

# Wet end operations with a furnish of 70% hardwoods and 30% bamboo at SPB

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Indian Paper Industry has gone through a critical period during the last decade due to the acute shortage of conventional raw material (Bamboo in India) particularly in Central and South Regions. As basic equipment used in these mills was designed for using bamboo, it was difficult to suddenly change the system to use hard woods, the only alternative raw material available in sizable quantities. However, for sustaining production the mill has faced the challenge boldly and gradually switched over from 10% to 70% hard wood in the furnish. In view of the difference in inherent characteristics of bamboo and hard wood fibres, certain skills had to be developed and experience was to be gained to run the equipment and machinery for the changed situation.

The information provided here gives the gist of difficulties faced in Stock Preparation and the ways found out to circumvent these difficulties to successfully run the machines with 70% hard wood and 30% bamboo. The objective and goal is, to be able to run these machines with the highest percentage of hard woods (as much as 100%). Therefore, the struggle continues to find solutions for various problems in the above mentioned sections.

## STOCK PREPARATION

Various advantages and disadvantages in consumption of chemicals and additives, merits of continuous Stock Preparation over a batch process and recommendations for using disc refiners are reported:

1. Increased use of mixed hardwoods has contributed to more fines as can be seen from fibre classification tests done for both bleached and unbleached pulps, tabulated in table 1.

TABLE 1 FIBRE FRACTIONATION

	a) 90% Bamboo + 10% Hardwoods		
	+ 50 Mesh	+ 100 Mesh	—100 Mesh.
Unbleached Pulp	59.7	16.4	23.9
Bleached Pulp	58.1	17.3	24.6
	b) 40% Bamboo + 60% Hardwoods		
Unbleached	34.1	32.7	33.3
Bleached Pulp	31.5	31.5	37.4

These fines, which are mostly vessel elements escape refining and come out as fluff in dryers.

2. Increased usage of hardwoods has resulted in appreciable reduction in consumption of rosin for sizing the paper. In 1964, when the furnish was almost exclusively bamboo pulp, the rosin required for sizing the paper at times was as high as 1.8%. With increasing hardwoods in the pulp furnish, the percentage of rosin required to size paper started gradually coming down. With around 30% hardwood, the rosin demand to meet ISI specification of 17 gsm cobb was 1.2% and with 60% hardwoods it is only 0.8%.
3. Another interesting fact noticed is the non-effectiveness of cationic wax emulsions in sizing the paper when hardwoods were introduced. Extensive trials done with wax emulsions showed that it is not very effective in substituting part of the rosin as claimed by manufacturers.
4. Use of gums for improved strength in unbleached kraft papers has definitely helped in improving

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the burst and tensile strength and fold without affecting the tear strength. These gums which are natural or modified guar gums are galactomannans which replace or supplement the natural hemicelluloses in paper resulting in better physical strength properties. A low concentration solution (0.5%) of gums when added to stock develops mucilages of pronounced colloidal character in the presence of water with a strong affinity to fibres. These mucilages are quickly absorbed by the fibres, forming hydrogen bonds between fibres and gum molecules and thus build additional linkage from fibre to fibre which influence the physical properties of paper.

In SPB actual plant scale experiments conducted with guar gums have improved the strength in paper. A typical experimental result is tabulated in table 2.

TABLE—2 DATA OF TRIALS WITH GUAR GUM 'A' AND GUAR GUM 'B'

Quality : 39 gsm Unbleached MG Ribbed Kraft :  
Machine No. 3 (Yankee Machine) :  
Machine Speed : 130 M/Min.

ADDITIVE	Consistency Range	°SR Range	BF	TF	BL (Meters)	FOLDS
Blank (No Additive)	2.8-3.1	31-41.7	16.5-18.4	48-60	3668-4349	14-24
Guar Gum 'A' (0.5% on OD Pulp)	3.0-3.8	35.2-38.4	19.0-23.0	47-64	4274-4739	20-31
Guar Gum 'B' (0.5% on OD Pulp)	3.4-3.7	35.2-37.2	19.3-22.4	61.4-65.9	4360-4895	26-30

#### POWER CONSUMPTION IN BATCH AND CONTINUOUS SYSTEM

SPB has both batch and continuous systems in stock refining:

The advantages of batch systems of stock blending are:

- Closer control of operations
- Better attention can be given for meeting specifications.
- Greater flexibility as various operations and addition of ingredients can be carried out independently.

- Easier grade changes due to larger time available during stock run out and
- Easier blending of stocks requiring different types of treatment.

But batch system is both labour intensive and power intensive.

MF Kraft made on two successive days by continuous Stock Preparation and by batch process showed that power consumed in Stock Preparation was 223 KWH/tonne by continuous system and 250 KWH/tonne by batch system.

The power consumed per °SR raise/tonne was 14 KWH by continuous system and 15.5 KWH by batch system.

#### 6. TYPE OF REFINER RECOMMENDED FOR REFINING A MIXTURE OF 60% HARDWOODS - 40% BAMBOO

SPB has conical and wide angle refiners. Fibre classification and handsheet tests did not show much difference in strength properties of fibre treated in the two types of refiners separately. SPB is going in for double disc refiners for the following reasons :

- Hardwoods, generally containing short fibres, require gentle treatment to get maximum fibrillation by providing refiner disc with higher inch contacts per minute which reduces the refining intensity. Thus the specific power per unit of refining area is kept low by a compromise between disc design and refiner speed.
- Disc refiners yield maximum fibrillation with minimum power consumption since majority of the work on the fibre is performed at the leading edges of the bars.

Therefore, by design criteria, it is possible to have a large number of bar crossings producing fibre of higher strength with minimum power application in disc refiners compared to conical refiners. It is expected that specific absorbed power i.e. KWH/MT/°SR will be roughly half for double disc refiners compared to conical refiners as it is possible to incorporate more number of bar crossing in the disc than in conical refiners.

#### PAPER MACHINE

This Mill has four, fourdrinier Paper Machines, Machine No. I and II (MF & MG) supplied by M/s Black Clawson, Machine No. III (Yankee) supplied by M/s KMW Sweden and Machine No. IV (MF Machine) is supplied by Bertrams I & I.

The Wet end of Machine No. I and II are identical with open Head Box, all table rolls, 6 flat boxes and Suction Couch (one Zone). No lump breaker rolls are provided for these machines. In the Press part, the first is the Suction Press with open draw from wire and the second one is a Reverse Press and the third is a smoothing Press. The Machine No. III is different by having pressurised Head Box and double felted suction presses. The Machine No. IV is the modern one with pressurised Head Box and with all the foils 8 flat boxes and suction couch (one Zone). Interestingly, even this machine is having open draw accompanied by Suction Press and Inverse Press in position.

The Machines are running successfully with furnish containing 70% hardwoods without making appreciable changes in approach flow systems.

As expected, most of the problems were on the wire part and subsequent wet end sections. Some of the problems which were encountered and the attempts made to get over the problems are summarised below :

#### WIRE CLOGGING :

At Machine No. I, II and III, this problem was predominant, adversely affecting the drainage and formation and thereby affecting production and quality. Soon after the problem was noticed on machines, it was discussed thoroughly with the wire manufacturers who readily agreed to make necessary modifications and to participate in solving this problem. In this attempt both twill weave and 4 shaft weave were used at times even the mesh size was changed. These changes did not bring results in solving the wire clogging problems. Subsequently, in the operation of the machine, it was resorted to cleaning the wire with dilute caustic solution (5% NaOH) which helped to a certain extent. But this cleaning resulted in production loss and fibre losses as every cleaning involved draining of rich water. Further, there was accumulation of fines at flat boxes necessitating to take out the boxes in running condition for cleaning purposes periodically.

Finally VHP needle Oscillating shower was installed on the Machine No. I and III which helped in combating wire clogging problem. Though these showers were recommended to be located before knock of shower one would have to place them as per the convenience and experience. With the installation of this shower, the down time for wire cleaning has come down considerably. It is obvious from the data given in Table 3,

TABLE—3 DOWNTIME REDUCTION DUE TO VHP SHOWER

April	—	810 Minutes.
June	—	250 Minutes. VHP Shower at wire installed.

By improving functioning of other showers at wire part, the SPB is hoping to solve this problem completely. In contrast to the seriousness of this problem on Machine I, II and III, on Machine No. IV, it is definitely much less. This is mainly attributable to foils in the wire part

#### FOILS VERSUS TABLE ROLLS

There seems to be definite advantages of using foils instead of table rolls as per experience of this Mill. Machine No. I and IV, both MF can present a picture of performance of table rolls and foils on the wire part. The foils which are on Machine No. IV gave definite advantages to improve the strength and better retention. This had resulted in carrying more fines on Wet Web which avoided wire clogging. However, this resulted in different problems at the Press parts and Driers. It was also experienced that Foils had reduced Twosidedness which improves the quality of product. The data given in table 4 illustrate these advantages.

#### OPEN DRAW AT COUCH

The higher hardwoods contents were expected to reduce the web strength properties necessitating closed draw particularly for lower gsm. Machine No. III with its pick up system is making it possible to manufacture light weight paper. The management is however seriously considering to modify other machines for a closer draw.

It has been strongly advised by manufacturer of Paper Machine to use Lump Breaker roll at the couch to consolidate the sheet which in turn is supposed to make web transfer to the Press easy. SPB has no direct experience, but is looking forward for trying this arrangement.

It was observed that the Paper Lead Roll (Hold-on Roll) before 1 Press gave serious problem of picking fibres. This was particularly found in Machine No. IV where retention of fines is better. Intensity of this problem had been brought down to a considerable extent by using of Teflon sleeve on this lead roll.

TABLE 4—COMPARATIVE PERFORMANCE OF TABLE ROLLS AND FOILS

	Machine No. 1 with all Table Rolls	Machine No. 4 with Foils.
°SR at Machine Refiners	22	31
°SR at Machine Flow Box	50	46
Consistency at Machine Flow Box	0.56	0.69
Substance (gsm)	60	60
Machine Speed FPM	700	880
Through Fraction %	40—45	25—30
Ash %	11	15.5
B.F.	9	15.5
Tear	50	50
Breaking length MD	2500	3900
CD	1500	2000
Average	2250	3000
Folds	7	5
Sizing, Secs	19	15
Smoothness, Bendtsen, Topside	200—250	250—300
Wire side	250—300	200—250
Porosity, Bendtsen	1500	100

#### PRESS PART

As hardwoods consist of more fines, the web after being transferred to the I Press, had serious problem of fibre pick up with stonite top roll. The fines were being collected frequently and disposed off. This was not possible without affecting productivity of the machine. This could be solved by installing self skinner roll (No-pick roll) at I press. However, stonite roll can also be used at I press, in case of the double felted press. It was observed that the performance of Inverse Press at 2nd or 3rd position was better than reverse press as open draw was less in the former case.

In the Inverse reverse press, stonite or Micro rock is used and here again the problems of fines are to be combatted with good doctring. Both Metal and Synthetic doctors can yield good results.

#### FELT CONDITIONING :

In view of the fines contributed by hardwoods, it is necessary to maintain the felt very clean for good runnability. In case of 100% synthetic felts, the cleaning can be achieved with VHP Oscillating

showers. This problem seems to result in the spot crushing because of the choked portion of the felts. This can be avoided by maintaining showers as well as vacuum boxes in good condition

#### DYERS :

It is a very common experience to observe lot of fluff accumulation in the I group of Dryers. The accumulation is more especially for machines containing foils in their wet portion. Reasonable results can be obtained by maintaining doctors in good condition. It is also desirable to remove the fluff periodically using vacuum cleaning or blowing compressed air.

As linting problem was reported by some user with papers containing hardwood fibre, it had become necessary to improve the wax pick No. This was achieved by using hot water at 60°C in the Size Press. Subsequently, the machine had to be slowed down from 750 ft to 660 ft in view of the available drying capacity. This slowing down of the machine was resulting in the production loss of 6-7 tonnes per day. Therefore, this practice had to be discontinued.