

PREDICTION OF HALF TONE AND BACK TRAP MOTTLE FOR OFFSET PRINTING



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Abstract :

Packaging is usually printed to provide information, illustration and to enhance visual display. Several printing processes are used commercially today. These processes include offset lithography, flexography, letter press, gravure, screen printing and digital offset printing. They vary in several important characteristics, the techniques by which they are applied to the paper or paperboard substrate and the processes by which they dry and become permanent and durable. Despite the variability, there are common features relating to printability which apply to all paper and paperboards.

One of the unpleasant effects is the unintentional spatial reflectance variations in the print commonly known as print mottling. But the quality of a print would always have been the key concern for every printer. The variation in quality of printing due to numerous reasons causes such unpleasant effect during printing. The key objective of this paper is to predict the print mottle (Half tone / back trap mottle) by testing the unprinted coated board in laboratory.

Keywords: *Print Quality, Printing techniques, Reflectance, Mottling, topography, coating coverage uniformity*

Introduction

Offset printing is a planography printing process. The principle of sheet-fed offset printing process is derived from the planography printing process. As the word planography conveys the meaning that the printing and non-printing area lie in the same plane, similarly sheet-fed offset printing process consists of both the plane i.e. printing and non-printing area in the same plane. Planographic printing process is generally a process in which separation of image and non-image area chemically with the use of certain chemicals in such a way that image area is ink receptive and non-image area is water receptive. This process is based on the fact that oil and water repulse and don't mix each other. The transfer of ink from one image area of the plane is controlled by maintaining the balance of water and ink. The printing unit of the offset press basically contains three cylinders: a plate cylinder, a blanket cylinder and an

impression cylinder. The plate is attached to the plate cylinder and the blanket is attached to the blanket cylinder. The impression cylinder carries the paper through the printing unit. It provides a support against which the blanket can impress an image on the paper. The paper is then transferred to the delivery tray. The desired print image is exposed onto a plate which is transferred from the plate to a rubber blanket and then subsequently to the printing substrate with the help of sufficient impression pressure, therefore offset is also called indirect process of printing. In offset printing, print mottle is caused due to irregular back trap of ink which happens due to irregular rate of drying. Ink and water uneven balance is major reason for various type of mottling. It also occurs due to non-uniform absorption of fountain solution on the surface of paper. Print mottling is basically a non-uniform appearance of paper surface with sufficient ink covering. The print mottle does not occur not only

in the solid printing but it appears on the half tone dots also. Some more reasons include other than those related to ink transfer. Print mottle can occur on almost all types of printing surfaces i.e. porous as well as non-porous surfaces. Print mottle can occur in different printing processes but the way it occurs varies.

To have better printability and consistent image transfer to the paperboard few basic requirements of the paper board which are discussed in this article.

They comprise surface smoothness, surface structure or topography, gloss level, opacity, surface strength, ink and varnish absorption, drying, rub resistance besides surface cleanliness. In specific cases, surface pH and surface tension or wettability are also relevant.

Objectives of Study

In the modern age of science and technology, the recent scientific

innovations have given rise to various technologies in each and every aspect of life including print sector also. Despite of the widening use of modern technology in the print sector, the sheet-fed offset printing still faces the various problems

during printing. Print mottling is one among them and printers have to cope up it as soon as possible to maintain the quality up to the mark. Therefore key objectives of this study are to explain the following aspects of print mottling in

Sheet-fed Offset printing:

- i. Back trap and half tone mottle in Sheet-fed Offset Printing
- ii. Predicting the mottle by using special tests.

Activity	Attribute Data	Between Appraisers		Decision	Appraisers vs. Standard	
		Kappa Statistic	Kendal Statistic		Kappa Statistic	Kendal Statistic
Prufbau - Mottle	Rating (1- 5)	0.82	0.96	Acceptable	0.86	0.95
Burnout Test	Rating (1- 5)	0.86	0.98	Acceptable	0.90	0.96

Methodology

This study was carried out in order to analyse the print mottle in sheet-fed offset printing. The whole study was based on observation and identification of mottle defects occurred during printing.

A large set of offset printed samples were selected from a collection of customer complaints on patchyprinting. These samples are of various intensity of patchy selected for SBS and FBB grades with grammage ranging from 250-400 g/m2.

The difference of print mottle level between various jobs was observed on the bases of perceptive evaluation by several standard observers by using attribute agreement analysis (AAA).

Types of Print Patchyness

Water Interference Mottle:

When paper absorbs fountain solution unevenly ink applied in the subsequent units lay unevenly. This ink and water imbalance results in the blur or low dot structure during printing. This result is known as water interference mottle.

Ink Trap Mottle:

During multicolour printing when paper passes from unit to unit, poor or inconsistent ink trap transfers non-uniform ink film on previous printed ink film on the substrate resulting in Ink Trap Mottle.

Back Trap Mottle:

When the printed sheet travels from one unit to another, the ink film on the paper surface traps back non-uniformly onto subsequent blankets doing uneven ink transfer and absorption on the paper surface. This defect is known as back trap mottling.

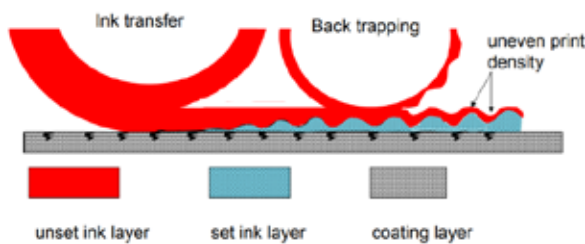


Fig 1 : back Trap mottle illustration



Fig 2 : Result of back trap mottle

Half tone Mottle:

Half tone mottle is of two types first one is due to uneven physical dot gain and other would be optical dot gain.

Dot gain is a phenomenon that dots size of printed matter by press is larger compared with that of press plate. The larger the dot gain is, the higher the printing density is. The dot gain is classified into optical dot gain and mechanical dot gain due to the mechanism. Optical dot gain is an apparent phenomenon derived from the light which passes through

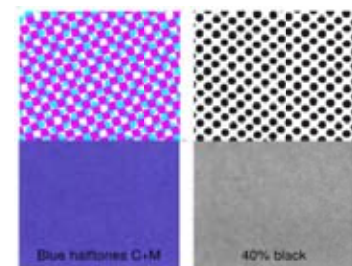


Fig3 : Illustration of optical dot gain

halftone dots, then scatters laterally under the dots within paper, and subsequently emerges back from non-image part at periphery of the dots as shown in Figure 1. The larger lateral light scattering within paper is, the larger optical dot

gain amount becomes. Mechanical dot gain arises from actual spreading of ink, in case excess pressure between blanket and press plate, excessive amount of ink used and so on.

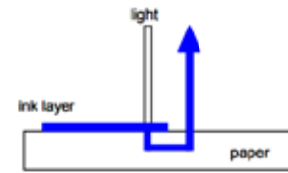


Fig 4: Light path at periphery of halftone dot

EXPERIMENTAL

In offset printing, print mottle is caused mainly due to

- (i) Irregular back trap of ink which happens due to irregular rate of drying. It is called as back trap mottle. It also occurs due to non-uniform absorption of fountain solution on the surface of paper. Ink and water uneven balance is major reason for various type of mottling
- (ii) Half tone mottle which is due to either irregular mechanical dot gain or optically dot gain.

In this present study we have considered to predicting the above two types of mottling with laboratory facilities.

Study -1: Burn Out Test& Results

The unevenness of the coverage of the coating layers on the same set of unprinted paperboard samples was evaluated with a burn-out test, where the burn-out test was performed according to the principle described by (Dobson 1975; Anderson, Eklund 2007). In this test, the sample is saturated with a solution consisting of 25 g/l of ammonium chloride in equal parts of water and ethanol. After saturation, the sample is dried under ambient conditions, followed by non-contact drying in a ventilated oven at a temperature of 225°C. During this heat treatment the base paper carbonizes and turns black, allowing non-uniformities in the coating coverage uniformity to be detected.

From the complaint gallery of mottling various grades of paper boards were selected for this study. The corresponding unprinted areas from the printed sheet and preserved samples

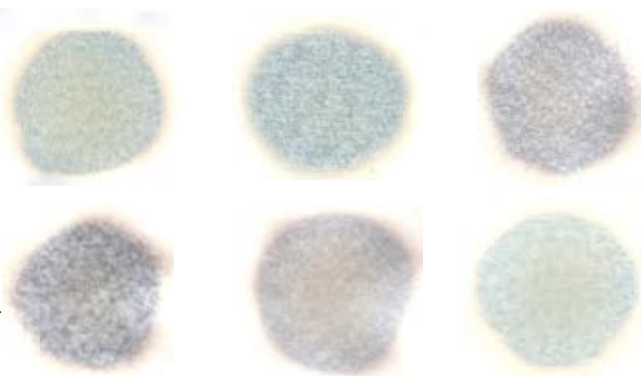


Fig5 : tested burnout samples of coated paperboard

from the corresponding lot were measured for burnout test. Overall appearance of the burnout test are as below.

Upon observing each burnout sample Vs customer complaint it was understood that there is an agreement between this test Vs the half tone complaint samples.

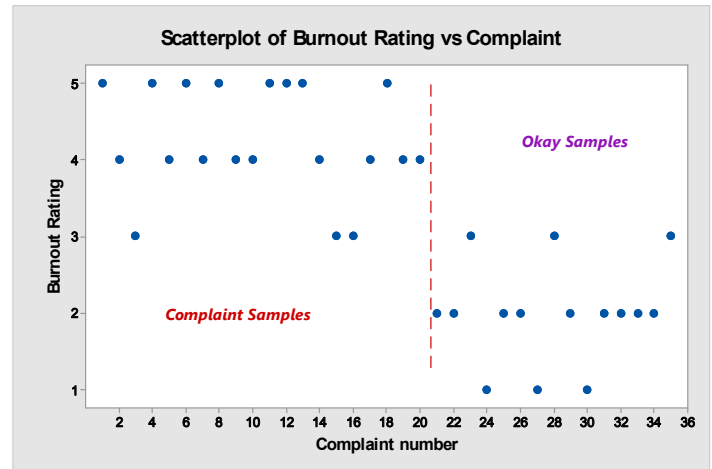


Fig 6 : Scatter plot of the relation between complaint samples Vs burnout test

Burnout samples were classified into 5 ranks, and named rank 1-5 from good to bad as results of perceptive evaluation by several testees. There was a fairly good agreement between the appraisers with respect to complaint samples Vs burnout results.

Hence rating scale is developed for the Burnout test which is

- (i) Widely used to assess the print quality of the paper board before releasing it to customer.
- (ii) Key tool for analysing the Patchy related customer complaints.
- (iii) Key test for any process development initiations, while taking trials (chemical / furnish trials).

Study -2: Back Trap Mottle & Results

Back-trap mottle is a common and serious print quality problem in lithographic offset printing of coated papers. It is caused by non-uniform ink retransfer from an already printed surface when it passes through a subsequent printing nip with the print in contact with the rubber blanket in that nip. A non-uniform surface porosity gives rise to mottle. A key parameter in mottling contexts is the coating mass distribution, which must be uniform. Good relationships between mottle and mass distribution have also been reported; the mottle pattern coincides with that of the coating mass distribution.



Fig 8: Uneven coating distribution on a paperboard

A test is developed to assess the print mottle on a coated paper board by using two inks Cyan and magenta. These colours are prone to result in print mottle while printing these ink one over other on a paper board strip by using “Prufbau Multipurpose Printability Tester”. The result of Print strip further is assessed to understand the intensity of print mottle due to the coated board.

Procedure:

Sample substrate of size $230 \pm 2 \times 47 \pm 0.5$ mm² to be taken. Cyan and magenta ink with precise weight to be applied on the inking unit of the prufbau instrument. Post uniform distribution of the ink, by using the separate printing discs, the inks are to be transferred to the paperboard sample, cyan first with the use of Prufbau Printing Instrument. Post printing of these two inks, test strip passes through blank rubber rollers (discs) which acts as back trapping. This entire set up of printing procedure is with Prufbau Printing Instrument.

Above test method was used to print sufficient samples from customer complaints and collated the data with respect to patchy complaints (Soild area). This exercise continued for 20 complaint samples and 10 okay samples and the results are further assessed by various appraisers to get common understanding on rejection level.



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Thus we have prepared rating scale based on the complaints and appraiser evaluation Consequently rating scale is developed for the back trap mottle test and is

- (i) Widely used to assess the print quality of the paper board before releasing it to customer.
- (ii) Key tool for analysing the Patchy related customer complaints especially in solid area.
- (iii) Key test for any process development initiations, while taking trials (chemical / furnish trials).

Conclusion

This paper explained different types of print mottling and identification of various variables contributing for occurrence of different aspects of print mottling in Sheet-fed Offset printing. Offset printing is a planography process based on chemical separation of image and non-image area i.e. ‘Ink and Water balance’. Due to this nature of printing process the various types of print mottles were predictable

During the analysis it was found that while printing through sheet-fed offset printing, print mottling is the most common and frequently occurring printing defect. It was observed that the results obtained during the study were in accordance with the print quality standard range. The rating scales thus developed were great relief to paperboard manufacturers to interpret the back trap and half tone mottle.

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