Stretching Captive Pulp Production - A Case Study

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ABSTRACT

This article deals with various steps taken by the mill to increase the capative pulp production, mostly by process changes with minimum investment and least impact on Chemical Recovery operations. The mill was initially utilizing many raw materials and mixed cooking was being practised. After elaborate trials in the laboratory using various fibrous raw materials, it was decided to reduce the raw materials to mainly two varieties, namely, Eucalyptus Hybrid and Casuarina. The mill was adopting mixed cooking of both the above raw materials. However, a laboratory study indicated that Casuarina requires lesser chemical than Eucalyptus.In SPB, attempts were made in bench scale to identify a suitable pulping aid in order to further reduce the cooking chemical requirement without unduly affecting the quality of pulp and cost of production.

INTRODUCTION

Seshasayee Paper Mills (SPB) was established in the year 1960 in Tamil Nadu with a capacity to produce about 20,000 tonnes per year using two paper machines. The mill then added two more paper machines one in 1968 and another in 1978, to increase its capacity to around 55,000 tonnes per year. The mill then commissioned its fifth paper machine in July 2000 with a capacity to produce an additional 55,000 tonnes per year. However for various reasons explained in this article, the mill was always short in captive pulp production.

Status in the year 2000

As explained above, while the mill can produce 1,15,000 tonnes per year (about 310 tonnes per day) of paper, the captive bleached pulp production was only 180 tonnes per day till recently due to various constraints in pulp mill and chemical recovery sections.

The mill has four 80 cu.m stationary digesters complete with its brown stock washing, screening and bleaching sections in the wood pulping street. Due to constraints primarily in the washing and screening sections, bleached wood pulp production was generally restricted to about 80-85 tonnes per day. The mill also has two horizontal continuous digesters complete with brown stock washing, screening and bleaching for bagasse pulping. Again due to restrictions mainly in brown stock washing, the production of bleached bagasse pulp was restricted to around 95-100 tonnes per day.

In the chemical recovery section, the mill has two LTV evaporators, two recovery boiler and a recaustisizing section with the capacity to process about 280-290 tons per day of black liquor solids.

RESULTS AND DISCUSSION

Expansion and modernisation project

Expansion and modernization project was conceived during late nineties with a view to double the capacity of the mill by installing suitable paper machine, pulp mill and chemical recovery. In view of the recession in the industry it was decided to curtail the expenditure by installing the paper machine alone complete with a waste paper de-inking plant. Again due to changes in the excise duty regulations and keeping in view the quality requirements of the final product, the de-inking project was also shelved. The mill, therefore, decided to maximize its captive pulp production using the existing pulp mill and chemical recovery. Considering the limitations in chemical recovery, efforts were made mainly to reduce black liquor generation in pulp mill.

Table 1. Pulping data of eucalyptus hybrid, casuarina and their blends

Particulars	UOM	Separate Cooking		Mixed
		E.hybrid	Casuaring	
Active alkali charge	%	20.0	19.0	20.0
Unbld. Pulp Kappa No. (at 25°C)		20.7	20.8	22.2
Screened yield	%	46.8	49.1	48.0

Table 2. Pulping results on effect of pulping aid

Description	UOM	Eucalyptus Hybrid		Casuarina	
		Without pulping aid	With pulping aid	Without pulping aid	With pulping aid
Active alkali charge	%	20.0	19.0	19.0	18.0
Dose of pulping aid	kg/t	-	0.175	-	0.175
Unbld. Pulp Kappa No.	-	20.7	21.0	20.8	21.0
Screened pulp yield	%	46.8	47.4	49.1	50.2

Wood pulp mill

Digester

The main advantages of separate cooking are:

Reduction in overall cooking chemical consumption.

Improved and uniform pulp quality

Based on these encouraging results, the mill now adopts separate cooking of Casuarina and E.Hybrid Table 1 gives the results of the study.

Generally, pulping aid acts as a surfactant that aids the penetration of cooking liquor by wetting and emulsifying the extractables. The increase in penetration allows the cooking liquor to have a faster and more efficient reaction. Pulping aid also ehances the penetration of cooking liquor to chips through the mechanism of liquor viscosity modification. With different pulping aid chemicals elaborate pulping experiments were done in R&D. Based on the encouraging results obtained in laboratory scale, a plant trial was taken for a month continuously to assess its actual performance. The plant scale results are presented in Table-2. Following remarks are drawn from the plant scale trials.

- A minimum of 5% reduction in active alkali charge per digester is possible, without affecting the unbleached pulp kappa number level of 19-22 using pulping aid.
- No problems encountered in Washing, Screening or Bleaching.
- Physical strength properties of unbleached pulp are comparable with or without Pulping aid.

Based on one month plant trial, the additional cost for use of the pulping aid was assessed at Rs 50-55 per tonne of BD pulp.

Few other steps such as additional steam lines, increasing the size of blow line, altering the total cooking cycle have also been implemented in order to increase the pulp production with reduced cooking chemical addition and black liquor generation.

Brown stock washing

Periodical cleaning of the drum washers using the high pressure jet pump and provision of bypass arrangements for each drum washer has helped in improving the condition of the drum washers. This has resulted in good mat fomation and consistency of the pulp. In addition to the above, SPB has gone for a "wash-aid" to improve the output of Brown Stock Washers and also to increase the density of spent liquor going to Chemical Recovery Plant. Wash-aid accelerates the drainage rate of the interlamellar liquid and thus disrupts the double-film nature of the foam bubble wall. It intensifies gas diffusion. By displacing the foam stabilizer from the interface, the surface elasticity of a foam boubble is reduced and the stability of from lamellae is drastically weakened until the foam structure is disrupted.

The mill carried out preliminary trials using various wash aids. Since the preliminary trials gave encouraging results, a plant trial was also undertaken.

Table 3. Performance of wood brown stock washing system with and without washing aid

Particulars	Dosage of wash aid g/t of OD pulp	WBL °TW at 70°C	Soda Loss (kg of Na_2SO_4/t of OD pulp)
Without Wash Aid			
Day-1	-	12.5	13.50
Day-2	-	12.5	15.60
Day-3	-	13.0	16.00
Day-4	-	12.5	13.70
Day-5	-	13.5	15.0
Day-6	12.5	16.50	
With Wash Aid			
Day-7	80-100	14.00	12.50
Day-8	80-100	14.0	12.50
Day-9	80-100	14.0	14.50
Day-10	80-100	15.0	14.40

- Wash water temperature maintained at around 70°C
- Mat consistency was around 13-14%

Table-3 gives highlights of the plant trial. Following are the inferences:

- For the same wash water addition, black liquor twaddle increased by two units
- Alkali loss with the washed pulp also showed a reduction of about 2 kg of Na_2SO_4 per tonne of pulp (form 15 to 13 kg)
- Considerable reduction in the foam generation was observed which seem to have helped in better washing.
- Operating personnel were of the view that the use of wash aid has helped in better washing in addition to improved throughput.
- The additional cost due to use of wash aid works out to approximately Rs. 25-30 per tonne of pulp.

Bleaching

In order to increase the throughput of the bleach plant, it was decided to carry out chlorine stage bleaching using two parrallel chlorination/tower system. As expected, when the chlorination was made more effective, the mill has been able to push more pulp through subsequent bleaching stages.

In addition to the above, a rearrangement of processed tower sequence was also implemented by which the retention time for reaction was considerably increased. The introduction of extraction peroxide stage helped to reduce the hypo-addition. Added to this, the quality of hypo solution was also improved using better quality lime and the hypo clarifier. These resulted in reduced choking of the drum washer mesh, which in turn helped to push more pulp thourgh the bleaching section.

Since the mill produces wide range of papers, some of them being coloured varieties, the mill always accumulated broke in white as well as coloured varieties. Extensive laboratory work was done on the bleachability of various colored brokes. These coloured brokes were classified as bleachable and not so easily bleachable varieties. The easily bleachable coloured broke was taken to the appropriate stage in the bleaching section for augmenting the bleached pulp availability. Adequate care has been taken to ensure that such bleached broke does not affect the shade or quality of final bleached white pulp.

Bagasse pulp mill

Bagasse preparation

The mill receives nearly 50% of its bagasse requirement from its own sugar mill namely Ponni Sugars. The balance 50% is received from outside sugar mills as undepithed bagasse. In order to maximize the overall yield, keeping the chemical recovery in mind, many trials were taken using various perforations in the depithers for Ponni bagasse. The bagasse received from outside was not undergoing any moist depithing operation earlier. A separate system was installed to depith the outside bagasse so that the

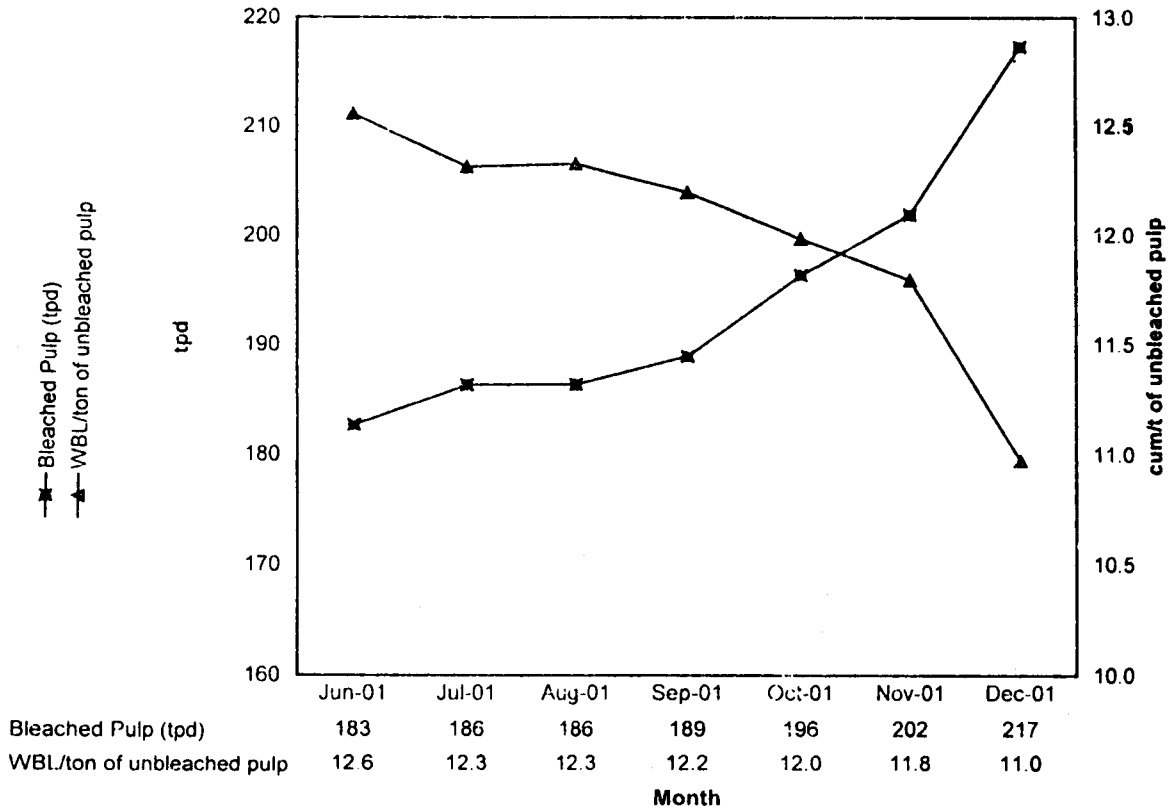

Fig. 1 Bleached pulp production vs black liquor generation

pith is removed in the depither itself and does not get carried along with black liquor to the chemical recovery section. Additional bagasse slushing facility complete with sand removal system was also introduced to minimize the scaling in the evaporators.

Digesters

It is always good to run the continuous digesters to their rated capacity so as to minimize the addition of steam. If steam addition is more, it gets carried into the brown stock washing system and subsequently to the evaporators. Extensive studies were done on the screw feeder design, bagasse feeding arrangement, the drive of the screw feeder etc. to ensure that the continuous digester always operates at its rated capacity.

In view of the restrictions in the chemical recovery section, the cooking chemical to the continuous digester for bagasse pulping contained caustic lye make up in the recovery. This make up was done using the weak white liquor in the recaustisizing section. Instead of this weak white liquor, the caustic lye make up was done using the black liquor, which resulted in reduced black liquor generation. The bath ratio control in the continuous digester is being done with weak black liquor. This has also helped to reduce the cooking chemical addition in the digester. As the use of pulping aid in hardwood pulping has shown significant reduction in cooking chemical consumption and also other benefits, extensive bagasse pulping studies were also carried out to establish its efficiency with bagasse. The bench scale findings are encouraging.

Following are the results:

- At the pulping aid dose of 175 g/t of OD of raw material, 1% yield improvement is experienced.
- About 10% cooking chemical dose could be reduced by using the pulping aid.
- Physical strength properties of unbleached pulps are comparable with control.

Based on bench scale study, a plant scale trial has been started recently and the performance is under observation. From initial results of plant scale trial, it has been observed that, about 10% chemical dose could be reduced without affecting the kappa number of pulp.

Brown stock washing

In view of high freeness levels despite using a low consistency blow in the continuous digesters, bagasse pulp is always dificult to wash. Hence a fourth stage was added for improved bagasse pulp washing.

In order to improve the washing, a definite percentage of wood pulp is being mixed with the bagasse pulp as a sweetener before the brown stock washing to improve mat formation and washing efficiency. It is also proposed to try wash aid for bagasse washing system.

Bleaching

The bagasse pulp requires milder bleaching conditions since it can be bleached easily. Hence only conventional 4 stage CEHH stage was being adopted. With increase in pulp production, peroxide was introduced in the extraction stage to improve brightness stability and simultaneously reduce hypo consumption. This was done along with rearrangement of process towers and bleach washers. Today, the bleaching sequence is CE_pHH for bagasse. All seal tank pumps were replaced with higher capacity pumps to improve the water management in the bleaching sequence.

CONCLUSION

Sustained efforts by the mill have improved the bleached pulp production from a level of 180 tpd in early 2001 to about 220 tpd in December 2001. This was achieved with a reduction in black liquor generation from a level of 12.5 cu.m/tonne of unbleached pulp to a level of 11 cu.m/tonne of unbleached pulp which works out to reduction of about 320 cu.m/day of black liquor generation. This is depicted in Fig. 1. The soda loss levels and bleach chemical consumption levels have remained fairly uniform throughout this period and there is no adverse effect on the quality of pulp.