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Development of Specialty Paper is an Art: Azure Laid Ledger Paper from Indigenous Raw material — Part V

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Azure laid ledger paper usually having yellowish colour is used for making of registered envelope. Registered envelope provides a protective medium for document, which is to be sent from one place to another. In India, the climatic conditions vary from one part to another part of the country. Also, the registered envelope should have sufficient mechanical strength in order to secure the document from damage and harsh atmospheric conditions during posting. It is necessary to develop such properties that may be helpful to protect the covered document against harsh atmospheric conditions and wear and tear during handling. In this paper, attempts have been made to impart such properties using indigenous raw materials like eucalyptus, bamboo and sawmill waste of pine. The results of laboratory made hand sheets are encouraging and match the specifications prescribed by ISP.

Introduction

Azure laid ledger is a highly specialized paper, which is extensively used for manufacturing of registered envelope. A paper without laid lines usually bluish green or light blue in colour having good writing surfaces is known as azure wove paper. Whereas, a paper with laid lines is termed as azure laid paper. The azure laid paper used in post office is yellow in colour. A registered envelope is a flat case, generally rectangular in shape from one sheet of paper. This paper is so folded as to provide a plain front and a box consisting of four overlapping flaps. Generally, three flaps are struck together the four, which may be gummed serving as a closure. Registered envelope provides a protective media for document, which is to be sent from one place to another. In India the climatic conditions vary from one part to another part of the country. Also the registered envelope should have sufficient mechanical strength in order to secure the document from damage during posting. Therefore, azure laid paper is smooth, less porous (prevents passage of moisture inside the envelope), well sized strong writing paper characterized by good tearing strength, high folding endurance, ruling quality, permanence and durability etc. Azure laid paper is manufactured from bleach sulphate pulp, which is free from shives and slivers. The following are the most important properties, which are essentially required for azure laid paper:

- Evenly and medium rosin sizing is required in order to get the right pick up and sufficient web strength without excessive absorption and binder migration of ink into the paper body during writing. The two sides have even degree of sizing.
- Formation of the paper is much important, as it influences many other important properties like compressibility, porosity, opacity and surface smoothness. Formation and opacity can be obtained using hardwood sulphate pulp.
- Surface strength is important and is frequently improved using starch in a size press.
- Azure laid ledger paper is subjected to repeated folding in which the requirement is durability or resistance to wear. The high double fold value is required and it measures a combination of tensile strength, stretch, pliability, compression resistance and various other shear stresses and strains. The high double fold value can be achieved by extra refining and by the use of long, pliable fibres. Surface sizing and the addition of

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filler can cause decrease in folding endurance. Therefore, blending of hardwood fibres, use of optimum filler dose and refining should be preferred for increasing of smoothness instead of (rather than) surface sizing.

- Tearing strength has particular significance in the evaluation of paper, which is subjected to tearing strains during conversion, and in service. It can be achieved by use of long fibres in pulp furnish and by controlling refining of pulp.

In the present investigation, efforts are made to manufacture azure laid paper from locally available cellulosic raw materials and compared with standard specified by Indian Postal department. Finally, it is observed that laboratory made azure laid paper serves the purpose of end users and meets all the specifications prescribed by ISP strictly.

Experimental Methodology

Collection of Pulp — Bleached pulp of brightness 85 °PV was collected from bleached filter of Star Paper Mills Ltd, Saharanpur located in the foot hills of Shivalik, in western UP. Wood chips of pine, bamboo and eucalyptus having proximate composition in the ratio of 1:2.3:11 were mixed and digested in batch digester at pressure 6.5 kg/cm^2, max pulping at 162 °C for 75 min with white liquor containing 16 per cent active alkali (as Na_2O), 20 per cent sulphidity, and 2.8:1 liquor to wood ratio. The unbleached pulp of kappa number 22, and yield 49.5 per cent was washed in Dorr washers, screened in Voith pressure screen and bleached by using CE_PHH bleaching sequence. The viscosity of pulp is 9.2 cps.

Stock Preparation and Sheet Making — The pulp is beaten to 40 °SR in laboratory WEVERK make valley beaker. Various wet-end additives, as mentioned in Table 1, are mixed into the pulp furnish. Direct yellow dye and Crysosidine – R dyes are also added to match the shade of azure laid ledger paper. Laboratory hand–sheet of 100 ± 2.5 per cent were made on semi-automatic Messmer sheet former. The laboratory made hand–sheets were pressed and air-dried in atmospheric conditions. In order to improve smoothness of paper surface sizing is done. The formulation of surface size chemicals is given in Table 1. After air-drying the laboratory made hand-sheet were conditioned at 27 ± 2 °C and 65 ± 2 per cent relative humidity and tested for various properties required for azure laid ledger paper.

Results and Discussion

The short fibred mill pulp is not able to produce high tearing strength and double-fold, hence it is necessary to blend mill pulp with softwood pulp in the ratio of 80:20 after beating separately to 40 °SR. In order to impart optimal azure laid ledger properties

Table 1— Wet end additives and surface size chemicals required for the development of azure laid ledger paper

Sl No.	Specialty chemicals	Per cent dosing	Purpose of addition
A	Wet end additives		
(i)	Alum ferric, (solid basis)	6.0	As a pH controlling agent, mordant and, anchoring agent
(ii)	Fortified rosin	1.1	To develop water repellence properties in paper
(iii)	Wax emulsion	0.25	To enhance the degree of sizing
(iv)	Amphoteric starch	0.5	To improve strength of paper, drainage and, retention
(v)	Sodium silicate	0.35	To disperse filler particles within the sheet
(vi)	Sapco K F	0.025	As a foam killing agent
vii)	Sulphuric acid	0.35	To maintain pH level of 4.5
(viii)	Direct yellow dye	0.05	To develop shade and colour of registered envelop
(ix)	Crysoidine dye	0.01	To develop shade and colour of registered envelop
(x)	Soap stone powder	8.5	To improve opacity and, printing characteristics of paper
B	Surface size chemicals		
(i)	Starch	3.1	To improve water resistant, bonds and, surface properties
(ii)	China clay	0.91	To improve opacity and, printing characteristics of paper
(iii)	Anionic urea formaldehyde	0.39	To improve cross linking

various wet end additives, as described in Table 1 were added into the furnish. 1.1 per cent fortified rosin and 6 per cent alum was added to develop water repellence properties in paper. The minimum requirement for $Cobb_{60}$ is 17 g/m^2; therefore, 0.25 per cent wax emulsion was added to get desired degree of internal sizing. In order to improve retention of fibres and fillers and to increase bonding through 3-*D* network 0.05 per cent amphoteric starch was added. In order to impart stiffness to paper, uniform distribution of non-fibrous additives, and to prevent air entrapment into white water system, which causes pinholes, and blemishes into the sheet 0.35 per cent sodium silicate was added. The additions of 0.05 per cent direct yellow dye and Crysoidine dye developed the yellow shade, which matches with the shade of registered envelope. 8.5 per cent soapstone powder of brightness 90 ^{0}PV smoothens the paper surface by filling out voids among fibres and improves printability; paper opacity, dimensional, stability, brightness, gloss and evenness of formation. The dried laboratory made hand–sheets were subjected to surface sizing using starch, china clay, and anionic urea formaldehyde in the ratio of 7.58:2.21:0.95.

Table 2 shows comparison between laboratory made hand-sheet with mill made paper and specification prescribed by ISP. The thickness of registered envelope is more than mill made paper and slightly lower than the prescribed specification Burst factor resembles to those of specifications prescribed by ISP, whereas burst factor of mill made paper is very low. Therefore the ability of mill made paper to absorb shocks is minimum and paper can damage during posting. Breaking length and tear factor of laboratory made paper is on higher side than that of mill made paper. It means that the laboratory made hand-sheets can bear more tearing strains during conversion, and in service. Double-fold of mill made paper and laboratory made paper is on higher side than that of prescribed specifications. Smoothness of laboratory made hand sheets and specifications prescribed by ISP are almost equal, whereas mill

Table 2 — Comparison of properties of laboratory made hand-sheets with specifications prescribed by ISP and mill made paper

Sl No	Parameters	Specifications prescribed by ISP	Results of mill A	Results of laboratory made hand-sheet
1	Basis weight, g/m^2	100 ± 2	104	98
2	Thickness,μm	150 ± 2.5	128	136
3	Bulk, cm^3/g	—	1.23	1.43
4	Ash, per cent	5 (max)	6.0	5.1
5	Burst factor	25 (max)	19	26
6	Breaking length, m			
	MD	—	3290	—
	CD	—	2460	—
	Avg	—	2875	4200
7	Tear factor			
	MD	—	73	—
	CD	—	77	—
	Avg	—	75	78
8	Double fold			
	MD	150	252	—
	CD	100	78	—
	Avg	125	165	152
9	Smoothness, s/50 mL	40 - 45	20	40
10	Opacity, per cent (^{0}PV)	90	97	97.5
11	$Cobb_{60}$, g/m^2	17 (max)	20	18
12	Hot extract pH	5 - 6	5.8	5.2
13	Wax pick, no	—	9A	10A

made paper is rough. The consumption of ink in mill made azure laid ledger paper will be more during printing and the possibility of damage by harsh atmospheric conditions will be comparatively more. The opacity, $cobb_{60}$ and pH of hot extract of paper are almost equal and resemble with each other. The laboratory made azure laid ledger paper is better than the mill made paper and follows all the specifications prescribed by ISP strictly.

Conclusions

1 A pulp furnish comprising sawmill waste of pine, bamboo and eucalyptus in the ratio 1:2.3:11 was found suitable to develop azure laid ledger paper. The blending of 20 per cent softwood fibres was found optimum to impart prescribed tear strength and double-fold.

2 A freeness level of 40 ^{0}SR with other wet-end additives like, 6 per cent ferric alum, 1.1 per cent fortified rosin, 0.025 per cent wax emulsion. 0.05 per cent amphoteric starch, 0.35 per cent sodium silicate, 0.025 per cent sapco KF, and 8.5 per cent soapstone powder were found to be optimum to impart essential properties required for azure laid ledger paper.

3 The addition to 0.05 per cent direct yellow dye and 0.01 per cent Crysoidine-R dye develop yellow colour, which matches with the shade of registered envelope.

4 Surface sizing chemicals like starch, china clay, and anionic urea formaldehyde in the ratio of 7.58:2.21:0.95 were found to be optimum to develop smoothness and surface properties.

5 The results of laboratory-made hand sheets resemble those of specifications prescribed by ISP, except sheet thickness, which is slightly on lower side one hand. The thickness can be improved by optimising the sheet pressing. On the other hand the results of laboratory made sheet are superior to those of mill made paper in many respects.

Recommendations

1 Before conducting plant trails, it is recommended to use dandy roll in order to lay down lines on azure laid ledger paper.

2 It is also recommended to use surfactants, formation aid, and retention aid to avoid air entrapment, which causes pinholes, and blemishes into the sheet, two-sidedness, and good sheet formation.

3 The use of surface size chemicals is recommended in order to improve the surface characteristics of paper.