Developments in bagasse fibre preparation in TNPL

Subramanian S., Narasimhan K., Dorairajan V., Mohan Rao N. R., Thusu N. K.

ABSTRACT

In the light of dwindling forest resources, Indian Pulp & Paper Industries is in search for alternative raw materials. In TNPL, bagasse which is a renewable resource raw material, is used. The effective depithing operation improves the fiber quality and thus the pulp quality. In this paper, our experience in moist depithing is explained. The mechanism and the influential parameters in moist depithing are discussed. Secondary depithing operation helps to improve the fiber quality further. Sand riffler introduction in secondary depithing minimises the sand content which helps to reduce wear and tear on machinery.

Introduction :

TNPL is producing Newsprint as well as writing and printing papers with bagasse as a primary raw material. The bagasse is obtained from Tie-up sugar mills as well as from open market. TNPL has installed coal fired boilers at sugar mills premises and supplying steam in exchange for bagasse. The bagasse thus got is depithed in two major off-sites itself and transported to main site by road. The bagasse purchased in open market and the nearby off-site which is hardly 4 km from the mill site is depithed at the mill. The depithed bagasse is stored in Piles after mixing with water. The stored bagasse is reclaimed for wet depithing to be used in chemical and mechanical pulping streets.

Need For Fibre Preparation

In TNPL 3.3 to 3.5 lakhs tonnes of bagasse is used per annum. Bagasse consists of 55% fibre and 35% to 40% pith (1). To produce good quality pulp from bagasse, the major portion of dirt & pith should removed due to the following reasons :

- Removal of pith by depiting improves the quality of pulp. The pith is used as a fuel in boilers thereby reduces coal consumption.
- Pith gives low yield, high Kappa and higher chemical consumption (2, 3).
- During pulping pith tends to swell after absorbing the chemical, and becomes gelatinous thus causing difficulties in washing, screening and bleaching by clogging the wire mesh (4).
- High pith in pulp may cause poor drainge and sticking problem on granite rolls.

Since the bagasse is agricultural residue, foreign materials like stone, sand, iron pieces etc , are likely to more in the sugar mills where the higher mechanisation of sugar cane is practised.

Moist Depithing

Moist depithing is the process of directly depithing the bagasse after crushing at a moisture around 50% (W/W) (5).

Mechanism (6)

A strong bond is formed between pith and fibre since pith and fibre are chemically identical in nature. Both have high percentage of pentosans and due to disordered molecular state of the hemi,cellulose group, pith and fibreare swollen in the natural state. After extraction of juice from sugarcane, when bagasse is

Tamil Nadu Newsprint & Papers Ltd.
P. O. KAGITHAPURAM-639 136
Trichy Distt. (Tamilnadu)

dried a strong bond is formed with fibre and pith. This bond may be a Hydrogen bond.

At present the depithing is carried out in main site as well in off-sites in vertically mounted depithers supplied by BJD, based on the design developed by Kimberly Clarke De Mexico. Based on the operating experience for the past eight years, developments/ improvements were done to achieve better depithing efficiency.

Influential Parameters of Depithing

The means of monitoring the degree of pith removal in moist depithing are :

1. Moisture content in the incoming whole bagasse.
2. The feed rate to the depithers.
3. The initial pith content in whole bagasse.
4. The clearance between the Basket and Hammer.
5. The thickness of the screen basket.
6. The diameter of the perforation of screen basket.

Observations During Trials

1. When the moisture content in the whole bagasse is high the percentage of pith removal is less. Due to high moisture in the screen basket holes also get clogged. This leads to frequent cleaning of the baskets.
2. The designed capactity of the depithers at TNPL is 16 tonns/hour. When the feed rate is irregular the efficiency and the quality of depithed fibre is affected. When the feed was regulated by adjusting the inlet opening gate to the depither to about 75%, this problem could be overcome and the quality of depithed bagasse has improved.
3. Since the sugar mills are going in for better recovery variety canes, pith content in the whole bagasse is increased (around 40%). This adversely affects the quality of depithed bagasse.
4. When the clearance between the hammer and basket is more, the free passage is more. When the clearance is reduced by increasing the hammer length improvement of quality of the accepted fibre with less percentage of pith is observed.
5. The thickness of the basket is also another parameter which affects the accepted fibre quality. When the thickness is more the travel distance is more. This results in jamming the holes of the screen baskets and reduces the percentage of pith removal. When the thickness is less, no clogging is observed and the percentage of pith removal is more.
6. The perforation diameter of the screen basket is one of the parameters that affects the quality of depithed fibre. Larger the diameter higher is the percentage of fibre loss in the pith separated. Smaller diameter reduces the firbre loss in pith.

Depither Maintenance Problems :

The low pH due to residual sugar in bagasse causes corrosion to screen baskets. The incoming foreign materials cause erosion to screen baskets and hammers. To avoid the frequent changing of hammers due to foreign materials special hard face welding is done at the tips.

Secondary Depithing :

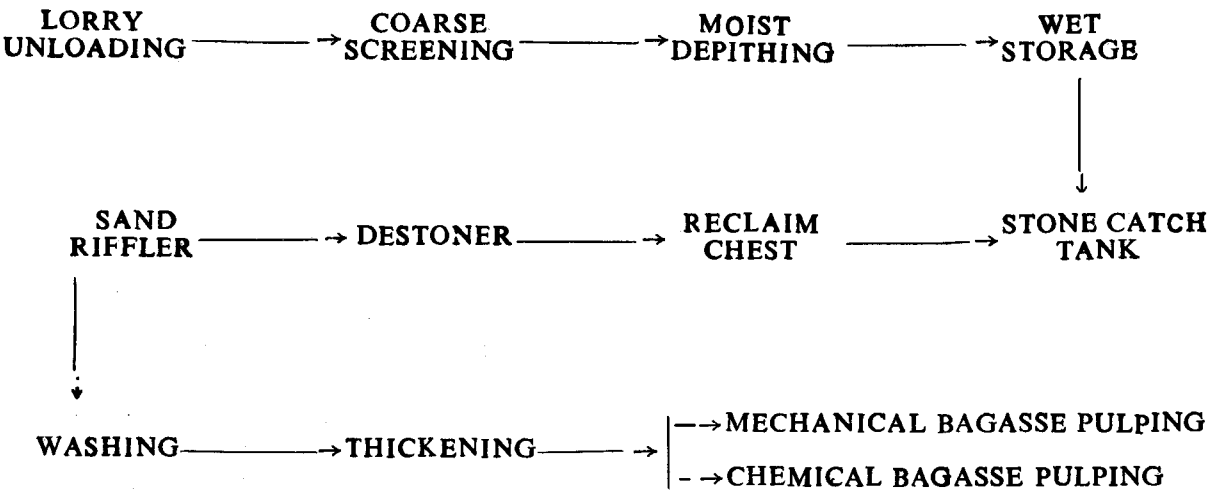
Since sugarcane is a field crop, it normally contains dirt and ash on arrival at the sugar mill. This is the only method to reduce the silica content to minimum level. This will substantially reduce the wear on the subsequent machinery. Secondary depithing removes dirt and pith and also helps to reduce the concentration of acids formed during storage.

In secondary depithing fibre is completety soaked in water (Consistency 3%–W/W) in the depithing process and has uniform moisture content before it gets to the digester thus resulting in uniform cooking. The sand left with depithed fibre after moist depithing and wet piling are removed as shown in Fig 1.

Operation

The depithed fibre is reclaimend from storage yard through conveyors to stone catching tanks where heavy foreign materials are removed. The depithed fibre is mechanically agitated in reclaim chest at low consistency. The slurry is pumped to Destoner where small stone Pebbles and coarse sand are removed at regular intervals. The over flow from Destoner passes through the sand rifflers four in numbers. Here the fine sands are removed to the extent of 35 to 40%.

Fig. No. 1 BAGASSE HANDLING PROCESS



Sand riffler outlet fibre slurry is pumped to Aqua separators (5 Nos.) where dirt and pith are removed. In secondary depithing operation the percentage of pith removal is 8 to 10%.

The separated pith is collected after dewatering in side hill screens and further thickened in plan press (Dryness 15%). Developments are going on to improve the dryness by using sugarcane crushers to 50% to directly fire in the boilers. Aqua outlet is passed through screw presses to improve the consistency further and then distributed to Chemical and Mechanical bagasse pulping streets.

Effect of Sand Riffler on Fibre Quality

Earlier when there was no stone catch tank and sand rifflers, the foreign materials used to enter the system thereby reducing the life of the Refiner segments, screw conveyors and plug screw feeder of continuous digesters. After installation of stone catch tank and sand riffler, the running hours of refiner segments has improved nearly by 2.5 times compared with our earlier running hours. Also the life of the plug screw feeder in digester has improved by 100%.

Effect of Depithing on Pulp Quality

Samples of whole bagasse, moist depithed Samples of whole bagasse fibre and secondary depithed bagasse fibre were collected for pulping to evaluate the pulp quality. For all the above three samples pulping was carried out using 12% chemicals as Na_2O. On depithing yield in creases from 50.5% to 54.0%. Kappa number reduces from 23 to 12. Tear index increases from 5.3 to 5.8. The results are shown in Table No. 1. The yield, Kappa No. and Brightness improvements are shown in Fig. 2, 3, 4.

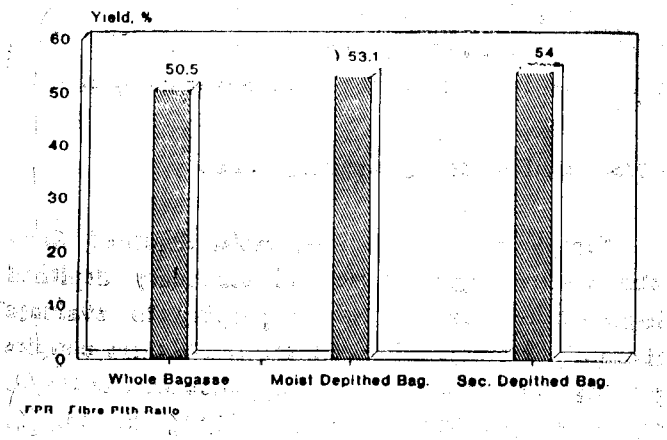
TABLE—1

EFFECT OF DEPITHING ON PULP QUALITY

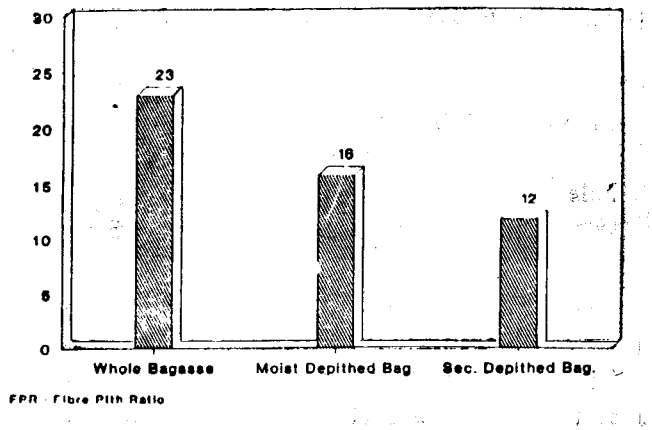
S. No.	Particulars	Units	Whole Bagasse	Moist Depithed Bagasse	Secondary Depithed Bagasse
1.	**Fibre-Pith analysis**				
	Useful fibre	%	52	63.2	67
	Pith	%	38	28.8	26
	Water solubles	%	10	8	7
	Fibre pith ratio		1.37:1	2.17:1	2.60:1

2.	**Pulping**				
	Chemicals as Na_2O	%	12	12	12
	Yield	%	50.5	53.1	54
	Screened rejects	%	2.1	1.2	.47
	Kappa No.		23	15	12
	Brightness	%-ISO	30	36.5	39.5
	WBL-pH		10.9	11.2	11.3
	R.A.A. at 200 gpl. T.S.	gpl	2.15	3.20	4.03
3.	**Strength Properties**				
	Freeness	ml	400	440	490
	Bulk	cc/g	1.6	1.63	1.68
	Tensile index	Nm/g	59.6	64	68.2
	Tear index	mNm^2/g	5.3	5.88	5.05
	Burst Index	$KPam^2/g$	3.46	3.73	4.11
	Brightness	%ISO	28	34.5	37.8
	Opacity	%	98.4	94.1	89 2
	Scattering Co-efficient	m^2/Kg	25	26.5	27 5
	Yellowness	%	39.1	34.5	30 4

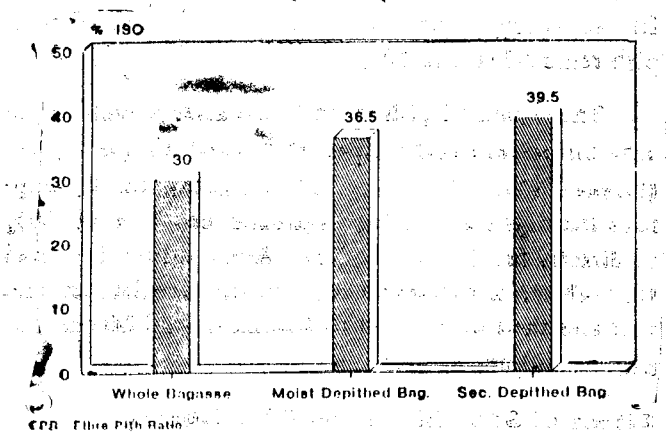
LOW FPR BAGASSE PULP QUALITY
Fig No. 2 - Yield



LOW FPR BAGASSE PULP QUALITY
Fig No. 3- Kappa No.



LOW FPR BAGASSE PULP QUALITY
Fig No. 4- Brightness



When pulping was carried out with the samples of higher fibre pith ratios, it was observed that the yield increases from 52.2% to 56.2%.

The kappa number reduced from 18 to 10. The tear index increased from 5.49 to 6-27. The cleanliness of the pulp was good. The results are shown in Table 2.

The yield, Kappa No. and Brightness improvements ars shown in Fig. 5.6 and 7

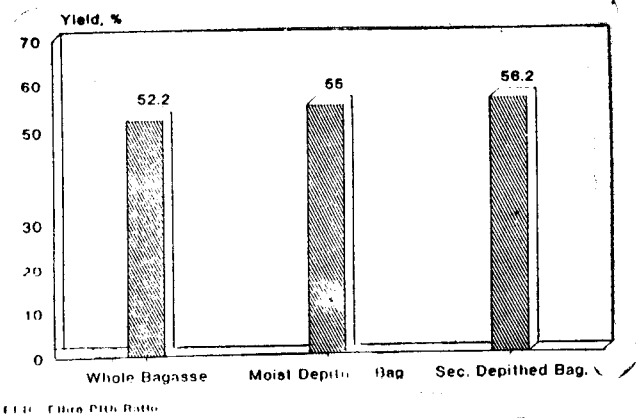
Conclusion

By monitoring the parameters during moist depithing maximum percentage of pith removal can be achieved with less fibre loss in the separated pith.

TABLE—2

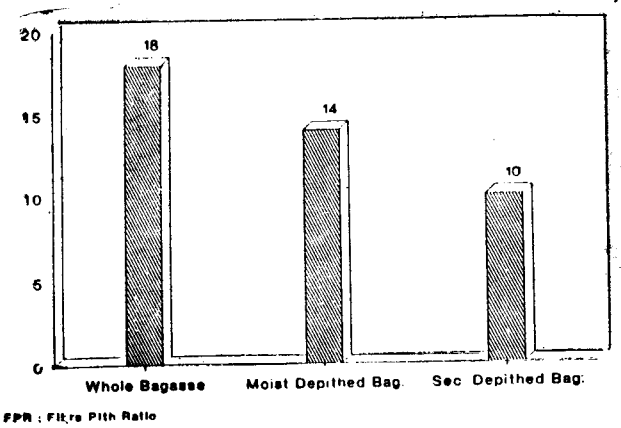
S. No.	PARTICULARS	Units	Whole Bagasse	Moist Depithed Bagasse	Secondary Depithed Bagasse
1.	**Fibre-Pith analysis**				
	Useful fibre	%	58.6	64.9	70
	Pith	%	31.1	25.7	23
	Water solubles	%	10.3	9.4	7
	Fibre pith ratio		1.88:1	2.52:1	3.00:1
2.	**Pulping**				
	Chemicals as Na_2O	%	12	12	12
	Yield	%	52.2	55	56.2
	Screened rejects	%	1.2	.7	.3
	Kappa No.		18	14	10
	Brightness	%ISO	32	36.8	41
	WBL - pH		10.8	11.5	12
	R.A.A at 200 gpl. T.S.	gpl	2.41	3.8	4 8
3.	**Strength Properties**				
	Freeness	ml	420	460	490
	Bulk	cc/g	1.5	1.6	1.65
	Tensile index	Nm/g	68.62	70.2	72.5
	Tear index	mN m^2/g	5.49	6.08	6.27
	Burst index	KPa m^2/g	3.65	3.9	4.41
	Brightness	%ISO	30	34.2	39
	Opaciy	%	98	92	88
	Scatter Co-efficient	m^2/Kg	25.4	27	28 5
	Yellowness	%	36.8	32 5	30

HIGH FPR BAGASSE PULP QUALITY
Fig No. 5 : Yield



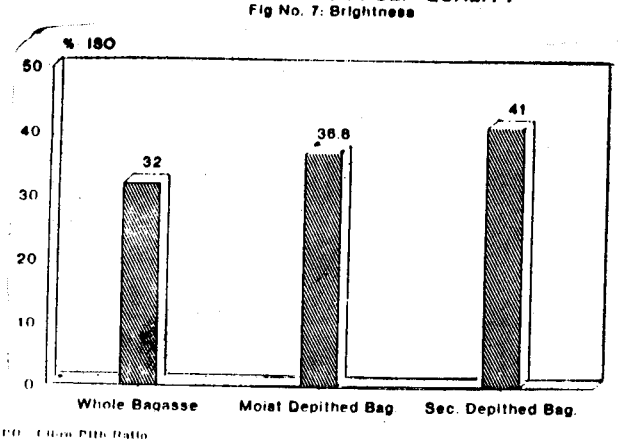
FPR : Fibre Pith Ratio

HIGH FPR BAGASSE PULP QUALITY
Fig No. 6: Kappa No



FPR : Fibre Pith Ratio

HIGH FPR BAGASSE PULP QUALITY
Fig No. 7: Brightness



Secondary depithing improves the quality of fibre and Sand Riffler system increases the life of the machinery.

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