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Development of Specialty Papers is an Art: Padding Paper from Indigenous Raw Materials — Part VIII

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In present investigation attempts are made to develop padding paper from locally available hardwoods like, *Eucalyptus tereticornis* with some proportion of long fibred cellulosic raw materials like *Dendrocalamus strictus*. These cellulosic raw materials are mostly utilized, in India, in different proportions. The results of laboratory made padding paper are suit promising. The padding paper can be used up to three-or four-times during pressing of decorative laminates. Laboratory made padding paper fulfils the purpose of decorative laminates manufacturers.

Keywords: Speciality paper, Padding paper, *Eucalyptus tereticornis*, Indigenous raw material

Introduction

Padding paper is highly specialized and exclusively used as 'cushion' for decorative laminate during converting process. Decorative laminates are usually laminated on to a fiber board giving a good-looking resistance surface. A laminate consists of multiple layers viz., absorbent kraft, barrier paper, ivory base paper, and overlay tissue. Each layer performs its own distinct function. It is impregnated by resin, mostly melamine formaldehyde, which is cured to form an inert, hard composite with the fibre expressive structure of the paper. An use of the laminates as working tables, cupboard fronts, or floors sets very high demands on the appearance of the laminate, which must be clean, have the correct light-resistant shade and surface structure, and be resistant to wear and scratching.

The laminate is built so that the plies are impregnated with resin, after which they are cut in to sheets and pressed to gather in a high density press with separating plates between the laminate boards. During pressing decorative laminate is kept between three to four sheets of padding paper, which protect the decorative laminate against burning, wearing, and smearing of surface texture. Now a very high pressure about 3000 lb/in^2 between 150 to 250 ^{0}C is applied on decorative laminate, which is cushioned on both sides by padding paper. The pressure and temperature is enough for pressing out any gases contained in the laminate, which thus becomes a solid, pore less structure. Generally padding paper is made in the basis weight range of 160 to 200 g/m^2 from clean kraft chemical pulp. The most important properties required for the development of padding paper and reasons with the basic definition are as follows:

- Padding paper should have uniform formation, free from blemishes, slime spots, pin holes and calendar cuts because gases liberated from decorative laminate at very high pressure and temperature may smear the surface texture of decorative laminate.
- The purpose of padding paper is to absorb gases and excess of M F resin liberated from decorative laminate during pressing and protect it from burning at very high temperature. The characteristics of padding paper should resemble somewhat with mattress. Absorbent grade pulp is preferred for the development of padding paper in order to achieve the said purpose. Generally, chemical kraft pulp of permanganate no. 11 is taken to develop padding paper.
- However, permanganate no. can be reduced in digester by using high alkali dose and increasing

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max. cooking time. But paper made from unbleached pulp shows shives, specks, and slivers. In order to avoid such type of defects alkali extracted pulp should be preferred.

- It is observed that both absorbent kraft and padding paper have similarities in basis weight and shade. Hence, a working person cannot recognize between them. If padding paper is taken in place of absorbent kraft paper due to mistaken for manufacturing of decorative laminate, then there is possibility of smearing the quality of final product. In order to avoid confusion between them tinting of scarlet red dye in padding paper is done during stock preparation.
- The air porosity (Gurley) of padding paper should be about 40 to 50 s/mL.
- The average wet strength should be about 270 and 240 g/cm in machine and cross direction respectively. The reason is that the vaporized gases and liquid liberated weaken covalent and hydrogen bonds during pressing and it results breaking of padding paper. Hence, it is essential to use M F resin in stock preparation to develop cross-linking in paper.
- The liberated vaporized gases and liquid should be absorbed readily and paper should have the tendency to retain it. Therefore, water klemn and castor oil penetration value are the most important properties. Both the properties show opposite behavior with refining. Both the properties can be optimized by selecting appropriate refining level.

The study aims at developing padding paper from indigenous hardwoods like *Eucalyptus tereticornis* with some proportion of long fibred cellulosic raw materials like, *Dendrocalamus strictus*. The important properties required for padding paper strictly fulfil the requirements of end users.

Experimental Methodology

Pulp Characteristics — Peroxide reinforced alkali extracted pulp of permanganate pulp 11 and brightness 43 ^{0}PV (Photo volt) was undertaken for the study. The approximate composition of eucalyptus and bamboo is 8.5:1.5.

Stock Preparation — In the first part of experiment unbleached pulp of permanganate no. 21 was collected and beaten at two distinct freeness levels, i.e., 32 and 37 ^{0}SR, respectively. The stock is divided in three sets:

Set 1— Both the pulps were treated with alum with continuous stirring to maintain pH about 6.5 to 7.0.

Set 2 — Both the pulps were treated with 0.5 per cent melamine formaldehyde and alum to maintain pH about 6.5 to 7.0.

Set 3 — Both the pulps were treated with 0.5 per cent melamine formaldehyde, 5.0 per cent soap stone powder, and alum to maintain pH about 6.5 to 7.0.

In the second part of experiment peroxide reinforced alkali extracted pulp of permanganate no. 11 was beaten to 28, 35, and 40 ^{0}SR freeness levels respectively. 500 g/t of scarlet red dye was added in each set to match desired shade of padding paper collected from the market. In the similar manner stock is divided in three sets:

Set 4 — Pulps beaten at three distinct freeness levels were treated with alum to achieve pH about 6.5 to 7.0.

Set 5 — In addition to alum pulps as described in set 4 were treated with 0.5 per cent melamine formaldehyde.

Set 6 — In the similar manner, pulps in addition to alum and M F resin, as described in set 5, were treated with 5.0 per cent soapstone.

Sheet Making and Evaluation — Laboratory hand-sheets of 160 and 200 g/m^2 were prepared on British sheet forming machine. These hand-sheets were air dried, conditioned and tested as per Tappi test methods. The results are reported in Table 1.

Analyses of Padding Paper Samples collected from market of different mills — Padding paper samples of different mills were collected, analyzed under microscope and compared with results of laboratory-made hand-sheets as no BIS specification of padding paper is available. The results are reported in Table 2.

Results and Discussions

Morphological analysis of padding paper, collected from mill A shows, comprises 75 per cent hardwood fibres and remaining 25 per cent bamboo fibres. Padding paper of Mill B consists of 85 per cent eucalyptus and 15 per cent bamboo fibres, whereas padding paper of Mill C contains 70 per cent hardwood and 30 per cent bamboo fibres. Normally

Table 1 — Effect of permanganate number, beating, and non-fibrous additives on padding paper properties

Particulars	Unbleached pulp of permanganate number 21						Peroxide reinforced alkali extracted pulp of permanganate number 11									
Freeness	32 °SR				37 °SR			28 °SR			35 °SR				40 °SR	
Code no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Substance, g/m^2	198	198	197	200	201	202	198	196	202	203	198	205	196	199	198	158
COP, s	60	65	80	82	105	110	22	21	25	40	55	60	85	90	85	22
TS	66	74	90	110	120	140	24	24	30	45	60	68	115	115	118	27
WS	33	69.5	85	96	112.5	125	23	22.5	27.5	42.5	57.5	64	100	102.5	101.5	24.5
Avg																
Avg water klemn, mm	12	10	9	10	8	7	41	36	26	40	35.5	28.4	39.5	34.2	27.1	44.5
Ash, per cent	1.70	1.80	5.3	1.80	1.80	5.25	1.50	1.50	4.00	1.60	1.50	5.30	1.60	1.60	5.32	—
Avg et strength, g/cm	252	267	320	347	427	493	252	293	320	307	428	502	398	475	525	252

1, 4, 7, 10, and 13 = alum added to maintain pH about 6.0 to 7.0
2, 5, 8, 11, and 14 = 0.5 per cent melamine formaldehyde and alum added to maintain pH about 6.0 to 7.0
3, 6, 9, 12, and 15 = 0.5 per cent melamine formaldehyde, 5.0 per cent soapstone powder, and alum added to maintain pH about 6.0 to 7.0

Table 2 — Comparison of laboratory-made results of padding papers collected from different mills

Properties	Mill A	Laboratory-made hand-sheets	Mill B	Mill C	Laboratory-made hand-sheets
Substance, g/m^2	200	199	165	158	160
Water klemn (30 mm/4 min), s					
TS	29	–	45	28	–
WS	25	–	43	26	–
Avg	27	34.2	44	27	44.5
COP, s					
TS	82	90	13	30	22
WS	135	115	17	33	27
Avg	108.5	102.5	15	31.5	24.5
Avg wet strength, g/cm	373	475	320	297	252

padding papers manufactured by Mill A and C are used for four-times during pressing of decorative laminate. On the other hand, padding paper from Mill B can be used up to three-times during pressing of decorative laminate. The padding paper gets filled up with M F resin and vaporized gases after reusing more than three-times and it becomes incapable to take further liberated gases and excess of M F resin during pressing of decorative laminate and may affect the quality of decorative laminate adversely. Keeping this in view, a pulp composition comprising of 85 per cent *Eucalyptus tereticornis* and 25 per cent of *Dendrocalamus strictus* has been selected for the development of padding paper.

Table 1 shows that padding paper of basis weight 200±5 g/m^2 made from unbleached pulp forms shives and specks. However the average castor oil penetration values of laboratory-made hand-sheets containing alum, alum and rosin, alum, rosin and soapstone at 32 ^{0}SR are 33, 69.5 and 85 s and at 37 are ^{0}SR 96, 112.5 and 125 s, respectively. On the other hand the water klemn values at 32 ^{0}SR are 12, 10 and 9.0 mm in 4 min and at 37 ^{0}SR 10, 8, and 7 mm in 4 min, respectively. Due to lower water klemn values and the presence of shives and specks in the sheet made from unbleached pulp cannot be shown as the development of padding paper.

The average castor oil penetration values of laboratory-made hand-sheets of basis weight, 200±5 g/m^2, made of peroxide reinforced extracted pulp of permanganate number 11 containing alum, alum and rosin, alum, rosin and soapstone beaten at 28 ^{0}SR are found 24.5, 27.5 and 42.5 s, at 35 ^{0}SR 23, 57.5 and 64 s and at 40 ^{0}SR 100, 102.5 and 101.5 s, respectively. On the other hand, the average water klemn values at 28 ^{0}SR are 41, 36 and 26 mm, at 35 ^{0}SR 40, 35.5 and 28.4 and at 40 ^{0}SR 39.5, 34.2 and 27.1 mm, respectively. The average castor oil penetration at 40 ^{0}SR of laboratory-made hand-sheet of peroxide reinforced alkali extracted pulp of basis weight 200±5 g/m^2 containing alum rosin is 102.5 s and water klemn value 34.2 mm, respectively, are found optimum. On the other hand, castor oil penetration value and water klemn of laboratory-made hand-sheet of basis weight 160 g/m^2 are 24.5 s and 44.5 mm, respectively, which fulfil the purpose of end users. The minimum requirement for wet strength for padding paper is 225 g/cm, which is found to excellent in all the cases.

Table 2 shows comparison of laboratory made padding paper with Mill made padding paper. The water klemn of laboratory-made padding paper of basis weight 200±5 g/m^2 is 34.2 mm compared to 27 mm of padding paper of Mill A. However the COP value of laboratory-made padding paper is 5.5 per cent less compared to padding paper of Mill A. On the other hand the water klemn of laboratory-made padding paper of basis weight 160±5 g/m^2 is 22.2 per cent less compared to Mill C and 38.5 per cent more than mill B. Similarly, water klemn value of laboratory-made padding paper of basis weight 160±5 g/m^2 is 17 per cent more than Mill C and almost equal to Mill B.

Conclusions

(i) Pulps furnish comprising 85 per cent Eucalyptus tereticornis and 25 per cent of Dendrocalamus strictus was found suitable for the development of padding paper. A freeness level of 40 0SR was found to be optimum to develop castor oil penetration value and water klemn.

(ii) 0.5 per cent M F resin and alum to maintain pH about 6.0 was found optimum value in order to develop cross-linking and to entrap fines. 500 g/t of scarlet red dye was found to match shade of mill made padding paper.

(iii) Padding paper made from unbleached pulp shows the presence of shives and specks. However, COP and wet strength are improved but water klemn is very low. It faces difficulties during absorbing gases and liquid. In order to improve water klemn of padding paper peroxide reinforced alkali extracted pulp is preferred.

(iv) The water klemn of laboratory-made padding paper made from peroxide reinforced alkali extracted pulp of basis weight 200+5 g/m2 is 34.2 mm compared to 27 mm of padding paper of Mill A. However the COP value of laboratory-made padding paper is 5.5 per cent less compared to padding paper of Mill A. On the other hand the water klemn of laboratory-made padding paper peroxide reinforced alkali extracted pulp of basis weight 160+5 g/m2 is 22.2 per cent less compared to Mill C and 38.5 per cent more than mill B. Similarly, water klemn value of laboratory-made padding paper of basis weight 160+5 g/m2 is17 per cent more than Mill C and almost equal to Mill B.

(v) Laboratory-made padding papers made in the basis weight range of 160 to 200+5 g/m2,fulfil the purpose of end users.