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GREEN MANUFACTURING IN BAGASSE PULPING IN PAPER PLANT

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Abstract:

Bagasse from in-house sourced cane scores over externally bought bagasse in terms of increased fibre content [63% as against 55%] ,as also higher fibre to pith fines ratio [2.2 as against 1.6] and that too of quality in terms of lowered solubles [9% to 11%] .

Advanced depithing operation ensures through efficient separation of fibre for subsequent pulping. Lukewarm water wet depithing followed by energy efficient screw press would lead to lower moisture content of material entering Continuous Digester resulting in reduction in steam consumption.

It is proposed to go in for dual steam pressure in the digester. LP steam (4 kscg) shall be admitted for raising temperature of pulp followed by MP steam (10 kscg) admittance. MP steam consumption shall be lowered by 70 to 75% through LP steam and warm water usage . In addition, Digester shall be comprehensively insulated with UGAM HRTI200 insulation paint so as to minimize radiation & convection heat losses.

In the subject installation of Digester unit of 100 TPD Bagasse Pulping unit of the Paper plant, with Steam derived from Energy efficient Back -pressure Steam turbine integrated to HP Chemical Recovery boiler, switch from MP to LP & MP steam and total advanced insulation of digester is expected to result in increased Green Power generation of ~4000 units/day, besides small reduction in steam consumption. Over & above, through indigenous milled fresh bagasse usage, increase in quality fibre of around 4 to 5 % ensures increased pulp productivity .

Keywords: Bagasse pulping, Wet depithing ,Continuous Digester, Nano-insulation paint, MP/LP steam, Pulp Productivity, Emission reduction.

Introduction:

With in-house milled bagasse of quality together with advanced depithing operation ensures thorough and efficient separation of fibre for subsequent pulping in bagasse based pulping unit of Seshasayee Paper Erode plant. Innovative energy efficiency scheme ensures energy conservation and cost saving in a big way. For clear appreciation and understanding of total process from bagasse to depithing through pulping to paper manufacture and co-gen steam and power generation, refer Fig.1[1].

Productivity with Quality of Bagasse

Bagasse as milled from adjoining Ponni sugar mill is of high quality [adopting the following best practices as elicited in Table -1] as compared to the bagasse sourced from other sugar mills located away and stored for a length of time .

TABLE-1 [2]

Productivity with Quality related to Bagasse Pulping -Advisory

- Cane quality control in harvesting in place.
- Minimization of cane trash, cane tops and binding material alongwith cane prior to milling.
- Minimal generation of fibre fines during cane preparation & milling operation.
- Solubles in bagasse to be minimal through hot water imbibition.

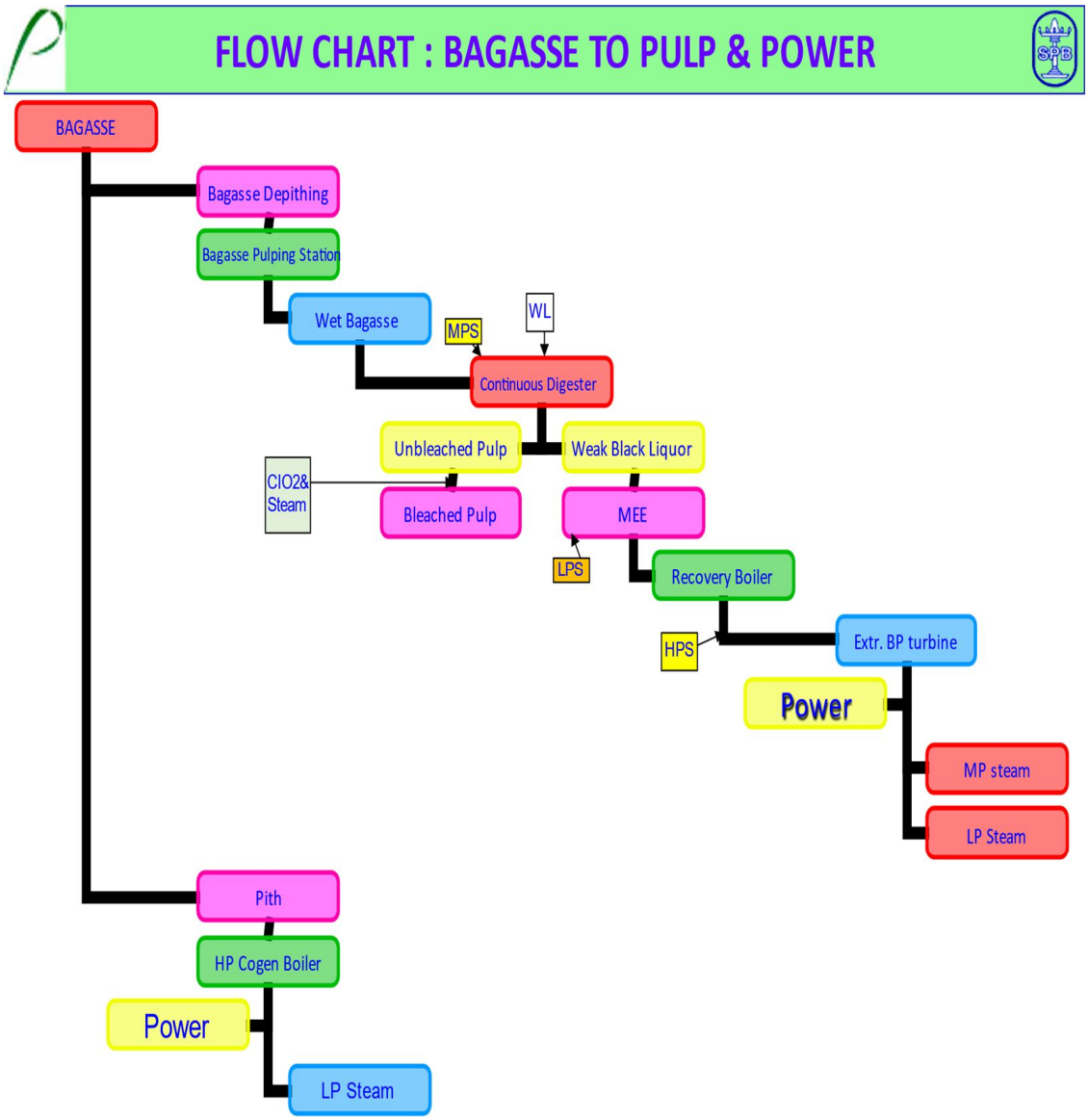


Fig. 1. Bagasse to Pulping & Steam & Power for Process

- **Maximizing fibre with minimum fibre fines, pith and solubles in finished bagasse to be made available for Wet depithing and bagasse pulping.**

The characteristics in terms of lower pith fines and solubles in depithed bagasse as can be seen from Table – 2 (illustration) leads to increased productivity of quality (estimated at around 4 -5 %) both in terms of pulp for paper manufacturing or liquor for Green power in Recovery complex .

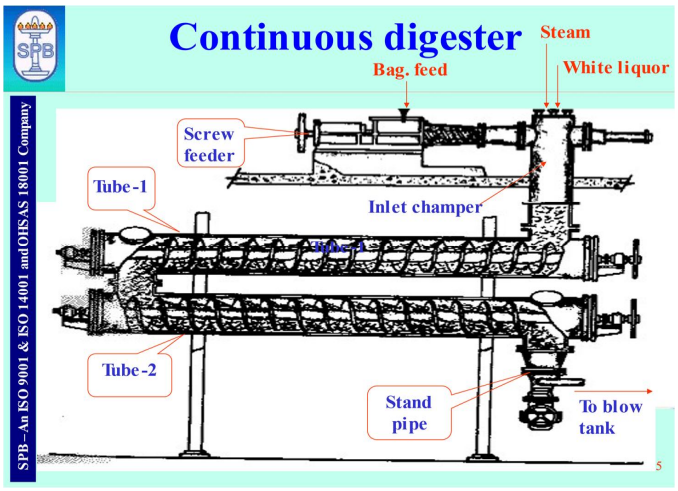
TABLE -2 [1]

De-pithed Bagasse break-up

Feed Source	Milled fresh Bagasse	Externally sourced Bagasse
Fibre	62-63 %	54%
Pith & Pith fines	27-28%	35%
Solubles	9-10%	11%

Facets of Bagasse Pulping

Primary objective of depithing of bagasse is to remove fibre from solubles and pith fines. Dry followed by moist depithing is to minimize fibre fines in accepts and low fibre in rejects. Wet depithing is carried out for -a) Sand & dirt removal & b) pith reduction in feed to Pandia Digester. Pulp yield and of quality are related to fibre content in feed to Digester. Fibre fines in rejects are beneficial only in terms of heat content. Standard practice is to wash with ambient water for wet depithing. Moist wet fibre is led to screw press for removal of moisture to the maximum extent possible; from where it is fed to Continuous Digester[CD] wherein white liquor is added. CD consists of 2 tubes with steam ,liquor and the feed material led to the first tube [Tube-1] through the inlet chamber. MP steam is being admitted in CD for bagasse pulp cooking. The product discharge is blown from Tube-2 exit [Refer Fig.2].



Energy efficient screw press is advocated for lowering moisture content of warm material entering Continuous Digester for effecting reduction in steam consumption in the digester.

Green Manufacturing through Switch from Higher pressure steam to Lower pressure steam

It is common practice to go in for Higher pressure steaming condition for generation of increased Power generation. As a corollary, switching from higher steam state to lower steam state for process utilities through energy conservation and innovative schemes would result in additional power generation from cogeneration unit . It is advocated to go in for use of warm fluid , then LP steam and finally MP steam for mill-wide usage for promoting Green manufacturing through reduction of fossil fuel usage.

Taking the cue from warm water imbibition for increased yield in sugar cane milling in all sugar plants, warm water [instead of water at ambient] is being proposed for wet depithing in the present bagasse pulping station. This aids also in more efficient removal of solubles [wax/epidermis etc] & silt/ dirt from depithed bagasse as the latter is led for steam cooking in Continuous digester .

With Chemical Recovery Boiler based on black liquor solids[a renewable energy fuel] designed for high pressure steaming conditions [65 kscg /460°C], passing HP steam to Back pressure STG with extraction, would result in generation of green power and steam for process[3,4] [Fig.3] as under :

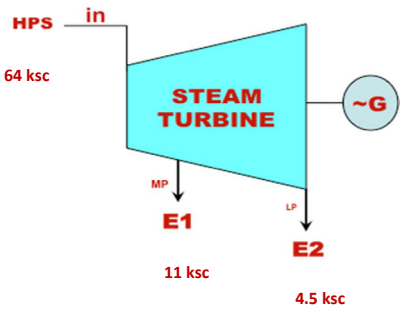


Fig. 3. Back pressure STG with Extraction related to Chemical Recovery HP Cogen

Through MP steam [11ksc] extraction, specific power generation would be 0.075 MW/t [5]

Through LP steam [4.5 ksc] extraction, specific power generation increases to 0.125MW /t [5]

It should be noted that even with Double Extraction Condensing steam turbo-generator [designed for higher pressure steaming conditions [105 ksc,505°C], specific power generation differential with MP to LP steam switch relates to 0.05 MW /t. Either way, this would mean that through MP to LP steam switch, one shall be able to gain an additional 50kW /t of steam consumption.

LP steam [3.5 kscg] shall be used to raise temperature of dilute pre-pulped solution to a much higher temperature. Finally entire cooking operation shall be carried out with minimal MP steam and operation completed as was the case earlier.

Switchover from MP steam to luke-warm water depithing and LP steam [partially/ totally] would result in increased Green power generation as can be seen from Illustration in Table-3.

TABLE –3

Impact of increased MP to LP steam Switch on Power Generation

MP steam to LP steam	5	6	7	8	9	TPH
Increase in Power generation	0.25	0.30	0.35	0.4	0.45	MW

Proposed Scheme

Presently, Continuous digester process for Bagasse pulping had gone in for use of MP [10 kscg] steam only. As against , we are advocating usage of three stages of [wet bagasse + white liquor] heating in Continuous Digester.

Phase 1 :

Luke-warm as available elsewhere in the mill shall ensure wet depithing at ambient being raised by ~ 20°C or so[28°C to 50°C].There would be reduction in LP steam consumption due to water preheating .

Phase 2 :

LP steam [3.5 kscg] shall be used to raise the temperature of the dilute prepulped solution to a much higher temperature.

Phase 3 :

Finally the entire cooking operation shall be carried out with MP steam [10 kscg] and operation completed as was the case earlier.

The energy benefits with stage-wise realization of the same are elucidated in Table -4.

TABLE - 4

Energy Conservation in Pandya Digester

Parameter	Existing	Proposed	Energy gains
Input :Depithed wet bagasse with Liquor	Ambient conditions	With warm water	
Temperature of feed	28-30°C	45- 50°C	12-15%
1st Stage	MP Steam injection 155-158°C	LP Steam injection	
Temperature		125-130°C	60-63%
2nd Stage		MP Steam injection	
Temperature		130-155°C	-

Energy Conservation Strengthening & Decarbonization

Pandya digester consists of 2 tubes each of 2 metres dia and 3 metres long with 9 m^3 holding capacity [volume] . As it is being filled up by hot material with direct steam injection the surface exterior would be quite hot and hence had to be insulated. As the insulation is scanty and not completely effective, there is bound to be heat losses through radiation and convection to the surrounding atmosphere.

It is proposed to go in for advanced Nano multilayer high resistance temperature paint [UGAM HRTI 400] applied over the entire tube exterior as also connected fittings and valves [6]. Not withstanding, even the pipe carrying the steam to the Digester tube has also to be coated with HRTI 400 paint. In order to be totally effective, multi-layer of 3 coats of the nano-paint [7] over both the digester tubes as well as the connected auxiliaries is being advocated. Once this is done, there would certainly be further reduction in steam consumption on a continuous basis.

With all of the above schemes in place, energy conservation in terms of MP to LP steam switch, as also reduction in steam consumption is clearly summarized in Fig.4 as under :

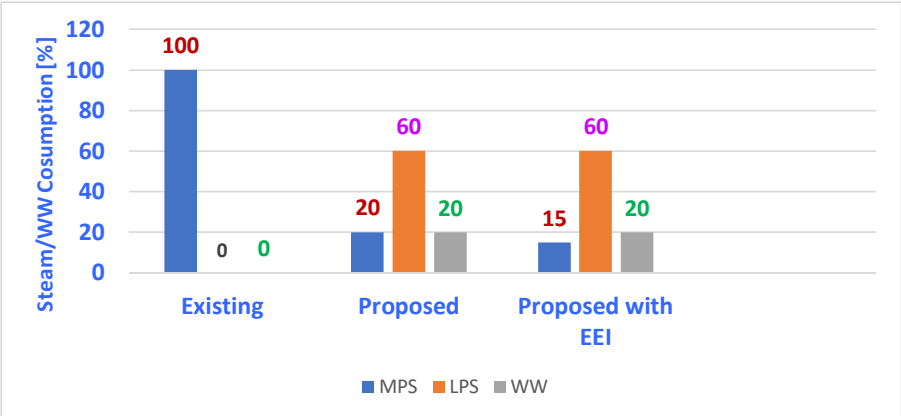


Fig.4. MP Steam to Warm water -LP steam-MP steam Switch

The 3 E gains for an illustration case are summarized in Table – 5 at next page:

Steam Management in Bagasse Pulping related to 3 Es

The impact of moving from HP steam to lower pressure steam and finally steam reduction through waste lukewarm water utilization is one of gains in all 3Es viz., Energy conservation, Cleaner Environment & Emission reduction as summarized in Table -6. at next page:

Productivity enhancement

With adjoining mill bagasse used for bagasse pulping, fibre yield is higher by 15 % with in-house quality depithed bagasse as compared to stored external bagasse depithed in the plant ; of -course, the pith fines and pith output in the accept decreases by 15 %. Additional ~ 2 % solubles is the increase in dead weight in case of externally sourced bagasse. All of the above obviously results in enhancement of productivity of quality to the tune of say 3 to 5 %. Needless to say, it has significant gains of all 3 Es , which are not factored in Table -6 as above.

Conclusions

The present study brought out through bagasse pulping advances focussing on all the 4 facets viz.,

a. Increased Productivity with Quality,

b. Green Power enhancement

c. Lowering of Stack Pollutants and

d. Carbon Emission reduction.

Maximizing the quality bagasse usage from the adjoining mill for depithing and subsequent pulping ensures increased fibre yield for paper manufacturing [attendant with lowered non-valued solubles].

Warm water depithing of bagasse followed by switch from MP to LP steam to the extent practicable, would result in increased Green Power generation from the associated Back pressure Steam

turbo-generator on a continuous basis with corresponding reduction in Absolute stack Pollutants discharge and Decarbonization.

TABLE - 5

Innovative Energy Scheme related to 3 Es-Bagasse Pulping-SPB

Bagasse Pulping Design : 100 TPD

Bagasse Pulping Normal : 60 to 70 TPD; Operating hours /day : 12 to 14 hours

Source of Bagasse for Pulping :Ponni Sugars [adjoining mill]

Parameter	Existing Scheme	Proposed Energy Scheme	Energy & Decarbonization gains
	MP steam	WW/LP/MP steam	
MP Steam	9	2	1 TPH MP steam
LP Steam		6	0.3 MW
Green Power enhancement	Basis	0.3 MW	4000 Units/day
MP Steam reduction		1 TPH	12 TPD
Carbon (Emission reduction) credits			2500 tCO2e/annum
Stack pollutants discharge reduction			2.5 to 3 %

TABLE – 6

Sliding from High to low energy level usage on 3Es

3 Es	Output	HP Steam	MP Steam	LP Steam	Lukewarm waste stream
Energy	Power generation	⇨ Increased ⇨			
Environment	Bottom/ Fly-ash	Reduction			
Emission*	GHG Emission	Reduction			

*. : It also includes Scope-3 Emissions.

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