

# Mixed pulping of jute-stick and other agricultural residues

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## SUMMARY

It is recognised that Jute-Stick (I) is a raw material of great potential, however it has some inherent drawbacks which may be overcome if it is mixed with other agro-wastes such as Jute root cuttings<sup>7</sup>, rice straw and jute caddies<sup>8</sup>. If papermills based solely on jute stick adopt a judicious mixing of the main raw material with other agricultural residues they may not have to face difficulty because of the seasonal nature of the jute crop. With this idea jute stick was mixed with other agricultural residues to study their pulping conditions and strength characteristics for different processes.

Although the main fibrous raw materials for making are bamboo and wood, the agricultural residues viz. jute-stick, mesta stick, cotton stalk, rice straw, bagasse, banana leaves and stem, jute caddies and jute root cuttings etc. have proved to be alternative sources of cellulose to supplement the present shortage of raw materials in pulp, paper and board industries (<sup>1,2,3,4</sup>). These agricultural residues as they are grown annually could be available for use every year. They need no special treatment for processing into paper. They are comparatively softer, having lesser lignin content, shorter fibre and open structure, as a result, they require lesser chemicals for pulping.

The idea of mixed pulping (<sup>4,5,6</sup>) has been introduced from a technoeconomic point of view, so that the pulp, paper and cellulose industries may use a variety of raw materials either alone or in mixed form according to the availability and cost in order to keep the plant running throughout the year. Moreover, mixed pulping produces at the very start, mixture of pulps that may impart various desired qualities in the finished paper and board.

Investigations, were, therefore undertaken in the laboratory to examine the possibility of utilisation of unconventional raw materials like jute-stick and other agro-wastes such as jute rootcuttings<sup>7</sup>, rice straw and jute caddies<sup>8</sup> through mixed pulping.

## EXPERIMENTS AND RESULTS :

### A. MIXED PULPING OF JUTE STICK AND JUTE ROOT CUTTINGS : KRAFT PULPING PROCESS :

Jute stick and jute root cuttings were mixed in different proportions and cooked in a 15 litre rotary digester at 20% chemicals, 25% sulphidity at 161-170° for 3 hours at liquor ratio 1 : 5. After determining the yield the pulp was beaten to a freeness of about 40° SR and finally standard hand sheets were made to determine the strength characteristics. Details are given in Table I.

### B. MIXED PULPING OF JUTE STICK AND RICE STRAW :

#### i) SODA CHEMIMECHANICAL PULPING PROCESS :

Jute stick and rice straw were mixed in different proportions and cooked in an open digester with 15% NaOH on weight of raw material at liquorratio 1 : 8 for 3 hours at 90-95°. The pulp obtained was washed and refined in a disc refiner. The yield was determined and strength characteristics were evaluated after preparing the standard hand sheets at a freeness of 40°SR. Results are given in Table I.

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TABLE—I. Pulping conditions and strength properties of mixed pulp of jute stick and other cellulosic raw materials.

Mode of pulping	Mixed raw materials	Percent chemicals as Na <sub>2</sub> O	Sulphidity	Strength of NaOH,	Liquor Ratio	Time of cooking/soaking hrs.	Temp. of pulping °C	Chip size of JS (metres)	Breaking Length (metres)	Fold No.	yield %
I Kraft pulping	JS : JRC										
	O : 100	11.6	3.9	—	1:5	3	165	—	8634	1350	62.2
	75 : 25	20	25	—	1:5	3	165	—	6550	480	52.5
	85 : 15	20	25	—	1:5	3	165	—	6492	400	51.5
	90 : 10	20	25	—	1:5	3	165	—	6460	370	50.5
	95 : 5	20	25	—	1:5	3	165	—	6310	275	48.0
II Soda	JS : JRS										
	i) chemimechanical pulping										
	25 : 75	—	—	15	1:8	3	95	—	3720	26	65.2
	50 : 50	—	—	15	1:8	3	95	—	4400	36	68.0
	75 : 25	—	—	15	1:8	3	95	—	2330	20	70.0
	100 : 0	—	—	15	1:8	3	95	—	3500	15	71.0
	ii) Kraft pulping										
	50 : 50	15	15	—	1:8	3	150	5-8	4600	20	60.0
	50 : 50	15	25	—	1:8	3	150	1-2	6000	80	57.5

\*JS=Jute stick, JRC=Jute Root Cuttings, RS=Rice Straw.

TABLE—II. Pulping conditions and strength properties of mixed pulp of jute stick and other cellulosic raw materials.

Mode of pulping	Mixed raw materials	Strength of NaOH%	Liquor ratio	Time of cooking/soaking hrs.	Temp. of pulping °C	Chip size cms	Breaking Length (metres)	Fold Number	Yield %
Soda Chemimechanical pulping	JS : JC								
	100 : 0	10	1:8	3	95°	—	3500	15	71
	50 : 50	10	1:8	3	95	5-8	6000	75	75
	50 : 50	15	1:8	3	95	8-2	6260	60	68
	0 : 100	10	1:10	3	95	—	6169	192	75
Cold Soda Chemimechanical pulping	JS : JC								
	100 : 0	10	1:8	48	Room temp.	—	2500	5	75
	50 : 50	10	1:8	48	-do-	5-8	3000	6	77
	50 : 50	15	1:8	48	-do-	1-2	3300	10	74
	0 : 100	10	1:5	72	-do-	—	5537	174	78

\*JS=Jute Stick, JC=Jute Caddies.

## ii) KRAFT PULPING PROCESS :

Jute stick and rice straw were mixed in a ratio of 1 : 1 and cooked in a 15 litre rotary digester at 15% chemicals and different sulphidities 15% and 25% at a liquor ratio of 1 : 8 for 3 hours at 150°. the chip size of jute stick was kept at 5-8 cms and 1-2 cms and that of rice straw 1-2 cms. The yield of the mixed pulp was determined and finally standard hand sheets were made at a freeness of 40 SR to study the strength characteristics. Details are given in Table I.

## C. MIXED PULPING OF JUTE STICK AND JUTE CADDIES

### I) SODA CHEMIMECHANICAL PULPING PROCESS

Jute stick was mixed with jute caddies in 1 : 1 proportion and cooked in an open digester with NaOH of 10-15% strength on weight on raw material at liquor ratio 1:8 for 3 hours at 90-95°. the chip size of jute stick was kept at 5-8cms and 1-2 cms. The yield was determined and standard hand sheets were made at a freeness of 40°SR to study the strength characteristics. Details of the pulping conditions and strength results are given in Table II.

### ii) COLD SODA CHEMIMECHANICAL PULPING PROCESS

Jute stick and jute caddies were mixed in a ratio of 1:1 and soaked in a NaOH solution of 10-15% strength on weight of raw material at liquor ratio 1:8 for 48 hours, the chip size of jute stick was maintained at 5-8 cms. and 1-2 cms. The pulp was washed to determine yield and finally standard hand sheets were made at a freeness of 40°SR to study the strength characteristics. Details are given in Table-II.

## DISCUSSION AND CONCLUSIONS

Table I shows that in the mixed pulping of jute stick and jute root cuttings by the kraft pulping process, incorporation up to 25% of jute root cuttings gave a pulp of high breaking length, high fold number and good yield.

Table I also shows that mixed pulping of jute stick and rice straw at 50:50 ratio by soda chemimechanical pulping process gave the best strength results at good yield. It was also observed that kraft pulping of jute stick and rice straw at 50 : 50

ratio gave a good breaking length and fold number at reasonably good yield.

Table II reveals that soda chemimechanical pulping of jute stick and jute caddies mixed at 50:50 ratio gives a pulp of good breaking length, good fold number and high yield at 15% NaOH concentration at 1-2 cms. chip size of jute stick. Whereas cold soda chemimechanical pulping of the mixed pulp material at the same proportion gives rather lower breaking length and fold number at high yield.

So mixed kraft pulp of jute stick and jute root cuttings can be used for making good quality, high strength paper, whereas mixed soda chemimechanical pulp of jute stick and rice straw can only be used for moderately low quality paper. The mixed soda chemimechanical pulp of jute caddies is suitable for high strength packaging paper only.

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