# Some Considerations in Stock Preparation of Bamboo Kraft Pulps

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## SUMMARY

The article deals with some aspects of stock preparation in paper mills using bamboo pulps as a major furnish. Valley beater evaluation of various fibre fractions of a bamboo kraft pulp is discussed. The study also includes the properties developed in disc and conical refining of bamboo pulps. Mixed furnishes containing bamboo pulp fibres are touched upon. Experiences in successful tackling of the fibre bundles problem in flash-dried bamboo pulps are described. The article also discusses properties of paper manufactured from slush and flash-dried bamboo pulp under identical operating conditions.


## INTRODUCTION

Bamboo fibre is a unique and versatile fibre available to Indian Paper Industry in large quantities. Approximately three fourths of our country's fibre potential is taken by bamboo and numerous varieties of paper are manufactured using this fibre. Apart from its independent use, it also lends itself easily in mixing with various secondary and primary fibres for paper manufacture.

## BAMBOO PULPS

Bamboo kraft pulp, morphologically, has the advantage of a softwood pulp in that it has a long fibre. But, it is too stiff and thick-walled to bond easily. Its 1/d ratio (150:1) is one of the highest for fibres. Chemical characteristics-wise, it is akin to hardwood pulp. It has a good amount of xylan-dominated pentosans. It has high ash content mainly due to silica.

The fines fraction of bamboo pulps, although it helps in better formation of paper, suffers disadvantages in beating and sheet strength. The fines interfere in freeness testing and give false freeness readings. The whole pulp gives the highest strength in unrefined state. The −20 +50 fraction gives best strength among the fibre fractions before refining, probably due to the synergestic effect of the presence of short and long fibres present and the absence of fines. Beating in a Valley beater of the individual fractions, it is found that the +20 mesh fraction gives the strongest pulp and −125 mesh the weakest. The −125 mesh fraction hardly improves its properties on beating. Table-1 shows the results of the fractions, beaten after classification.

The fibre fractionation of bamboo pulp offers possibilities of producing very strong papers by segregating fines. One of the new integrated paper mills seem to have adopted this technique on mill scale. Even with the fines fraction, bamboo pulps develop fairly good strength to manufacture cultural papers, fluting medium, heavy basis weight liners and boards.

## EVALUATION OF BAMBOO KRAFT PULPS

Valley beating behaviour of a bleached bamboo kraft pulp is shown in Fig. 1. The burst factor and breaking length show an upward trend upto 250 ml CSF and further beating reduces them. Tear factor drops and double folds increase with increased beating. Photomicrographs taken at various freeness levels indicate the extent of fibrils present after beating. There are no fibrils visible in the unbeaten pulp. The amount of fibrils visible increase with increased beating and the zero ml CSF pulp has the heaviest fibrillar network. The parenchyma in the unbeaten to zero beaten stage

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TABLE—I EVALUATION OF INDIVIDUAL FRACTIONS OF FIBRES
(Clark Classifier and Valley Beater with Bamboo Bleached Kraft Pulp)

| Property | +20 mesh | | mesh −20+50 | | mesh −50+65 | | mesh −65+125 | | mesh −125 | Whole Pulp | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freeness, ml CSF | 710 | 250 | 690 | 250 | 650 | 250 | 600 | 250 | 350 | 700 | 250 |
| Beating Time, Mts | 0 | 45 | 0 | 41 | 0 | 29 | 0 | 19 | 0 | 0 | 35 |
| Breaking Length, M | 1900 | 6100 | 1610 | 5840 | 1770 | 5220 | 1600 | 4870 | 1200 | 2450 | 5050 |
| Burst Factor, Mullen | 8.1 | 49 | 6.3 | 44.2 | 7.8 | 41.6 | 5.2 | 32.8 | 6.8 | 10.2 | 40.9 |
| Tear Factor, Elm | 161 | 136 | 118 | 98 | 96 | 69 | 52 | 42 | 28 | 113 | 94 |
| Double Folds, MIT | 6 | 480 | 4 | 120 | 6 | 41 | 2 | 28 | 32 | 9 | 95 |

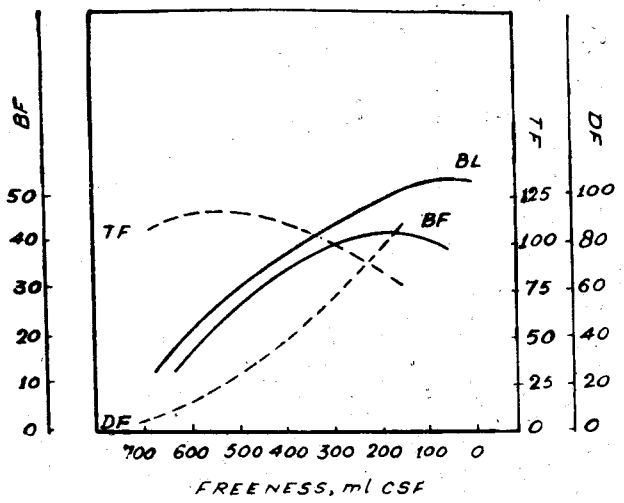


FIG. 1. BEATING CURVES

remain unchanged as seen in the photomicrographs. Optical microscope and reflex camera were used for this study.

The beaten bamboo pulp offers advantages over other pulps, viz. pulps from softwood, hardwood or agricultural residues, in that it has good bulk and opacity and fairly high tear. These characteristics help in the manufacture of quality Printing papers and wrapping papers. The thick-walled and stiff fibres with their fines score over softwood pulps in dimensional stability and formation. A study comparing beating properties by various lab equipment including PFI mill is in active progress.

However, the low burst and tensile energy absorption of the bamboo pulp are factors to be taken care of, while using bamboo pulp for the manufacture of sack kraft papers. Use of a mechanical compacting system, as in Clupak technique solves this problem, by increasing stretch threefold, thus resulting in a good Tensile Energy Absorption (TEA) value.

## BEHAVIOUR IN CONICAL AND DISC REFINERS

The high hemicellulose content in bamboo fibres makes it less energy consuming, at least in refining, compared to softwood pulps. For medium refining of bamboo pulps for the production of printing papers, about 125 to 175 KWH per ton electrical energy is consumed. The refining energy by using only disc refiner is higher than by using only conical refiner. When both conical and disc refiners are used, the disc refiners can be used to do the main job of strength development. The finishing job can be done by a conical refiner. The combination of disc cum conical refiners is being used to have a flexible system, whereby one can vary the fibrillation and cutting characteristics of the fibre to cater varying properties, as demanded by the customer. However, a series of disc refiners only or conical refiners only can also be arranged using different tackles for cutting and brushing purposes.

An examination of the properties of pulp refined by disc and conical refiners separately Table-II shows that the disc refiner develops overall strength better (by about 20%) and produces lesser fines (10+15%) than does the conical refiner. This study was done with 100% bamboo pulp furnish only. The pulps used in this study were of a Permanganate Number of 23±1 and of a brightness of 80 PV, obtained by CEHH sequence. It is worthwhile expanding this study to include wood pulps, pulps from agricultural residues and mixed pulp furnishes.

## BAMBOO PULP IN MIXED FURNISHES

It is not uncommon to use bamboo pulps in combination with other pulps. Waste paper, after removal of contraries, is hydrapulped and mixed with bamboo pulp and then beaten. Sometimes, it is mixed halfway through the beating of bamboo pulp. Hardwood pulp, rag pulp, straw pulp and

TABLE—II COMPARISON OF PULP PROPERTIES ON CONICAL AND DISC REFINING

| Properties | Disc Refiner | | | Conical Refiner | | |
|---|---|---|---|---|---|---|
| Freeness, ml CSF | 670 | 390 | 300 | 680 | 360 | 280 |
| Refining Time, Mts | | 25 | 35 | | 20 | 27 |
| Breaking Length, Mts | 2010 | 2950 | 3670 | 2025 | 2750 | 3105 |
| Burst Factor, Mullen | 11.2 | 22.1 | 26.8 | 10.9 | 19.0 | 23.1 |
| Tear Factor, Elm | 135 | 118 | 98 | 138 | 101 | 80 |
| Double Folds, MIT | 7 | 34 | 49 | 7 | 31 | 48 |
| Bulk, cc/g | 2.1 | 1.72 | 1.58 | 2.1 | 1.71 | 1.62 |
| **Fibre Classification (Clark)** | | | | | | |
| +20 mesh % | 30.1 | | 19.3 | 30 9 | | 16.1 |
| −20+50 mesh % | 22.1 | | 12.2 | 22.9 | | 11.6 |
| —50+125 mesh % | 11.3 | | 18.3 | 11 6 | | 16.4 |
| —125 mesh % | 36.5 | | 50.2 | 34.6 | | 55.9 |
| Energy consumed, CWH/T | | | 170 | | | 125 |

imported softwood pulps are used along with bamboo pulp.

In mixed furnishes, it is always advantageous to beat separately and then mix, rather than mixing and beating. A mixed beating of hardwood and bomboo fibre would drop the tear too low. Whereas a softwood and bamboo fibre blend refined together does not bringout the optimum strength out of them. If rag is to be used alongwith bamboo, it should be beaten separately for cutting of fibres to facilitate improved formation and blending. Bamboo should be mixed after a fibrillation process. The blends also require proper equipment selection as they deal with fibres of varying size and distribution. An equipment doing an admirable job with one fibre may pose problems with another fibre or blends of fibres.

It should be noted that backwater system where bamboo is mixed with short fibred pulps or pulps of agricultural residues cannot be closed compeletely due to the very high amount of fines.

## USE OF FLASH-DRIED BAMBOO PULP

A flash dried pulp due to the process of dewatering, shredding and hot air drying produces a few fibre bundles known as 'Knits' The knits are negligible or lower in unbleached pulps compared to bleached pulps. It is imperative that the knits are disintegrated fully before going into paper machine. Otherwise, the paper made may contain fish-eyes. The modern design of the flash-drying unit, due to the introduction of the drum type dewatering presses, superior shredders and effective control of temperature in flash-drying, produces much less knits than in the initial design.

Several mills using flash-dried pulp have found simple hydrapulping sufficient to disintegrate the knits, especially in case of unbleached flash-dried pulps. In case of bleached bamboo flash-dried kraft pulps, a hydrapulper—deflaker combination or, if capacity permits, a hydrapulper with a recirculation for about 25 to 30 minutes would suffice in knit removal. If the bales are fresh, much less treatment is required.

Table—III1 explains how the hydrapulper and hydrapulper-deflaker system with recirculation removes knits. In this study, the knit count was determined by disintegrating the pulp sample after ageing it for 2 hrs 15 min in a Tappi pulp disintegrator for 6 minutes and making 1 gram (OD) sheets. The knits in the sheets are counted and average knits per gram is taken as knit count. This procedure correlates well with the flash-dried pulps behaviour after six months of natural ageing.

In the above table, consistency at hydrapulper was 3.5%. The time denotes the time of recirculation. The experiment was carried out with three month old bales. The figures for fresh bales pulp would be much lower and deflaker would not be necessary. After the treatment, the pulp is processed similar to a slush pulp.

## COMPARISON WITH FLASH-DRIED AND SLUSH PULP

Evaluation of the flash-dried and slush pulps in a valley Beater shows that the same trend exists in both cases. Referring to Figure 2, which depicts how tear and bulk vary with respect to breaking length, one interesting thing is evident. For a given breaking length, the tear and bulk are higher in flash-dried pulp than in slush pulp.

A week's run of the same grade of paper on slush pulp and flash-dried pulp separately on mill scale manufacture confirmed the same trend as in Valley Beater. Figure 3 shows the curves of tear and bulk at different figures of breaking length. Table IV are the results of paper testing of the above run.

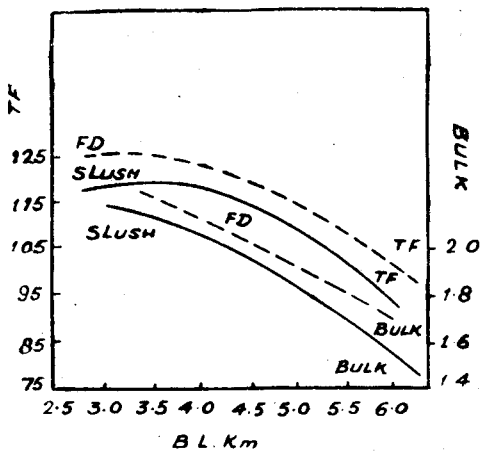


FIG 2. TEAR FACTOR & BULK VS B.L IN VALLEY BEATING OF SLUSH AND F D PULPS.

TABLE—III KNIT COUNT REMOVAL

| Running Time (Circulation) | Hydrapulper with deflaker | Hydrapulp |
|---|---|---|
| Before treatment | 480 | 480 |
| After 1 minute | 290 | 380 |
| 3 min | 15 | 200 |
| 6 min | 10 | 140 |
| 12 min | Neligible | 90 |
| 18 min | Nil | 60 |
| 24 min | — | 40 |
| 30 min | — | 35 |

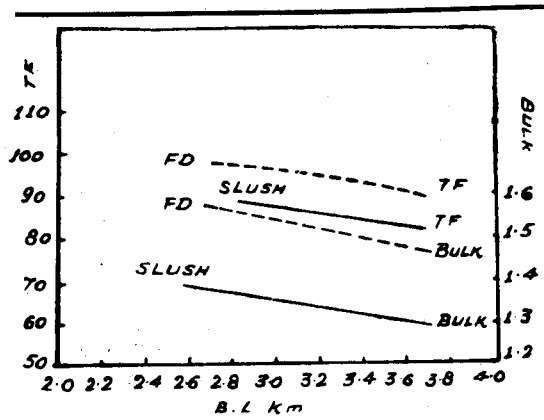


FIG 3. TEAR FACTOR & BULK VS BL IN PAPERS FROM SLUSH AND FD PULPS

TABLE—IV COMPARISON OF PAPER FROM SLUSH AND FLASH DRIED PULP

( Averages of roll tests for six days each )

| Properties | Paper made from slush pulp | Paper made from FD pulp |
|---|---|---|
| Basis weight, gsm | 56 | 56 |
| Caliper, Microns | 74 | 86 |
| Bulk, cc/g | 1.32 | 1.53 |
| Burst Factor, Mullen | 17.3 | 15.2 |
| Avg. Breaking Length, M | 3475 | 3260 |
| Avg. Tear Factor, Elm | 85 | 94 |
| Avg. Double Folds, MIT | 26 | 23 |
| Ash content, % | 9.8 | 10.2 |
| Opacity, % | 83 | 86 |

## CONCLUSION

Bamboo kraft pulp definitely offers advantages which can profitably be used choosing the right equipment and treatment. It lends itself easily in mixed furnishes. After proper disintegration of fibre bundles in flash-dried pulp behaves similar to slush pulp from the papermaking view point.

## REFERENCES

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