Modified pulping process for newsprint grade pulps from bagasse

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Sugar industry being India's second largest industry producing about 4,800,000 tonnes of centrifugal sugar the better utilization of byproduct i. e. bagasse cannot be overlooked. During recent years there have been several noticeable trends in rapid expansion of pulp and paper. The trends include greater utilization of agricultural residues. The use of bagasse is accelerating rapidly.

Extensive investigations have been undertaken throughout the world on utilization of bagasse for various end products like rayon grade pulp, bleached and unbleached paper (Atchison, 1968 Atkinson, 1953. Bhat, 1953). Considerable amount of research work has been done on utilization of bagasse for newsprint.

Experiments of Bhargava (1954) has celearly indicated that writing and printing papers could be manufactured using 70-90% bagasse pulp in admixture.

A new modified pulping process has been developed in Forest Research Institute for production of newsprint grade pulps from bagasse using mild alkali condition under atmospheric pressure at 95±2°C for 30 to 60 minu es using defibred bagasse. The above process gave ultra high yield 70-90% on whole bagasse with satisfactory strength properties and brightness.

Experimental

Preparation of Washed Whole Bagasse :

The loose bagasse was soaked in water for one hour. After soaking it was stirred for 15 minutes with speed stirrer. After 15 minutes the bagasse was kept for 10 minutes to allow the dust and other foreign particles to settle down. The floating bagasse was removed by hand and dried in air to 10-12% moisture content for future experiments.

Separation of Long and Short Fibres :

The washed bagasse was treated with Na_2CO_3 at 95±2°C under the following conditions :

Na_2CO_3, %	:	2
Bath ratio	:	1 : 10
Time of open boiling, Min.	:	60

The treated bagasse was disintegrated by passing through a laboratory disc refiner at clearance of 25 μ. The disintegrated bagasse was screened on 0.25 mm slot width screen. The bagasse which was retained on the screen has been termed as long fibres. The fraction passing through the screen is termed as short fibres, The fraction of short fibres contained some useful short fibres and pith of bagasse.

Treatment of bagasse fibres in open vessel :

The treatment of bagasse fibres with alkali was done in a indirectly heated vessel equipped inside with a mixing and defibrising device.

The bagasse (whole as well as long fibres separately) were treated under the following conditions.

Conditions of treatment	Whole Bagasse	Long fibres	Short fibres
Chemical (%)	2.4 – 6.4	1—4	Untreated
Temperature (°C)	95±2	95±2	
Time (Minutes)	30	30—60	
Bath ratio	1 : 4	1 : 4 and	1 : 5
Refining, μ	7.5, 2.5	7.5, 2.5	

Mixing of Long Fibres and Short Fibres :

Short fibres were kept untreated and were mixed to treated long fibres in the original ratio (70% : 30%). The properties of blends of long and short fibres are recorded in Table 3. Flow diagram of the process is shown in Fig. 1.

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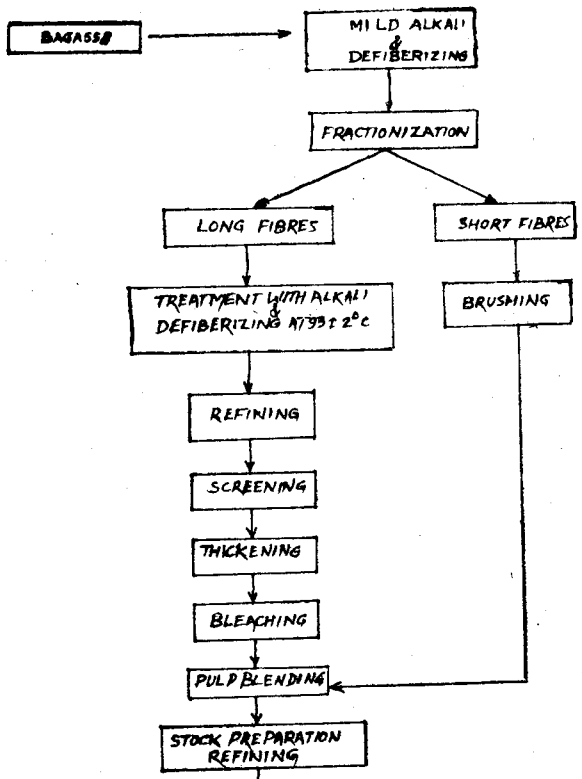

FIG. 1 PROPOSED FLOW DIAGRAM OF THE MODIFIED PROCE

Addition of Sodium Sulphite :

Trials were also taken to improve brightness of pulp by the addition of 2% Na_2SO_3 to Caustic Soda. The results are recorded in Table 1.

Addition of Bamboo Pulp :

A commercial bleached bamboo pulp was beaten to 210 ml. CSF. 20% of bleached bamboo pulp mixed with 80% of bagasse pulp prepared under condition given in Table-1 Sl. No. 2. The brightness of blends are given in Table-4.

Bleaching Response :

Bleaching response of long fibres, short fibres and whole bagasse was also studied by using the following sequence of bleaching :

(a) **Long Fibres :**

Ist Stage Hypochlorite

Available Cl_2 in Calcium Hypochlorite,	% :	10
Consistency,	% :	10
Temperature, °C	:	50
Time, minutes	:	45
pH	:	10

IInd Stage Hydrogen Peroxide

H_2O_2, %	:	1
Consistency, %	:	10
Temperature, °C	:	80
Time, minutes	:	120

(b) **Short Fibres :**

H_2O_2. Stage

H_2O_2 %	:	1
Consistency, %	:	10
Temperature, °C	:	80
Time, minutes	:	120

(c) Whole bagasse was cooked with 3.2% NaOH and 2.0% Na_2SO_3. The brightness is reported in Table—1, Sl. No. 7.

Beating of Bagasse Fibres :

The bagasse and long fibres were beaten in PFI mill at different revolutions to bring the freeness about 300-150 ml. (C. S. F.), while short fibres were defibrised to 60 ml. (C S.F.) freeness.

Results and Discussions :

Whole Bagasse :

The conditions of treatment of whole bagases at different concentration of Caustic Soda has been given in Table—1. The treated bagasse was refined in PFI mill to a freeness varying from 160-330 ml. (C.S.F.). From Table-1 and Fig. 2 it is observed that the pulps were very weak when treated with 2.4—4.0% total alkali. The strength properties improved when the treatment was donewith 4.8%—6.4% NaOH. The strength properties of whole bagasse when treated with 4.8% NaOH is suitable for newsprint grade paper while the pulp obtained with 6.4% NaOH is suitable for cheap grade printing papers. Brightness varied from 31.6 to 39.7, when cooked with 2.4—6.4%, while the opacity was more than 92% in every case. The yield of treated bagasse was more than 80% as shown in Fig. 2.

Long Fibres :

Table-2 and Fig-3 depict the conditions of long fibres. The Perusal of this table revealed that the treatment with 2.0% NaOH for 60 minutes was suitable for cheap grade paper. Thus it is observed that long fibres can be treated with lower chemicals (3% NaOH) to produce better pulp than whole bagasse (4.8% NaOH). The yield of long fibre was more than 80% (Fig. 2).

TABLE—1. WHOLE BAGASSE PULPING AND STRENGTH PROPERTIES OF HAND SHEETS

Sl. No.	Conc. of NaOH	NaOH	Unscreened yield	P.F.I. mill	Freeness	Strength Properties of Standard Sheets				
	gpl	%	%	Revolutions	ml. (CSF)	Tensile index N. mg.	Tear index $mN.m^2/g$	Burst index $kpam^2/g$	Brightness I.S.O.	Opacity %
1.	6	2.4	90.2	5000	300	—	0.59	—	32.0	98.9
2.	8	3.2	89.6	4000	330	5.50	0.84	—	31.6	98.6
3.	10	4.0	87.1	4500	290	6.39	0.86	—	32.1	99.3
4.	12	4.8	85.2	4000	170	16.60	2.34	0.08	—	93 6
5.	14	5.6	82.6	1000	165	29.37	3.00	1.17	—	92.3
6	16	6.4	80.4	1000	160	35.56	3.81	1.48	39.7	—
7.	8+5*	3.2+2.0*	79.2	—	—	—	—	—	33.6	97.8

*Sodium sulphite

Pulping Conditions :

Time of treatment, minutes	:	30
Bath ratio	:	1 : 4
Temperature of treatment,°C	:	95±2
Refining, μ	:	7.5, 2.5

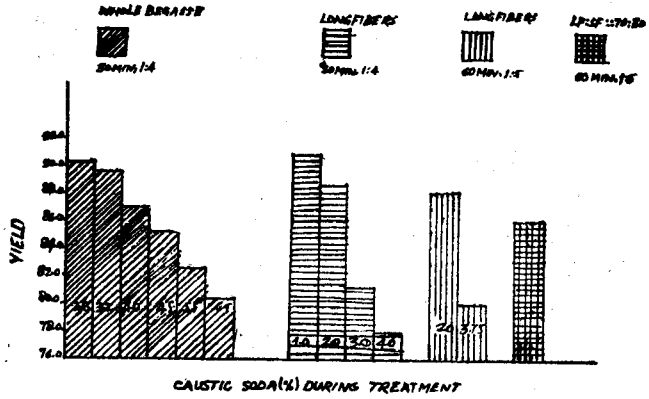

FIG 2. YIELD Vs CAUSTIC SODA(%)

Blending of Long and Short Fibres :

Table-3 and Fig-3 give an indication of strength properties of blends of treated long fibres and untreated short fibres. The mixing of short fibres was done in the original ratio i.e 70% : 30%. The results of pulp blend produced using 3.0% NaOH long fibre was sufficiently strong to give the newsprint paper requirement. This study also revealed that mixing of treated long fibres with untreated short fibres gave sufficiently strong sheet and the total chemicals used were also reduced.

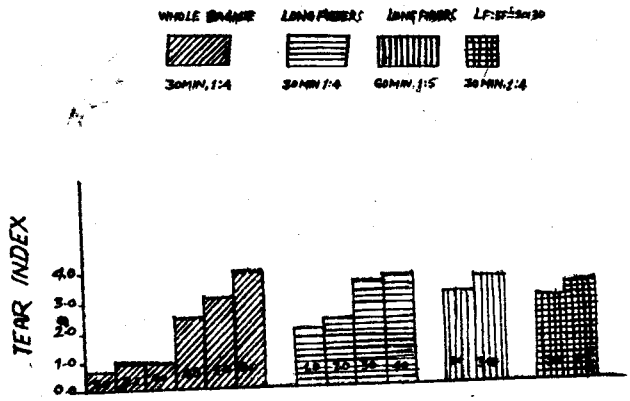

FIG.3 TEAR INDEX Vs CAUSTIC SODA %

TABLE 2. LONG FIBRE PULPING AND STRENGTH PROPERTIES OF HAND SHEETS

Sl. No.	Conc. of	Bath ratio	Time of treat-ment	NaOH	Unscree-ned yield	P.F.I.	Free-ness	Strength Properties of Standard Sheets				
	gpl	—	Min.	%	%	Rev.	Ml. (CSF)	Tensile index N.mg.	Tear index mN m^2/g	Burst index kpam²/g	Bright-ness ISO	Opacity %
1.	2.5	1:4	30	1.0	90.8	6000	1[illegible]0	8.73	0.89	—	30.5	99.1
2.	5.0	1:4	30	2.0	88.6	4500	325	12.01	1.19	—	31.1	98.6
3.	7.5	1:4	30	3.0	81.2	4000	200	37.60	3.40	1.42	32.0	96 4
4.	10.0	1:4	30	4 0	78.1	Valley beater	275	36 84	3.56	1.63	34.4	90.7
5.	5.0	1:5	60	2.0	88.0	3000	205	20.57	2.96	0.35	29.8	98.3
6.	7.5	1:5	60	3.75	80.1	2000	1[illegible]0	35.86	3.50	1.63	30.6	90.0

TABLE—3 STRENGTH PROPERTIES OF TREATED LONG FIBRES (70%) AND UNTREATED SHORT FIBRES (30%) BLENDS

Sl. No	Conc. of NaOH	Bath ratio	Time of treatment	NaOH	Freeness	Strength Properties of Standard Sheets				
	gpl	—	Min.	%	Ml. (CSF)	Tensile index N.mg.	Tear index mN. m^2/g	Burst index kPam² /g	Bright-ness ISO	Opacity %
1.	7.5	1:4	30	3	150	27.60	2.72	0.73	28.6	99 3
2.	10.0	1:4	30	4	210	23.56	3.20	0.64	29.7	98.5

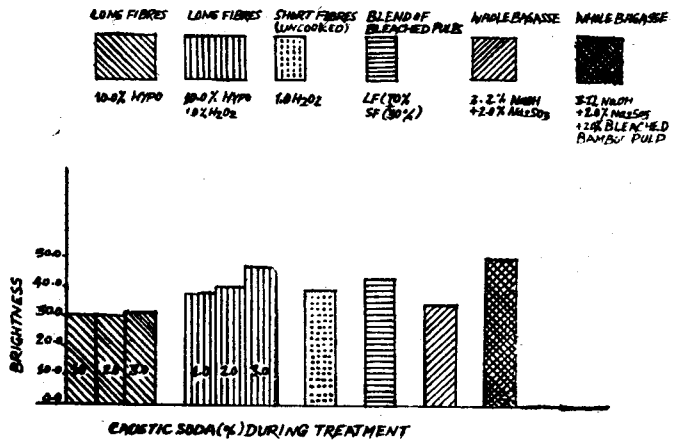

FIG. 4 BLEACHING RESPONSE OF BAGASSE FIBRES

Bleaching Response :

Table-4 and Fig-4 depict the bleaching response of the long fibres, short fibres and whole bagasse with the addition of hypo, H_2O_2, Na_2SO_3 and bamboo bleached pulp. The brightness of pulps of long fibres bleached with hypochlorite at different concentration (1-3%) do not improve with 10% Calcium hypochlorite. Addition of 1% H_2O_2 after hypochlorite bleaching improved the brightness significantly. The brightness of long fibres treated with 3% Caustic soda (Sl. No. 7 of Table-4 gave a brightness of 47. Short fibres (untreated) were also bleached with 1% H_2O_2 and the bleached short fibres was mixed with 70% of long fibres bleached with H/H_2O_2 sequence. The maximum brightness obtained was about 43. The whole bagasse treated with 3.2% NaOH with addition of 2% Na_2So_3 and 20% bleached bamboo pulp had a brightness upto 49.7 I.S.O.

TABLE—4 BLEACHING RESPONSE OF LONG FIBRES, SHORT FIBRES AND WHOLE BAGASSE

Sl. No.	Conc. of Caustic Soda gpl	Caustic Soda %	Type of fibres	Sequence of bleaching		Consistency %	Temp. °C	Time Min.	Brightness ISO
1.	2 5	1	L F.	H	10%	10	50	30	30.8
2.	5.0	2	L.F.	H	10%	10	50	30	30.9
3.	7.5	3	L.F.	H	10%	10	50	30	31.0
4.	Untreated	—	S.F.	H_2O_2	1%	10	80	90	39.3
5.	2.5	1	L.F.	H/H_2O_2	10%/1%	10/10	50/80	30/120	38.2
6.	5 0	2	L F.	H/H_2O_2	10%/1%	10/10	50/80	30/120	39.7
7.	7.5	3	L.F.	H/H_2O_2	10%/1%	10/10	50/80	30/120	47.0
8.	Blend (L.F.+S.F.) (70+30%)	3	—	—	—	—	—	—	42.7
9.	Whole Bagasse 8+5 (Na_2SO_3)	3.2 (Na_2SO_3)	—	—	—	—	—	—	33.6
10.	Blend Sl. No. 9+20% bleached bamboo pulp		—	—	—	—	—	—	49.4

H = Calcium hypochlorite

CONCLUSIONS

The following conclusions were drawn from the present study for the manufacture of newsprint.

1. Acceptable quality newsprint grade pulp could be produced in laboratory using whole bagasse and fractionation techniques using simple pulping process developed at Forest Research Institute Dehra Dun.

2. The bagasse when fractionated after mild alkali treatment produces strong pulp with lower amount of alkali. The blends of short and long fibres from bagass gives acceptable grade of pulps in high yields.

3. The study conducted on pulp bleaching is preliminary and warrants detailed inverstigations.

4. Addition of 20% bleached bamboo pulp to whole bagasse pulp improves the strength properties and brightness.

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