

Print Through with relation to OBA and Surface Sizing Agents

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When print through is compared using varying amounts of ink, it is observed that total print thorough is least for sheets of paper made from hardwood. Total print through increases when OBA is used in non-surface sized papers. The inclination for ink penetration and pigment vehicle separation is lesser in surface sized papers.

INTRODUCTION

The print through refers to the undesirable effect of a print in which the printed image on a paper sheet is visible from the reverse side. It is defined as the contrast between the printed and unprinted portions of the sheet when viewed from the reverse side of the print.

OBJECTIVE

As one of the largest publisher-printer we are using different varieties of writing and printing papers. A complaint of "Less Opacity" from both, the printer as well as the publisher has been of a major concern to us. The objective or rather the objectives of the said study was to

- Get acquainted with the inherent limitations in optical properties of the paper.
- Measure these limitations.
- Correlate these measurements with paper properties.
- Learn about the parameters of ink, considered by the ink manufacturers. The last objective is unfulfilled.

THEORY

Larson and Trollas suggested that the print through is a

combined effect of the following three factors

- Show through due to lack of opacity of paper.
- Penetration of pigment into the paper.
- Loss of opacity due to vehicle pigment separation.

Print through is quantitatively expressed as

$$PT = \log(R_{\alpha.rev} / R_{p.rev}) \quad [1]$$

$R_{\alpha.rev}$ = Reflectance of reverse side of unprinted sheet backed by pile of same paper

$R_{p.rev}$ = Reflectance of reverse side of printed sheet backed by a pile or same paper

The component of print through due to lack of opacity was calculated using the equation developed by Bristow

$$PT_{ST} = \log(R_{\alpha.rev} / R_x) \quad [2]$$

R_x = reflectance of unprinted sheet backed by a same sheet of the same paper with a known amount of ink. When these values are compared against varying amounts of ink, it is observed that total print thorough is least for sheets of paper made from hardwood and most for softwood papers. Bagasse papers lie in between these two. The same trend is followed for pigment penetration and pigment vehicle separation .

Table 1. Surface Papers used for Stationary Products Manufacture

Sample No	Basis Weight (Gsm)	Approx. Furnish	$R_{\alpha.rev}$	$R_{p.rev}$	R_x	PT	PT ST	PT-PT ST
1	54 gsm	Bagasse + Hardwood + Bamboo	82.75	61.91	66.63	0.13	0.09	0.03
2	54 gsm	Bagasse + Bamboo	72.12	56.80	60.84	0.10	0.07	0.03
3	56 gsm	Eucalyptus + Bamboo	77.43	63.07	68.23	0.09	0.05	0.03
4	56 gsm	Bagasse + Hardwood + Bamboo	80.43	62.38	67.05	0.11	0.08	0.03
5	56 gsm (yellow)	Bagasse + Hardwood + Bamboo	76.16	59.62	63.98	0.11	0.08	0.03
6	56 gsm	Eucalyptus + Bamboo	78.21	59.26	65.26	0.12	0.08	0.04

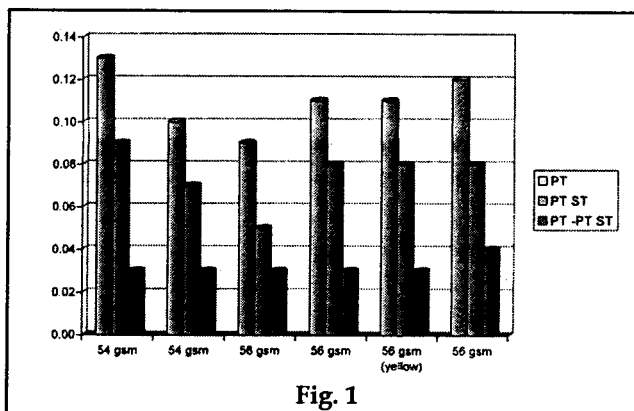


Fig. 1

Table 2. Surface sized papers used for single color printing

Sample No	Basis Weight (Gsm)	Approx. Furnish	R _a %	R p.rev	R _x	PT	PT ST	PT-PT ST
1	58 gsm	Eucalyptus + Bamboo	74.14	63.49	66.78	0.07	0.05	0.02
2	60 gsm	Bagasse+Hardwood	76.32	62.15	65.80	0.09	0.06	0.02
3	60 gsm	Bagasse+Bamboo	75.42	60.81	64.63	0.09	0.07	0.03

EXPERIMENTAL

Aim: To determine the total print through and print through propensity in different writing and printing papers.

Apparatus: Baby offset printing machine, offset black

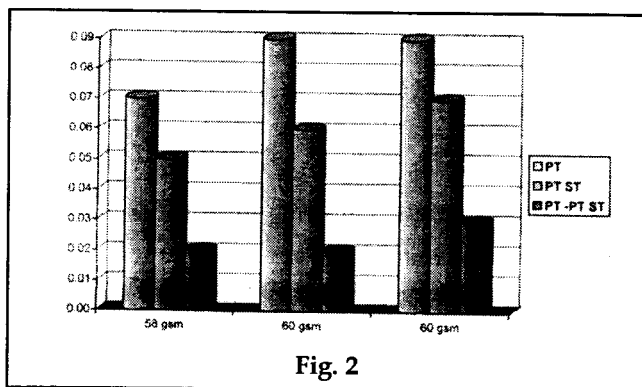


Fig. 2

ink, different writing & printing papers as per details in Table.

Sample Preparation

A 4 Sized (210 X 297 mm) sheets of all of the above mentioned samples were taken. After seasoning at 27 degrees centigrade temperature and 65 % RH in room air conditioner for 24 hours the sheets were packed in separate polyethylene bags and were taken for printing. Samples used are listed in Table 1.

Printing of samples

The printing was done by offset process by using a polyethylene plate as medium of image transfer. Black squares of size 100mm X 100 mm was printed on each sheet. The ink tack and the roller settings were maintained constant during the print run. The sheets so prepared were kept back in the polyethylene bags for further use.

Optical Measurements

The measurements were made on an L & W instrument

Table 3. Non Surface Sized Paper used for Single Color Printing

Sample No	Basis Weight (Gsm)	Approx. Furnish	R _a %	R p.rev	R _x	PT	PT ST	PT-PT ST
1	54 gsm	Bagasse + Bamboo	73.04	60.80	64.47	0.08	0.05	0.03
2	57 gsm	Hardwood + Bamboo	66.85	57.01	60.89	0.07	0.04	0.03
3	60 gsm	Eucalyptus + Bamboo	72.95	58.36	63.11	0.10	0.06	0.03
4	60 gsm	Hardwood	74.44	63.78	66.32	0.07	0.05	0.02

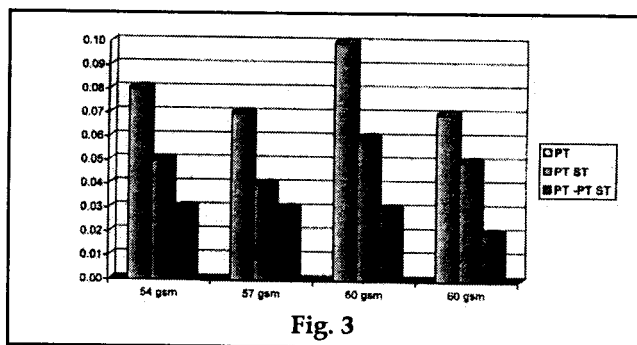


Fig. 3

at a renowned paper mill in India. The measurements are:

R_a.rev = Reflectance of reverse side of unprinted sheet backed by pile of same paper

R_p.rev = Reflectance of reverse side of printed sheet backed by a pile of same paper

R_x = reflectance of unprinted sheet backed by a same sheet of the same paper with a known amount of ink.

The total print through and print through due to lack of opacity were determined. using the formulae developed by Larson and Trollas [eq. 1].

The component of print through due to lack of opacity was calculated using the equation developed by Bristow [eq.2].

The difference PT - PT_{ST} will indicate the print through propensity (an inherent inclination) due to ink penetration and pigment vehicle penetration (Table).

Print through was observed in light of furnish, structural and optical properties as listed below

RESULTS AND DISCUSSION

Furnish

Furnish plays an important role in deciding the optical future of the paper. More of hardwood in furnish increases the opacity. Papers with bagasse will exhibit print through due to lack of opacity. With hardwood, i.e. more of shorter fiber, the penetration of pigment will increase. The best combination in terms of least print through propensity due to pigment vehicle will be bamboo + hardwood.

Structural Properties

- Bulk- Bulkier papers were found to have lesser total print through.
- Porosity- Perhaps one of the trickiest properties to have been observed. Theoretically, papers with higher porosity will have a greater tendency to exhibit print through. However the indication is the pore size is the one component that influences the print through.
- Sizing - No direct relation between sizing values and print through was observed.
- Ash Content - Papers with higher loading discourages penetration of pigment in the paper. But this has its own limitations regarding the lowered

Table 4. Non Surface Sized Papers used for Multi Color Printing

Sample No	Basis Weight (Gsm)	Approx. Furnish	R _{a,rev}	R p.rev	R _x	PT	PT ST	PT-PT ST
1	80 gsm	Hardwood + Bamboo	64.54	61.81	61.74	0.02	0.02	0.00
2	80 gsm	Hardwood	73.53	69.00	69.95	0.03	0.02	0.01

bulk as well has strength.

Optical Properties

- a) Brightness- Higher the brightness, higher the print through. More complications follow as we discuss the color scale.
- b) Opacity – Naturally more the opacity less the print through. A lot of work is being done in recycled fiber technology. It seems that these fibers are the fibers of tomorrow.
- c) "L" value- A whiter paper will not only enhance the print quality of the paper but does not interfere much

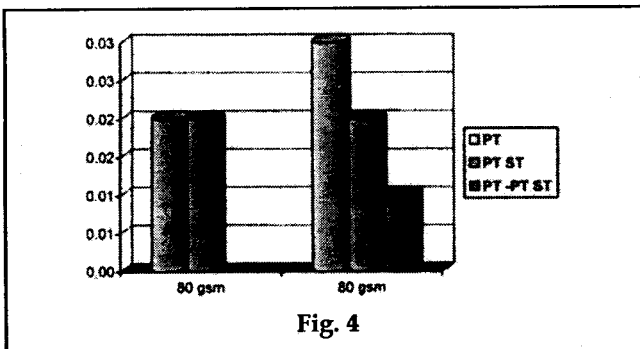


Fig. 4

with the print through. A controversial statement though. We know that brightness is reflectance in the blue region and whiteness is reflectance over all the regions. A customer describes whiteness to brightness. The mill can manipulate upto 1 to 2% in ISO Brightness by using dye which is cheaper. However they will have to work harder to increase even by 1% in whiteness

- d) 'a' value: Reddish color will discourage print through. Green shade was not encountered.
- e) 'b' value: a yellowish shade will resist print through in all the forms. This shade is also most soothing for young readers. However in India, the acceptance of a yellowish shade is debatable. Bluish shade will reduce print through due to lack of opacity.

CONCLUSION

The problem of print through is a major irritant to the printer and user. The interactions with the paper fraternity have given an impression that somehow the

Table 4. Non Surface Sized Papers used for Multi Color Printing

Sample No	Basis Weight (Gsm)	Description	Approx. Furnish	R _{a,rev}	R p.rev	R _x	PT	PT ST	PT-PT ST
1	70 gsm	Surface sized Maplitho	Eucalyptus + Bamboo	78.04	67.29	70.32	0.06	0.05	0.02
2	80 gsm	Surface sized Maplitho	Eucalyptus + Bamboo	77.47	70.11	69.94	0.04	0.04	0.00
3	80 gsm	Surface sized (Super Print)	Bagasse + Bamboo	79.96	70.70	73.02	0.05	0.04	0.01
4	100 gsm	Surface sized Maplitho	Eucalyptus + Bamboo	76.85	72.67	74.11	0.02	0.02	0.01

paper maker is not associating himself with this problem. Through this we, at Navneet are trying to convey a message to the paper makers to correlate the paper industry with this problem not only between the printer, the ink manufacturer and the printer's customer.

Chemistry of Print Through

Paper are divided in two classes for convenience sake :

- a) Surface Sized and b) Non Surface Sized

a. Surface Sized : It is seen that Styrene Maleic Anhydride resins (SMA) used in past as an effective surface sizing agents are now being used in dry end paper making to enhance surface properties and

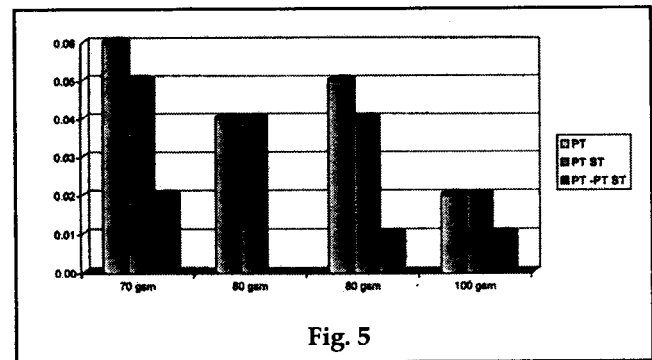


Fig. 5

printing qualities of paper. Dry end sizing is an add on operation in paper making process. The brightness of paper is particularly important to paper malers since it is often costly and time consuming to increase it. Because SMA imides are light yellow compounds, it is possible that they act as a light dye interfering with an accurate measurement of brightness. For a yellow dye, however that reflectance of light at 457 nm should decrease. However this case is not observed. The possible reason may be the interaction between imide resins and compounds from broke or deinked pulp.

b. Non-Surface sized : The ordinary cream wove papers come under this class. Total Print through of the sample number (2) from Table 3. is lesser than that of its nearest surface sized counterpart i.e. sample number (1) from Table 2. The reason can be attributed only to the lower brightness of the former at about 77% as compared to 84% of the later. The bleaching sequence for (2) is CEH, while one for sample number (1) is DEp. The propensity is however more in number (2) due to use of blue. The OBA which attempts to increase the already feeble brightness in (2) by 1 to 2% is seen to impart this tendency.

Internal Sizing : There is no known effect of the type of size used i.e. AKD, ASA, Fortified rosin or Alum rosin.

Developments at the user end after the Study :

The whole study gave us an insight of how to exploit the optical properties of paper to the best. As a printer we could now also focus on ways to ask the mills to increase smoothness and bulk at the same time. This understanding has resulted in some improvement in runnability of the paper, reducing printed waste and lesser complaints from the consumers. Improvements will definitely follow if the ink industry reponds in the same way as the paper mills have.