

Some Studies On Sulphate Pulping Of Jute-Stick

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Introduction

The pulp and paper industry in India has to undergo rapid expansion as the anticipated demands for paper and board are much higher than the existing capacities. At present bamboo and wood and to some extent grass, straw etc. are mainly used by the pulping industries. To meet the ever-growing demand for various cellulosic products in the country, we cannot depend wholly on these conventional raw materials, so intensive efforts for using agricultural residues e.g., jute-stick and mesta-stick, wheat and paddy straw bagasse, stalks of soya bean and cotton, hemp, flax and corn stalk, grasses, reeds etc. are very necessary.

Early history reveals that these agricultural residues had been used in different parts of the world for the manufacture of paper and board eg., printing and writing papers have been made from paddy straw; sugarcane bagasse has been used as raw material for newsprint; stalk of soya bean and cotton were used

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as substitute for straw in making straw board.

Of all these agricultural residues jute and mesta sticks are very important as a good source of cellulose. Although it has been through research investigations at different Institutes that jute-stick can be used successfully for the manufacture of newsprint, writing and printing papers etc., still the conditions of pulping specially by sulphate process have not been worked out fully in comparison to other raw materials and require more investigations.

For this purpose, the conventional sulphate process of pulping was undertaken and investigations were made to study the effect of changing the variables of alkaline pulping viz., material-to-liquor ratio, chemical percentage, sulfidity, time and temperature of digestion, rate of rise of temperature etc. The effects of these variables and their interactions were studied thoroughly in order to arrive at the desired conditions for maximum yield, strength and economy of the pulping process as well as for planning of future development of pulp and paper industries based on agriculture residues like jute-stick.

Materials and Equipments
Jute-stick of normal quality was

selected as raw material for pulping. It was first broken into chips of about 1" to 1.5" in length and its moisture content was determined. Chemicals used were commercial grades of caustic soda and sodium sulfide.

The equipments used consisted of:

1. Electrically heated Rotary digester for cooking.
2. Laboratory Beater for evaluating pulp.
3. Standard sheet-making machine for making handsheets of about 60 gsm for performing physical tests.

Experimental

In all experiments the chips of jute-stick (1 kg. charge in each expt.) were first cooked in the Rotary digester using caustic soda and sodium-sulphide as cooking chemicals for certain time and temperature. The pulp was withdrawn from the digester, washed and pressed, the moisture content and unbleached pulp yield were determined. It was next beaten in the laboratory beater, the freeness was controlled to about 40°SR, standard handsheets from this pulp were made. They were conditioned and tested physically. The variables as studied were the following:

- (a) Effect of material-to-liquor ratio.

Pulping experiments were done 1:5 to 1:10. The conditions of with varying liquor-ratios from pulping were as under :

Time to maximum temperature $1\frac{1}{2}$ hrs. Maximum temperature 170°C
Time at the maximum temperature $\frac{1}{2}$ hr. Percentage of chemicals 25%
Sulfidity 25%

Results

TABLE I

Expt. No.	Material-to liquor ratio.	Unbleached pulp yield. %	Permanganate No.	Breaking length (m)	Fold
1.	1:5	43	15.9	5650	115
2.	1:6	44	16.2	5720	150
3.	1:7	47	18.5	5860	201
4.	1:8	49.38	19.6	6210	245
5.	1:9	56.21	20.2	7010	250
6.	1:10	62.1	22.3	7902	261

Time to maximum temperature—50 Mins. Maximum temperature; 170°C

Time at maximum temperature; 3 hrs. Liquor—ratio ; 1:5
Sulfidity ; 25%

Results

Table II

Expt. No.	% Chemicals.	Yield %	Permanganate No.	Breaking length (m).	Fold.	Characteristics of pulp.
1.	15	70.3	27.4	8000	203	{ Stiff, black, un-cooked pulp which were difficult to bleach.
2.	17.5	54.5	19.2	7660	259	
3.	20	52.3	15.8	7540	256	{ Soft pulp, light coloured with easy bleach-ability.
4.	25	48.7	15.1	6836	58	
5.	28	47.6	14.7	6550	12	
6.	30	46	13.1	3500	4	

Results

Table III

Expt. No.	Time at max. temp. hrs.	Unbleached pulp yield %	Permanganate No.	Breaking length (m)
1.	1	62.64	20.1	5692
2.	2	59.1	16.15	5950
3.	3	52.3	15.8	7540
4.	4	48.3	14.20	7560
5.	5	46.2	13.40	6202

Chief findings were :

1. Development of strength at a higher liquor-ratio during pulping.
2. Improvement of yield at higher liquor-ratio.

(b) Effect of percentage chemicals
Several digestions were carried out by varying percentage of chemicals and NaOH viz., 15%, 17.5%, 20%, 25% and 30% (on basis of O. D. jute-stick. The conditions of pulping were as under :

Chief findings of the experiments :

1. With chemicals below 20%, the pulp became stiff, partially cooked and dark-coloured.
2. With chemicals above 20%, the pulp became soft, light-coloured and properly cooked.

From the above table II, use of 20% chemicals was found to be suitable from the view point of strength and yield, for cooking jute-stick by this process.

(c) Effect of changing time of digestion :

Time for cooking at maximum temperature was varied from 1 to 5 hrs., keeping chemicals 20% on raw material, liquor-ratio 1:5, maximum temperature 170°C and sulfidity 25%. The following results were obtained:

It was observed from above results that :

1. Yield of pulp decreased with increase in cooking time.
2. Strength properties became maximum for cooking periods of 3 to 4 hrs.
3. Permanganate No. diminished with increase in time of digestion.

(d) Effect of changing temperature of digestion :

Here 20% chemicals on basis of o.d. jute-stick and maximum temperatures viz., 150°C, 160°C, 170°C and 180°C of digestion were used. Other conditions were as under :

(e) Effect of changing sulfidity of digestion :

The effect of changing sulfidity from 10% to 30% using 20% chemicals as NaOH on o.d. jute-stick, maximum temperature of 170°C and 4 hrs. at maximum temperature, was studied.

From above results, use of 25% sulfidity was found to be most suitable from the viewpoint of strength and yield.

To sum up, the suitable conditions for preparing normal bleachable pulp from jute-stick by sulphate process are as follows :
Chemicals, 20% as NaOH on raw material, liquor ratio 1:5 maximum temperature of cooking 165°C-170°C, sulfidity 25% and cooking time at maximum temperature 3 to 4 hrs.

Time to maximum temperature 55 mins.

Time at maximum temperature 4 hrs.

The following results were obtained :

Results

Table IV

Expt No.	Temperature of digestion. °C	Unbleached pulp yield %	Permanganate No.	Breaking length (m)
1.	150	58.3	17.7	7344
2.	160	54.2	16.2	7500
3.	170	48.3	14.8	7560
4.	180	44.2	13.0	7140

From above results it was evident that :

1. Yield and permanganate No. diminished with increasing temperature of digestion.
2. Breaking length did not change with temperature and rema-

ined almost same.

3. Temperature of 165°C-170°C was taken as working temperature in cooking jute-stick as yield and permanganate No. were normal for getting bleachable pulp.

The following results were obtained :

Results

Table V

Expt. No.	Sulfidity.	Unbleached Pulp yield %	Parmanganate No.	Breaking length (m)	Fold
1.	10%	46.2	20.68	4957	112
2.	15%	48.33	17.7	6444	203
3.	20%	48.6	16.28	7110	241
4.	25%	48.9	15.0	7550	260
5.	30%	49.4	21.58	6601	278

Conclusion

In the pulping of jute-stick by sulphate process for using unbleached jute-stick pulp in admixture with other grades of pulp, the most suitable conditions for pulping have thus been laid down.

These conditions of pulping are, however, subject to changes according to the nature of the pulp required to be manufactured from jute-stick for use in particular grades of paper.