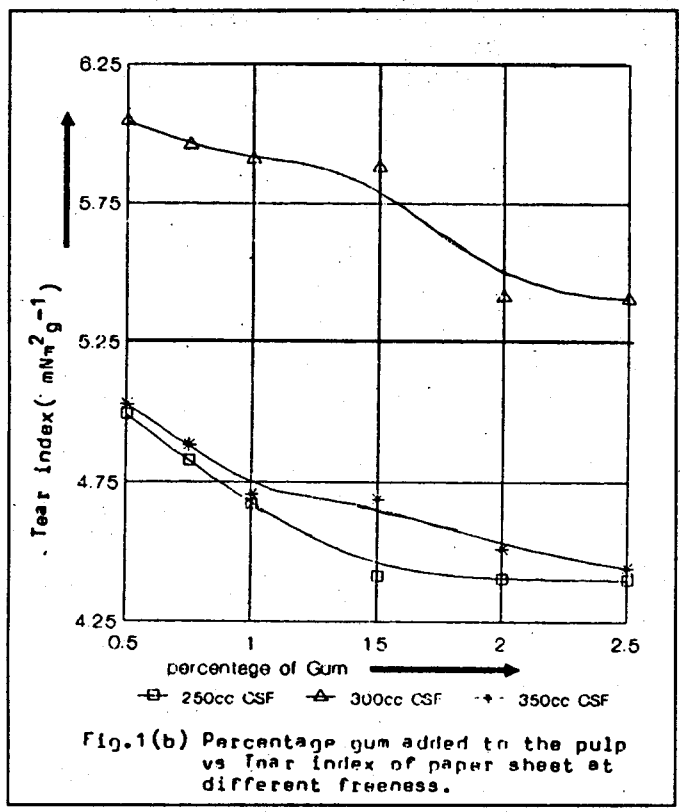

Fig.1(b) Percentage gum added to the pulp vs Tear index of paper sheet at different freeness.

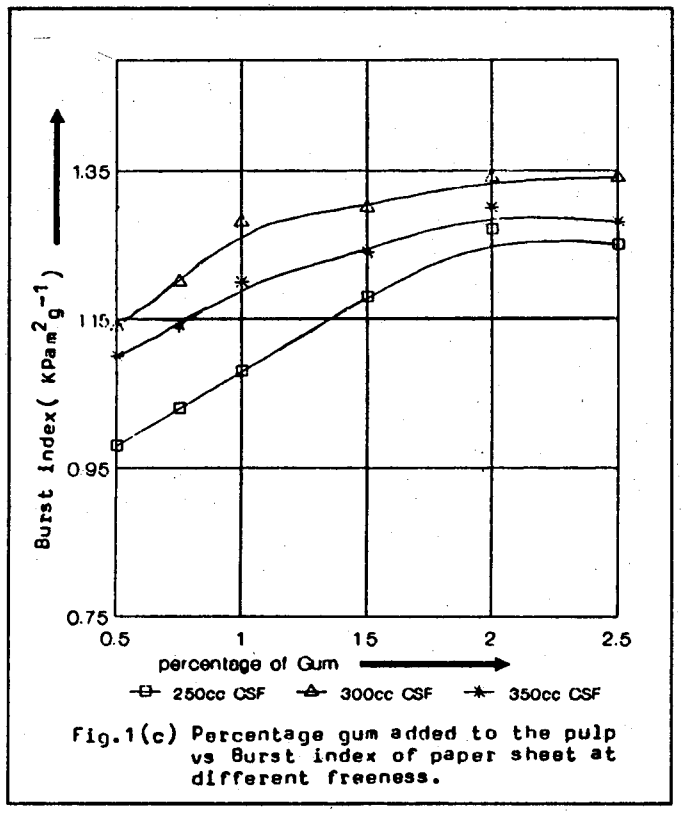

Fig.1(c) Percentage gum added to the pulp vs Burst index of paper sheet at different freeness.

Table 3.

Effect of Dhaincha seed gum on greaseproof properties of the paper

Freeness (cc CSF)	Gum added (%)	Beating time (min)	Drainage time (Seconds)	Burst index ($KPam^2g^{-1}$)	Tear index mNm^2g^{-1})	Double fold	Blister test	Oil transedation period (seconds)
170	1.0	150	165	2.88	3.92	1200	good	--
	1.5	165	175	3.10	3.43	1100	good	--
	2.0	175	180	3.36	2.94	1000	good	--
	2.5	180	190	3.62	2.74	1000	v good	1800 +
	3.0	190	200	3.86	2.55	900	v good	1800 +
	3.5	200	210	3.80	2.45	700	v good	1800 +

tionship between percent gum added vs strength properties. It is evident from the figure that the tensile index increases with increase of the amount of gum added to the pulp. With 2.0% gum, the paper shows better tensile strength property. Similarly, burst index is found to be more with 2.0% gum, while the tear index decreases with the increase addition of gum to the pulp. At 2.0% gum, the burst index is found to vary from 1.27 - 1.34 K Pam^2g^{-1} in the three different freeness, while tear index and tensile index vary from 4.403 - 5.412 mNm^2g^{-1} and 22.556 - 23.697 Nmg^{-1} respectively. however, the best results are obtained with 2.0% addition of gum at 300 c.c. CSF.

The paper sheets formed from pulp stock beaten to about 180 c.c. CSF with addition of 3.0% gum imparted greaseproofness to the sheets. the greaseproof properties of the paper sheets are shown in Table 3.

CONCLUSION

The Dhaincha seed gum prepared in the laboratory has been found to be an effective wet

end additive and by incorporating the gum in the stock, the strength properties of the paper can be considerably increased.

As the plant biomass of *Sesbania aculeata* is suitable for making good quality pulp for writing and printing paper, the seeds out of the same plant, which is a waste, can be utilised for the production of gum useful as wet end additive for paper industry. The husk and kernals obtained after removal of gum from Dhaincha seeds possess high protein value and can be utilised for cattle/ poultry feed.

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