Effect of bleached pulp viscosity on strength properties of bamboo sulfate pulp

SAH, SUMAN, MAHESHWARI SUBHASH AND KULKARNI A.Y.*

SUMMARY

This paper deals with the effect of variation in bleached pulp viscosity, due to degradation during bleaching and its effect on physical strength properties
The results show that with an increase in pulp viscosity, the physical strength properties, ie., tear factor, burst factor, breaking length and double fold increase significantly. However, at the viscosity level of 8 cps and above, the increase in strength properties is not significant. Similarly, alpha cellulose content of the pulp also increases with increase in pulp viscosity, upto 90% alpha cellulose content and then levels off. Since, bleached pulp viscosity has a direct correlation with strength properties, this test may be carried out frequently to monitor the process variables.

The physical strength properties of paper depend on the quality of raw material, its pulping, bleaching and subsequent paper-making process. The bleached pulp viscosity gives a relative indication of the extent degradation of raw material during the various stages of processing and ultimately reflects on the strength properties of paper. This is because the viscosity of pulp is also a measure of the average degree of polymerization and has a direct bearing on the strength properties of pulp[1]. However, some anomalies exist in this relationship. For instance two pulps of the same raw material prepared by different processes of bleaching will not show the same viscosity-strength relationship, although the % lignin removed may be more or less same in these samples. On the other hand these pulp samples bleached with any given process will show a reproducible trend of viscosity-strength relationship.

The viscosity test is less cumbersome and quick as compared to the laboratory evaluation of pulp for physical strength properties, as a guide for further processing. However no Conclusion can be drawn about pulp strength properties from viscosity results unless previous investigations have identified the relationship. Khanna & Coworkers[2] reported the relation of bleached pulp viscosity for a mixture of Bamboo and Eucalyptus with its strength properties. But the variation in bleaching pulp viscosity was done by varying the cooking conditions to get the unbleached pulp of varying Kappa nos. and viscosity and then bleaching under optimum conditions. Pai and Meshramkar[3] reported the variation of pulp viscosity at every stage of bleaching (CEHH), for bamboo, Eucalyptus and Mixed hardwoods. The lower mechanical properties of bleached sulphate pulps for low viscosity values were also reported by other authors.[4,5,6].

This study has been undertaken to establish a correlationship between the various strength properties of Bamboo (Dendrocalamus strictus) and the pulp viscosity after bleaching. The variation of pulp viscosity is made by changing the bleaching conditions and chemicals for a pulp brightness of 75-80%.

EXPERIMENTAL

Sound bamboo (Dendrocalamus strictus) chips were collected and classified in Williams chips classifier. The chips classification data are recorded in Table-1.

PULPING

The pulping was carried out using a 15 lit. capacity electrically heated rotary digester. The chemical and conditions were adjusted to obtain a pulp of

*PULP AND PAPER RESEARCH INSTITUTE, JAYKAYPUR-765 017, ORISSA

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TABLE—1 CHIPS SIZE CLASSIFICATION

SCREEN SIZE, mm	CHIPS RETAINED, %
+32	15.4
—32+25	20.6
—25+22	13.1
—22+19	9.9
—19+16	13.0
—16+13	13.9
—13+ 6	12.7
— 6+ 3	1.4

35±2 Kappa No. The conditions of cooking and results are recorded in Table-2.

BLEACHING

A CEH sequence was used for bleaching the pulps. In order to get the variation in the pulp viscosity, several small scale (50 g OD) bleachings were carried out under different conditions, in a laboratory set up and then large scale bleachings (500 g OD each) were carried out under the optimized conditions of bleaching. The bleaching conditions and results are recorded in Table-3.

TABLE—2

PULPING DATA

O.D. weight of chips, Kg	— 2.0
Active Alkali as Na_2O on O.D. chips %	— 16.0
Bath ratio (Chips : Liquor) Diluent	— Water
White liquor sulfidity ± 1 %	— 19

COOKING SCHEDULE

50 to 120°C, Min	— 60
at 120°C, Min	— 30
120 to 170°C, Min	— 60
at 170°C, Min	— 20
'H' factor	— 525
Unbleached pulp Yield on O.D. chips, %	— 44.0
Rejects on O.D. chips, %	— 1.7
Kappa No.	— 35

BLACK LIQUOR

pH	— 12.1
Total solids, gpl	— 285
Active Alkali as Na_2O at 200 gpl T.S gpl.	— 10.1

TABLE—3 BLEACHING WITH CEH SEQUENCE

PARTICULARS	1	2	3	4	5	6	7
CHLORINATION							
Cl_2 added,%	10.00	10.00	8.00	8.00	8 00	8.50	7.00
Cl_2 consumed, %	8.30	8.30	6 88	6.78	7.10	7.40	7.00
Final pH	1.6	1.6	1.9	1.9	1 6	1.6	1.6
ALKALI EXTRACTION							
NaOH added, %	2.1	2.2	1.7	1.7	1.8	1.9	1.6
Final pH	10.2	10.4	9.5	9.6	9.1	9.6	9.4
HYPO STAGE							
Cl_2 added, %	5.00	5.00	3.50	3.00	3.00	2.50	2.00
NaOH added, %	Nil	Nil	0.8	0.8	Nil	0.8	0.8
Cl_2 consumed, %	4.60	4.43	2.88	2.6	2.64	2.37	1.92
Final pH	5.8	6.2	8.6	8.6	7.2	8.2	8.3
Total Cl_2 added, %	15.00	15.00	11.50	11.00	11.00	11.00	9.00
Total Cl_2 consumed, %	12.90	12.73	9.76	9.38	9.74	9 77	8.92
Brightness, % (Elrepho)	85.1	79.6	78.0	78.6	80.5	74.7	72.8
Viscosity, Cp (CED)	4.0	4.8	6.3	6.8	7.7	8.1	10.8

NB :

1) Unbleached pulp (a) Viscosity — 22±1 cp (CED)
   (b) Kappa No. — 35±2
2) Chemicals were added on OD Unbleached pulp basis
3) **Constant Conditions :**

	C	E	H
Temp.°C	28±2	55±2	28±2*
Ret. time, hr.	0.75	1.0	4.0
Consistency, %	3.0	10	10

* Except expt. no.1 where temp. was maintained 35±2°C

PHYSICAL STRENGTH PROPERTIES

The bleached pulps of different viscosities (Nos. 1-7 Table-3) were beaten separately in a laboratory valley beater to four different slowness levels and standard hand sheets of 60 ± 1 gsm were prepared on British hand sheet making machine. The strength properties were tested after conditioning the sheets at 60% RH and 27°C±2 temperature. The strength properties Vs °SR results were plotted and by interpolation, strength properties at 40°SR were taken and recorded in Table-4. The strength properties at 40°SR Vs bleached pulp viscosity are shown in Fig. 1.

CHEMICAL ANALYSIS

Alpha cellulose content of bleached pulp was determined by TAPPI (T203 OS-74) standard procedure and recorded in Table-5. Alpha cellulose content Vs bleached pulp viscosity are shown in Fig. 2.

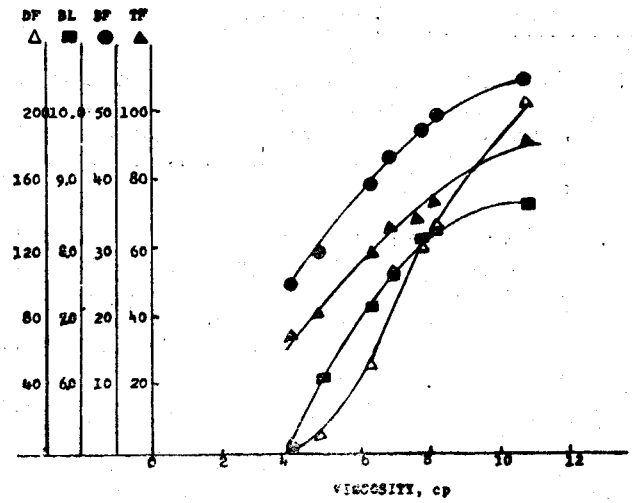

FIG - 1 Pulp Viscosity Vs Physical Strength Properties

TABLE—4 PHYSICAL STRENGTH PROPERTIES AT 40°SR

S. No.	Viscosity Cp (CED)	Bulk CM³/g	PHYSICAL STRENGTH PROPERTIES Tear Factor	Burst Factor	Breaking length, Mts.	Double folds No.
1.	4.0	1.51	34	22	4400	4
2.	4.8	1.48	40	29	6100	8
3.	6.3	1.52	58	39	7100	50
4.	6.8	1.41	65	42	7604	106
5.	7.6	1.48	67	46	8100	120
6.	8.1	1.41	72	49	8160	132
7.	10.8	1.45	91	54	8590	205

TABLE—5 RELATIONSHIP BETWEEN VISCOSITY AND ALPHA CELULLOSE

Sl. No.	Viscosity Cp (CED)	Alpha Cellulose, %
1.	4.0	72.0
2.	4.8	80.0
3.	6.3	88.0
4.	6.8	89.5
5.	7.6	91.0
6.	8.1	90.0
7.	10.8	96.3

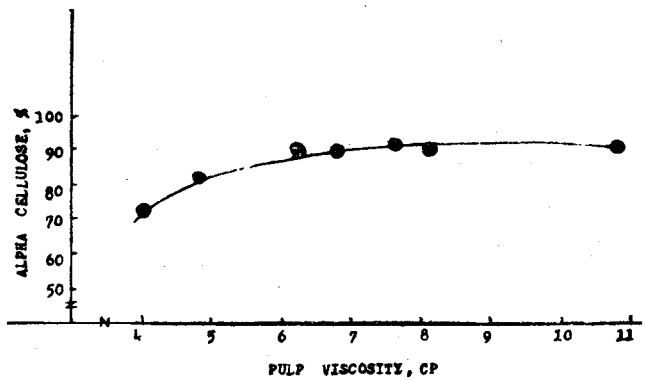

Fig. - 2 Pulp Viscosity Vs Alpha Cellulose Content

OBSERVATIONS AND DISCUSSION

1. For this study unbleached pulp of a high Kappa No. was selected bscause of its high initial viscosity, so as to obtain a wide range of bleached pulp viscosities for subsequent studies.

2. The variation in pulp viscosity was obtained by varying chlorine charge during chlorination and hypo stage as well as by selectively adding NaOH in the hypo stage. But in the alkali extrection stage optimum alkali[7] was added to get a final pH of 9.5.

3. It can be observed from Fig. 1 and Table-4 that with increasing viscosity (4-10 cps) all the properties i.e. burst factor, tear factor, double fold and breaking length increase. However, after a viscosity of 8 cps the increase in strength properties is not significant. It was not possible to obtain a pulp with viscosity < 11 cps in the given brightness range.

4. Fig. 2 shows that with increasing pulp viscocity the alpha cellulose content increases upto about 90% and then levels off.

CONCLUSION

A wide range of fluctuation may occur in the bleached pulp viscosity during processing due to variation in the raw-material quality, cooking conditions and chemicals etc.

With increasing viscosity of bleached pulp, the physical strength properties i.e. burst-factor, tear factor, double fold and breaking length increase significantly. However at a viscosity of 8 cps and above, the increase in strength properties is not very significant. Similar to strength properties the alpha cellulose content alsc increases with bleached pulp viscosity upto 90% and after wards it levels off.

The determination of bleached pulp viscosity is comparatively simpler and less time consuming compared to other standard methods for pulp evaluation. Hence, it is recommended that for anticipating the trend of various physical strength properties of bleached pulps, its viscosity can be taken as a guide line. This method can also be used to monitor the process parameters in order to obtain pulps of desired strength properties.

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REFERENCES

1. Clark, J A. 'Pulp technology and treatment for Paper' - P.115

2. Khanna H.K. Sriveshwar, R.M. and Jaspal, N.S. *Ippta* (1976) XIII, No.2 P. 164.

3. Pai, P.A. and Meshramkar P.M. *Ippta* (1978) XV, No. 2, P. 36

4. Jensen, W. etal Paper and Timber, 36, 1961, P-387

5. Casciani, F. etal Tappi 33, 1950, P. 588.

6. Value, chrg. Svensk papper stidning, 54, 1951, P 613

7. Bapna Sandhya, Maheshwari Subhash, Jivendra and Kulkarni A.Y, Paper presented at IPPTA ZONAL meeting Dehradun, Sept, '80.