

# Evaluation of Surface Properties of Hardwood Pulps

SOOD, Y.V.,\* MANTRI, T.C.,\* SHARMA, Y.K.\*

## SUMMARY

The vessel pick and surface roughness tests were carried out on bleached pulp handsheets prepared from Bastar area hardwoods.

The test results obtained on handsheets demonstrated that *Terminalia tomentosa* and forest composite hardwoods have much high vessel pick tendency than other species. Vessel pick tendency is reduced considerably on beating the pulps. The vessel pick ratio of individual test species is comparable with kraft eucalypt and magnesite beech pulps below the freeness level of 200 (ml) CSF. Roughness test indicates that handsheets from *T. tomentosa* have higher roughness compared to other species.

## INTRODUCTION

A large quantity of bleached hardwood pulp is being used for the manufacture of fine grade writing and printing papers. There is a peculiar problem with the printing of papers which contain hardwood furnish, the picking out vessel elements causing unprinted spots in the prints on high speed printing press. This problem is more pronounced in offset lithographic printing due to damped printing plates and high tack of ink employed in this process.

The vessel elements are generally shorter than fibres and many times wider in hardwoods. The difference in dimensions between fibre and vessel element contribute to the picking trouble. Picking tendency of vessel elements depend on physical and morphological configuration of wood fibres associated with them. Assessment of vessel pick tendency has engaged the attention of several workers. Marton and Aggarwal (1) developed a method to separate vessel elements from fibres to study strength properties separately. Colley et. al (2,3) have reported the vessel picking tendency of papers made from various eucalyptus and hardwood species. Colley (4) and Phillips (5) have also reported the reduction in the vessel picking tendency with increased beating of various eucalyptus and hardwood pulps. Byrd et. al (6) and Brutt (7) have studies that refining of hardwoods reduces vessel picking and fuzz problems (oak elements).

A study on the vessel pick tendency and surface roughness on bleached pulp handsheets prepared from Indian Hardwoods i.e. *Madhuca latifolia*,

*Dalbergia paniculata*, *Diospyros melanoxylon*, *Terminalia tomentosa*, different diameter classes and forest composite from Bastar area was undertaken to get indication of their potential utility in printing grades.

However, this is a comparative study on handsheets and does not make true relationship with paper on paper machine, as the retention of fines from back water may effect the pick tendency.

## EXPERIMENTAL

### PULPING, BLEACHING AND EVALUATION OF PULPS

Pulp samples were prepared by sulphate process using 17% active alkali, 25% sulphidity and 1:3 bath ratio and bleached with CEHH sequence. The details of chip samples preparation, cooking and bleaching and evaluation of pulps have been given in the earlier report (8).

The pulps were beaten in a PFI mill. The handsheets were prepared according to ISO Method DP 5269. The sheets of approximately 60g/m<sup>2</sup> were prepared and tested for vessel pick, surface roughness, brightness and opacity after conditioning at 27 ± 10°C and 65 ± 2% R. H. The methods used for different tests were:—

Vessel pick number	— details given below.
Surface roughness	— details given below.
Brightness	— ISO 2470
Opacity	— ISO 2471

### METHODS USED FOR VESSEL PICK NUMBER AND VESSEL PICK RATIO

The methods used for vessel pick number and vessel pick ratio were similar to that described by

\* UNDP/FAO/GOI Project, Hindustan Paper Corporation Ltd., Dehra Dun (India).

Colley (2,9), however, higher printing speed (60cm/s) was used instead of 30cm/s. This was to compensate the effect of different atmospheric conditions used for paper testing, 65% RH and 27°C in comparison to Colley's method which described 65% RH & 20°C. Higher temperature causes drop in the tack of ink.

To determine vessel pick number, the printing was carried out with IGT Printability Tester AIC2 (electric model). This printability tester is a small printing unit on which printing can be carried out under controlled printing conditions of printing pressure and speed. The prints can be made upto 32 mm width. For vessel pick tests, strips of 25 mm width and approximate 150 mm length were cut and were printed on the glazed side of handsheet using following printing conditions:—

Type of ink	— Black tacky non-drying IGT Collie ink.
Amount of ink	— Equivalent to ink layer of 10 microns.
Blanket	— IGT litho blanket shore hardness 90.
Speed	— Constant, 60 cm/s.
Printing pressure	— 490 N.
Disc	— 2 cm. aluminium.

Immediately after printing, the wet print surface was brushed twice in the direction of print to lift up the vessels dislodged during printing of the test strip. This method was particularly followed to avoid the flattening of the some of vessels. A set area of 2000 mm<sup>2</sup> was marked on the printed strip and number of white spots greater than 120 µm width were counted.

To determine vessel pick ratio, a reference paper MG litho paper from Australian Paper Manufactures Ltd., was tested under the above conditions. The ratio of the vessel pick number of test samples to that of reference sample was calculated and reported as vessel pick ratio.

## SURFACE ROUGHNESS

Surface roughness of the glazed side of hand sheets was measured on a Parker Print Surf Roughness Tester. Tests were carried out under offset conditions. Offset blanket was used as a backing and clamping pressure was set at 980 kPa which corresponds roughly to the offset printing conditions.

## RESULTS AND DISCUSSIONS

Surface properties of bleached pulps are recorded in Table-I. For comparison results of bleached kraft eucalypt pulp and magnesite beech pulp are also given. Vessel pick tendency of *T. tomentosa* bleached pulp is comparatively higher than other pulps. Further, it is evident that the vessel pick ratio of

*M. latifolia*, *D. paniculata*, *D. melanoxylon* is comparable to the kraft eucalypt pulp and magnesite beech pulp below 200 CSF level. It can be seen from Fig. 1 that *T. tomentosa* pulp gives much higher vessel pick than the eucalypt and magnesite beech pulps studied.

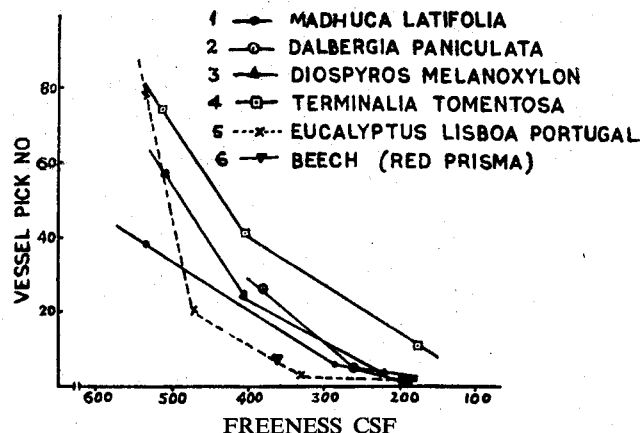


Fig. 1. Vessel Pick No. of Different Hardwood pulps

The surface roughness values of various pulps are shown in Fig. 2 at the 250 (ml) CSF level. This indicates that the handsheets of *T. tomentosa* and

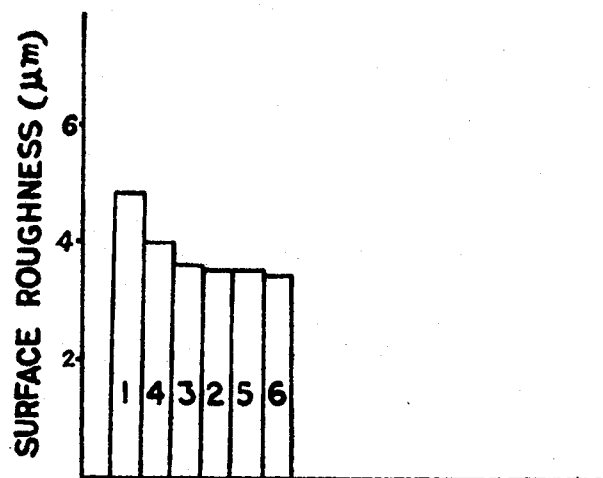


Fig. 2. Surface Roughness of Different Hardwood Pulps Interpolated at Freeness Level of 250 CSF.

*M. latifolia* are comparatively rough than other pulps. Fig. 3 shows the vessel pick number for handsheets prepared from pulps of different diameter classes and forest composite. It is evident that pulps from diameter class IV hardwoods have highest vessel pick tendency as compared to diameter classes II and III. For comparison, the vessel pick number for different pulps interpolated at freeness level of 250 (ml) CSF are given in Table-III. Low vessel pick number for diameter class II may be attributed to lower age group species. The vessel pick number for forest composite is exceptionally higher when compared to eucalypt and beech pulps used in this study (Table-III).

TABLE—I. SURFACE ROUGHNESS AND VESSEL PICK NUMBER OF HARDWOOD PULPS

Wood species	Freeness CSF (ml)	Surface roughness (Parker Print Surf) $\mu\text{m}$	Vessel pick no. per 2000 $\text{mm}^2$	Vessel pick ratio	Brightness Elrepho (%)	Printing Opacity (%)
<i>Madhuca latifolia</i>	535	5.65	38	0.88	75.6	84.1
	285	4.75	6	0.16	74.1	83.2
	195	4.65	3	0.07	73.3	82.8
<i>Dalbergia paniculata</i>	380	3.85	26	0.68	78.6	79.9
	260	3.60	5	0.13	77.5	77.6
	190	3.45	2	0.05	75.6	73.1
<i>Diospyros melanoxylon</i>	510	4.55	57	1.25	72.1	82.2
	405	3.95	24	0.76	70.2	81.6
	220	3.55	4	0.09	68.7	78.7
<i>Terminalia tomentosa</i>	515	4.75	74	1.64	73.9	79.0
	405	4.35	41	0.91	71.1	79.8
	175	4.05	11	0.24	71.1	79.5
Eucalypt kraft pulp, (cacia. Lisboa Portugal)	535	4.65	78	1.73	82.6	77.2
	470	4.10	20	0.44	81.2	75.4
	330	3.80	3	0.07	80.7	72.9
	178	3.25	2	0.04	79.8	70.2
<i>Nymolla magnefite</i> (red prisma beech pulp)	360	3.55	7	0.10	77.9	71.7
	185	3.40	2	0.03	76.9	67.5

TABLE—II. SURFACE ROUGHNESS AND VESSEL PICK NUMBER OF HARDWOODS PULPS OF DIFFERENT DIAMETER CLASSES AND FOREST COMPOSITE

Sample	Freeness CSF (ml)	Surface roughness (Parker Print Surf) $\mu\text{m}$	Vessel pick no. per 2000 $\text{mm}^2$	Vessel pick ratio	Brightness Elrepho (%)	Printing Opacity (%)
Dia. Class II (10-30 cm)	515	4.65	122	1.57	76.0	80.5
	470	4.40	96	1.23	74.5	77.4
	340	3.55	20	0.27	—	—
	225	3.50	8	0.10	71.8	75.4
Dia. Class III (30-50 cm)	600	5.45	222	3.64	74.5	78.7
	545	5.25	158	2.59	74.1	78.3
	445	4.50	103	1.68	71.8	77.5
	240	4.35	33	0.15	71.1	76.3
Dia. Class IV (above 50 cm)	515	4.80	196	2.28	72.7	77.6
	420	4.35	125	1.45	71.3	77.0
	225	3.95	41	0.48	69.8	75.0
	125	3.80	10	0.12	69.6	74.0
Forest composite	540	4.80	259	2.42	75.5	77.4
	445	4.25	130	1.22	74.2	76.2
	285	3.65	27	0.25	72.1	76.6
	158	3.60	19	0.17	70.5	75.1

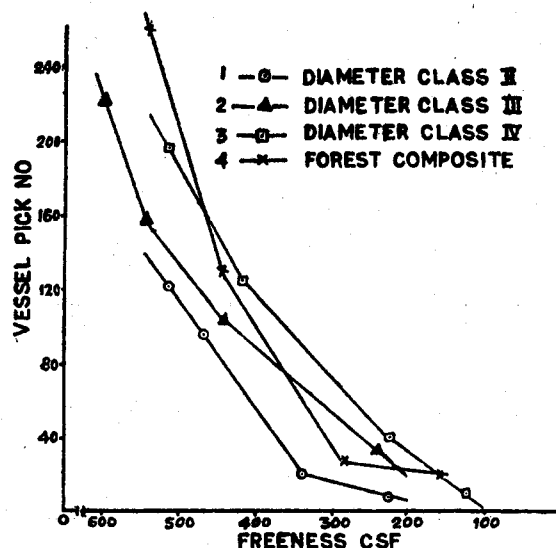


FIG. 3. VESSEL PICK NO OF BASTAR HARD WOODS

TABLE—III. VESSEL PICK NUMBER OF PULPS VARIOUS INTERPOLATED AT 250 CSF

Pulp	Vessel pick No. per 2000 mm <sup>2</sup>
<i>Terminalia tomentosa</i>	22
<i>Madhuca latifolia</i>	5
<i>Dalbergia paniculata</i>	4
<i>Diospyros melanoxylon</i>	6
Eucalypt	2
Beech	2
Dia. class II	10
Dia. class III	32
Dia. class IV	48
Forest composite	24

Beating has shown remarkable effect on the reduction of the vessel pick number. This can be attributed to the increase in the consolidation of sheet, flexibility and bonding potential of fibres and also in the breaking up of the vessel elements. Further, at

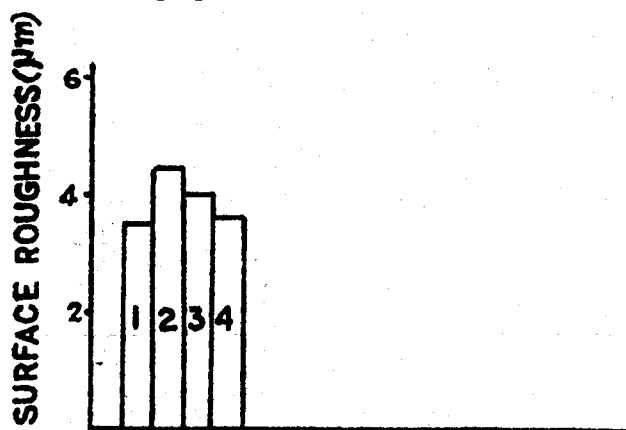


Fig. 4. Surface Roughness of Bastar Hardwoods Interpolated at Freeness level of 250 CSF.

low freeness level the absorbency of paper is low which may cause the slow ink absorption and results less ink transfer and low picking during printing. While at high freeness level, absorption of ink vehicle is very fast which results in increasing the ink tack and causes more picking.

The surface roughness of paper handsheets prepared from diameter class II, indicates lower values as compared to other diameter classes and forest composite as shown in Fig. 4.

### CONCLUSION

It can be concluded from above that :—

- (1) Pulps from *T. tomentosa* give higher vessel pick tendency than other wood species examined.
- (2) *T. tomentosa* and *M. latifolia* have higher surface roughness than other species.
- (3) The vessel picking tendency of diameter class IV hardwoods is higher as compared to other diameter classes from Bastar area.
- (4) The Bastar forest composite hardwoods have higher vessel pick number than eucalypt and beech pulps used in this study.
- (5) Surface roughness values of diameter class II is lower than other diameter classes and forest composite pulp samples.
- (6) Beating of the pulps reduces vessel pick tendency and improves surface roughness.

It can be concluded from the above study that for improvement in the printing quality of paper from Bastar area some sort of surface sizing is necessary.

### ACKNOWLEDGEMENT

The authors are thankful to Dr. J. Fellegi, Project Manager, UNDP/FAO/GOI Project, New Delhi, Dr. A.R.K. Rao, Project Co-ordinator, UNDP/FAO/GOI Project, Hindustan Paper Corporation Limited, New Delhi for their helpful discussions and valuable suggestions.

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