

STUDIES ON SODA-SULPHUR PULPING

Part IV. Pulping of Jute-stick by Soda-sulphur Process

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Stronger pulps with higher yields in relatively short cooking time are obtained by application of soda-sulphur process in case of rice [1] and coconut rib [2], similar results have been obtained in case of jute-stick with the application of elemental sulphur to the cooking liquor consisting of sodium hydroxide solution. The jute-stick soda-sulphur pulps thus produced is a good source of making writing and printing papers.

Key words: Soda-sulphur, Jute-stick, Pulping.

INTRODUCTION

Jute stick is obtained as a by product of jute cultivation. It is burnt off as domestic fuel and also used by villagers as fencing purposes. Nitrocellulose for the production of lacquer and cellulose was manufactured on a laboratory scale in India from jute stick [3] as an alternative to wood pulp and cotton liners. Jute sticks contain 20.29% pentosan corresponding to 12.15% by weight of furfural which can be recovered by direct distillation from sulphuric acid suspension [4]. Xylose was extracted by Khundkar [5] and his co-workers first by hydrolysing jute stick powder with sulphuric acid. Studies on jute sticks have revealed that they can be suitably treated to render them fit for making rayon grade pulp [6].

The recent studies were made on jute stick by soda-sulphur process from jute plant of *C. olitorius* type for making paper grade pulp where elemental sulphur was added to the cooking liquor (NaOH solution) in the digester.

EXPERIMENTAL

The chemical composition of the jute stick from *C. olitorius* type of jute plant was also determined [7-11] and the results are given below:

Alpha-cellulose	50.01%
Lignin	19.28%
Hemi cellulose	22.00%
Ash	2.09%
Nitrogen containing substance	0.81%

Preparation of the raw material. Jute sticks were at first sun dried and then cut into pieces of approximately 1" in length. Moisture content of the material was determined in an electric oven at 105° by keeping samples for 18 hours.

Analysis of caustic soda and sulphur. The analysis of caustic soda was done by conventional method [4] and the analysis of elemental sulphur was carried out by Tappi standard method [13].

Digester. A rotary digester of stainless steel was used for pulping jute stick.

Determination of permanganate number. The permanganate number was determined according to Tappi procedure [14].

Formation of handsheets. Standard handsheets each weighing 60 g/M² were made from unbleached and different bleached pulps in Rapid Kothen sheet forming machine and conditioned according to Tappi standard [15-16].

Jute stick pulps were made by using the following optimum conditions:

NaOH 24.0%, Sulphur 1.0%, Temperature 170°, Time in hours 3.0, Material liquor ratio 1:8, Pressure kg/cm² 7.0.

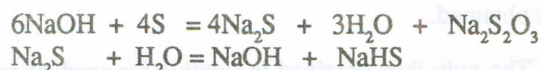
RESULTS AND DISCUSSION

The unbleached and bleached yields (in present) for both CEH and CEHEH pulps are 49.03, 45.51 and 44.44 respectively, the values are higher than the corresponding values obtained by others 3, 24-29. Jute stick contains 50.01% alpha cellulose in jute stick indicates that there was no abnormal loss in cellulose under the respective optimum conditions and the loss was minimum during soda-sulphur pulping.

The unbleached pulp-yield 49.03% was obtained with the addition of 1.0% elemental sulphur to the cooking liquor. There was no beneficial effect of adding more than 1.0% elemental sulphur to the liquor. In expts. 8 of Table 1, it is found that the permanganate number, tear factor and brightness of the pulp are 12.24 (lowest in the table), 80.03 (highest in the table) and 37.50 (also highest in the table) respectively indicate that the addition of 1.0% elemental sulphur to the cooking liquor are rightly selected.

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The beneficial effect of adding elemental sulphur to the cooking liquor is supported by the following reactions mechanism:



The hydrosulfide, thus formed, acts as a buffer and tends to the reduce the degrading or injurious effects of more active sodium hydroxide on cellulose and hemicellulose giving rise to higher pulp yield and stronger pulp. In addition, the hydrosulfide reacts with lignin to produce thioglignin which in turn makes lignin more readily soluble in alkali and thus reduce time required for pulping. In case of jute-stick, the cooking time thus reduced from 5.0 hours for soda or sulphate process to 3.0 hours for soda-sulphur process.

The permanganate number (12.24) is lower than those obtained by others including Karim for soda (14.13) and sulphate pulp (13.17). The permanganate number shows that the yields obtained under optimum pulping conditions were not at the expense of pulp purity and the chosen con-

ditions of chemicals, time, temperature, concentration, etc. were adequate for good delignification.

The brightness for CEH and CEHEH soda-sulphur jute stick pulps were 79.5% and 82.0% respectively and these values are higher than corresponding values obtained by other [29].

The highest fibre length (0.86mm) was given by CEH soda-sulphur pulp and that for CEHEH soda-sulphur pulp was 0.84mm. The values are higher than the values obtained by others [24-29] for different jute stick pulps. The different values for fibre length indicate that the soda-sulphur jute stick pulp is short fibre one and there was practically no degradation for this pulp.

The breaking length and burst factor of the unbleached as well as bleached pulps increased upto 60 minutes beating time due to gradual increase in the area of fibres in optical contact but the tear factors increased upto 50 minutes beating time and then they decrease in fibre-length of the corresponding pulp. The tear factor for CEHEH soda-sulphur jute stick pulp was 139.55 which is higher than that obtained by Islam [24].

Table 1. Establishment of cooking conditions for soda-sulphur jute-stick pulps. In each experiment the material taken in g.o.d. basis was 1 kg.

Expt. No.	NaOH (%)	Sulphur (%)	Temperature (°C)	*Time hr	Material liquor ratio	Unbleached yield (%)	Permanganate number	Breaking length (metre)	Tear factor	Burst facto	Bright ness
1	18	-	-	-	-	Remained	Undigested	-	-	-	-
2	20	-	-	-	-	Not well	Digested	-	-	-	-
3	22	-	-	-	-	51.01	13.48	5885	70.00	94.04	35.0
4	24	-	-	-	-	49.03	12.24	6105	80.03	98.24	37.5
5	26	-	-	-	-	46.50	11.66	6400	66.66	101.24	39.7
6	-	0.0	-	-	-	Remained	Undigested	-	-	-	-
7	-	0.5	-	-	-	46.11	15.14	6344	76.66	100.64	32.0
8	-	1.0	-	-	-	49.03	12.24	6105	80.03	98.24	37.25
9	-	1.5	-	-	-	49.47	12.40	6150	79.62	98.44	37.2
10	-	2.0	-	-	-	49.62	12.65	6202	79.00	98.98	37.0
11	-	-	160	-	-	51.18	14.51	5600	70.04	91.01	33.3
12	-	-	170	-	-	49.03	12.24	6105	80.03	90.25	37.5
13	-	-	180	-	-	45.21	10.54	5013	76.47	84.46	40.0
14	-	-	-	2	-	52.52	15.79	5554	75.91	91.20	31.4
15	-	-	-	3	-	49.03	12.24	6105	80.03	98.24	37.5
16	-	-	-	4	-	43.54	10.04	6609	71.00	104.57	42.5
17	-	-	-	-	1:7	49.30	12.39	6000	77.11	96.45	37.0
18	-	-	-	-	1:8	49.03	12.24	6105	80.03	98.24	37.5
19	-	-	-	-	1:9	48.82	12.00	6182	78.52	100.73	38.1

*Time in hours including 70 minutes to reach the temperature.

Table 2. Laboratory evaluation of unbleached, CEH bleached and CEHEH bleached soda-sulphur jute-stick pulps.

Type of pulp	Beating time min.	Breaking length [17] metre	Tear factor [18]	Burst factor [19]	Freeness [20] (ml)
Unbleached	00	6105	80.03	98.24	900
	10	6214	86.50	99.99	889
	20	6325	91.10	101.78	880
	30	6449	98.08	103.78	870
	40	6601	107.35	106.22	858
	50	6752	121.52	108.65	847
	60	6788	113.85	109.23	836
CEH* bleached	00	7322	99.19	107.47	880
	10	7400	102.96	108.61	870
	20	7518	108.00	110.35	859
	30	7699	116.37	113.00	850
	40	7850	126.40	115.22	841
	50	8000	135.08	117.42	831
	60	8053	128.13	118.20	820
CEH** bleached	00	6550	105.68	100.00	876
	10	6610	109.55	103.22	866
	20	6767	114.00	105.32	855
	30	6905	120.46	110.13	846
	40	7220	127.00	110.13	835
	50	7443	139.55	113.68	825
	60	7489	127.21	114.23	816

*In CEH system, C is meant for chlorination where 60% chlorine was supplied at 3.5% consistency, pH 1-2, room temperature 25-30° for 1 hour and the remaining 30% chlorine was supplied as NaOCl during CEH bleaching where H means sodium hypochlorite treatment at 3.5% consistency, pH 9-11, room temperature 25-30° for 1 hour. The intermediate step was E means caustic extraction (2% against g.o.d. basis pulp for 1 hour at 13.5% consistency and temperature 75-80°. Chlorine and sodium hypochlorite solution were analysed by Tappi standard method [21].

**In CEHEH system, C is meant for chlorination where 60% chlorine was supplied and out of remaining 30%, 15% was supplied as NaOCl during first H means first sodium hypochlorite treatment and the rest 15% was supplied during second H means second sodium hypochlorite treatment. Other conditions of CEHEH. remained unaffected as those in CEH.

Table 3. Yield, brightness, fibre-length and diameter of bleached soda-sulphur pulps of jute-stick.

Type of bleached pulp	Bleached yield (%)	Brightness [22] (%)	Fibre length [23] (mm)	Fibre diameter [23] (mm)
CEH	45.51	79.50	0.86	0.024
CEHEH	44.44	82.00	0.84	0.024

CONCLUSION

1. By application of soda-sulphur pulping process to jute stick, a stronger pulp with higher yield in less cooking time is obtained.

2. The pulp thus obtained is suitable for production of writing and printing paper of high quality.

3. Unbleached pulps both evaluated and unevaluated ones may be used for making newsprint, packing and writing papers.

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