IPPTA - 2017

Technical Session-IV

Prediction of Half tone Mottle and Back trap mottle in offset Printing

ITC LIMITED, Paperboards and Specialty Papers Division

Project Presentation

5th August 2017

SUSA Activity – Standing on 6A core pipe.

Name(s) : Santosh– Rafi contractor

Location & Agency : FH7 **Date & Time: 10 th Jun`17 at 11:30 AM**

Safe Behavior(s) : Stand on Wooden plank while packing reams at height

Unsafe Behavior(s) : Standing on 6A core pipe piece while packing reams at a height.

Srinibas Daini	Discussion held with Santosh
Why are you standing on a core pipe?	Unable to pack the reams of more height pallet. So using core pipe.
Do you think it is safe?	There is a chance of falling if we stand on a core pipe.
Why you are doing the unsafe work with knowing the hazard ?	To complete the packing fast , I taken the short cut method, which is unsafe.
Can you avoid such unsafe work practice?	Definitely I will avoid doing unsafe work.

ITC LIMITED, Paperboards and Specialty Papers Division

Annual Segment Turnover
~ Rs. 4500 Crores
(~US $ 650 Million)

Total Capacity – 675,000 tons

Manufacturing Units – 4

- Bhadrachalam
- Kovai
- Tribeni
- Bollaram

3500 Employees

Servicing requirements in nearly 30 countries

Glimpses of ITC PSPD Products

Turns every sip sublime

Whiteness Redefined

The Original FBB

For Display Packaging

Packs a Punch

Machine-friendly Digital Board

Appearances Matter

Engineered for frozen foods

The Stiffer Art Board

Judge a Book by its Cover

For Expressive Packaging

Robu@st

Leave nothing behind

Value Packed

Vanishing Container

Crush Resistant

The Great Greyback

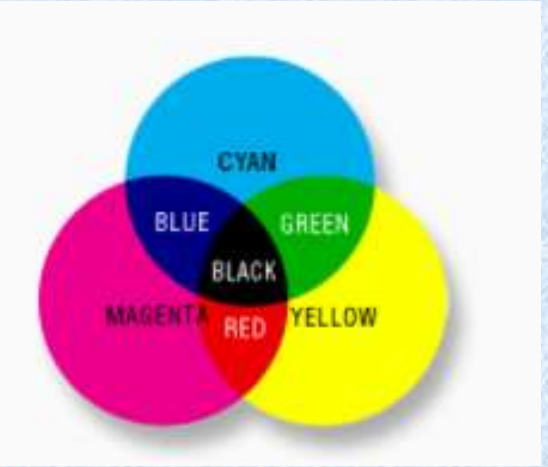
Forging Strong Bonds

Offset Printing Technology- Basics

Offset printing is the most commonly used method today, and has many advantages over other forms of printing, especially when we need high and consistent image quality.

This is a process used for printing on a flat surface, using plates. An image is transferred to a offset plate which is chemically treated so that only image areas (such as type, colors, shapes and other elements) will accept ink. Water and ink is applied to the plate. Because of the chemical treatment, ink only “sticks” to the image areas, which reject the water. Areas without images reject the ink. The images with ink are transported then from the plate to the surface of blanket. The task of printing blankets that are made of special multi-layer rubber is to convey the image to the paper.

Offset printing uses the process colour or four colour known as CMYK.
‘**C**‘ stands for Cyan (a colour in the blue/green spectrum),
‘**M**‘ stands for Magenta (a colour midway in the red/blue spectrum),
‘**Y**‘ stands for Yellow and
‘**K**‘ stands for Key (the black key plate).



*The ink printing over the paper surface gets **off** in the blanket and finally **set** on the paper*

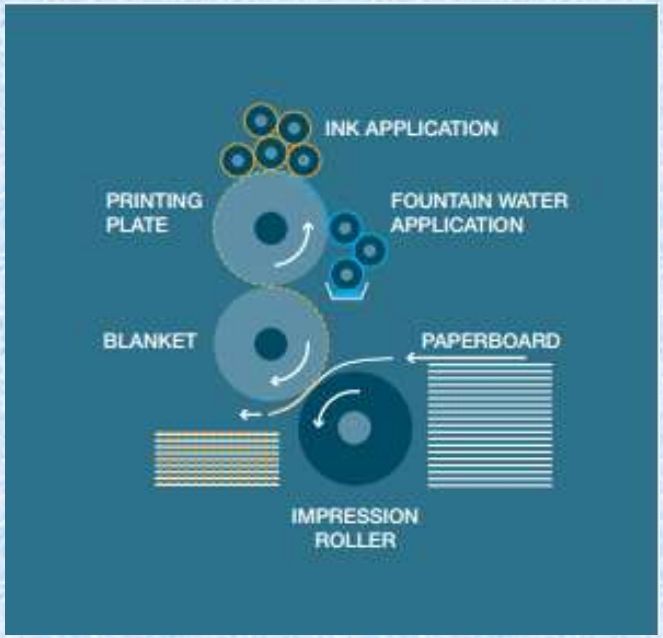
Offset Printing Technology- Introduction

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.

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:

i) plate cylinder,
ii) blanket cylinder
iii) 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.



Offset Printing Technique.

Print Mottle in Offset 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.

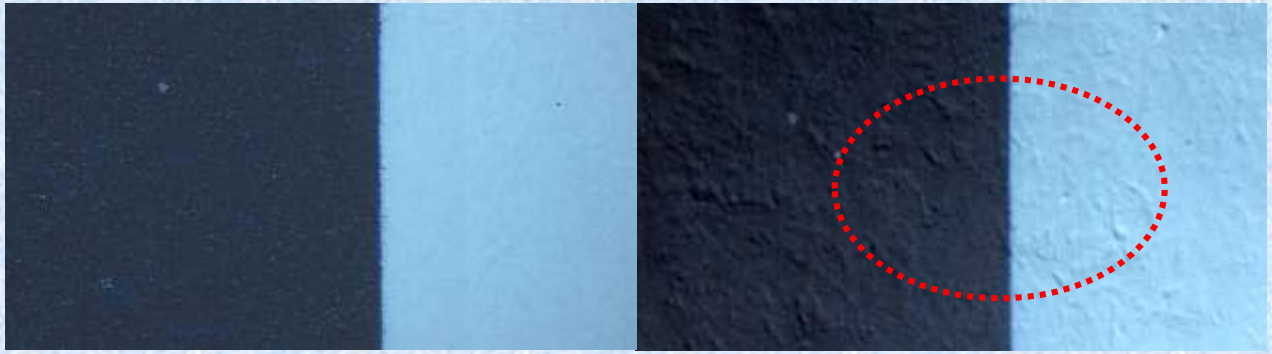
- It also occurs due to non-uniform absorption of fountain solution on the surface of paper. Print mottling is basically a non-uniform appearance of paper surface with sufficient ink covering.

- The print mottle not only occurs 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 are

> “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 “

Print Mottle Images

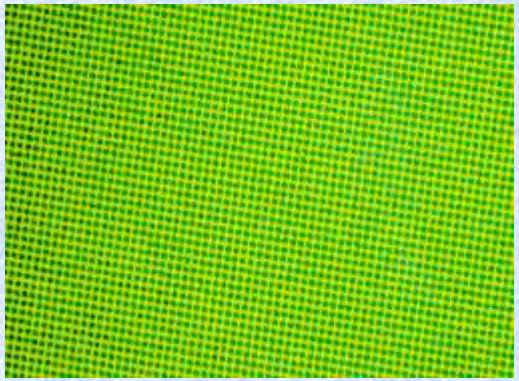


Good Sample – Uniform Surface Topography

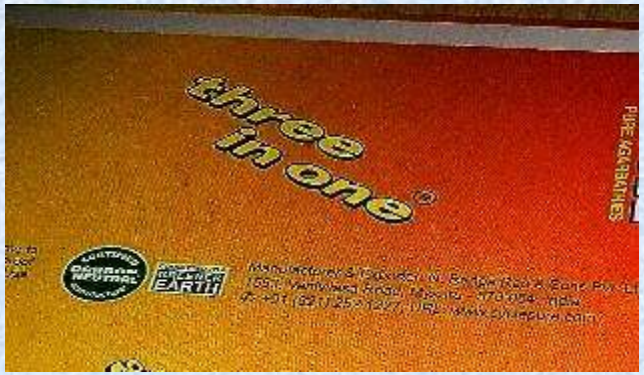
Bad Sample – Non Uniform Surface Topography

The bad samples are exhibiting significantly inferior surface topography on the unprinted paperboard surface, which is also getting reflected on the printed surface

Back Trap Mottle



Half tone mottle



Mottle in halftone magenta – yellow vignette trapping area.

Objective of the 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

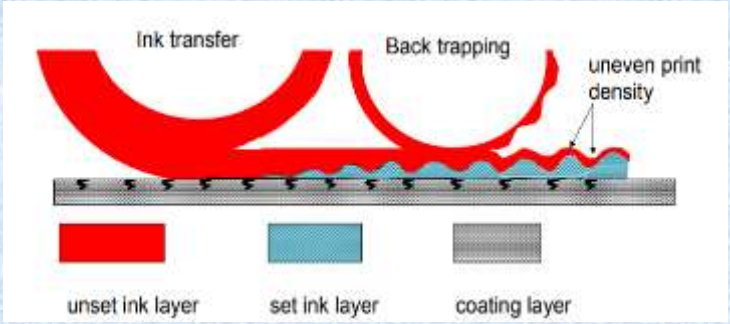
ii. Predicting the mottle by using special tests.

Types of 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.



(back Trap mottle illustration)

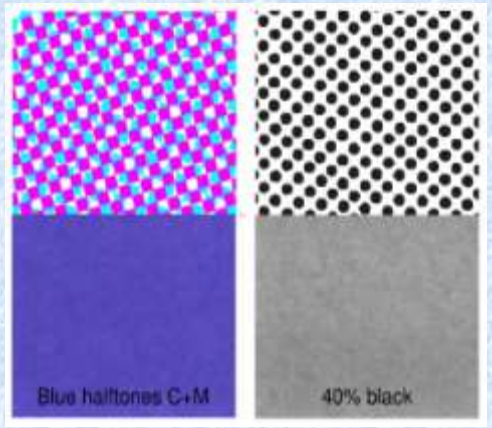
(result of back trap mottle)

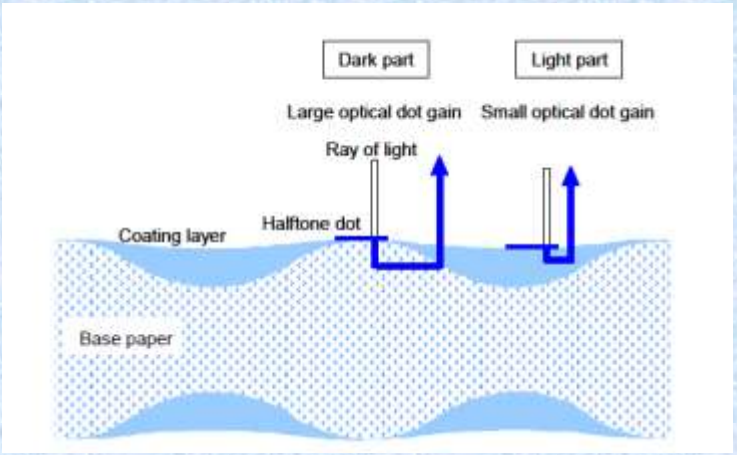
Halftone Mottle

Half tone mottle appears due to

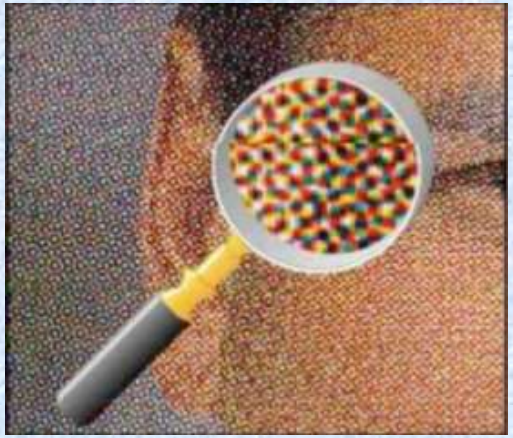
i) uneven physical dot gain
ii) optical dot gain.

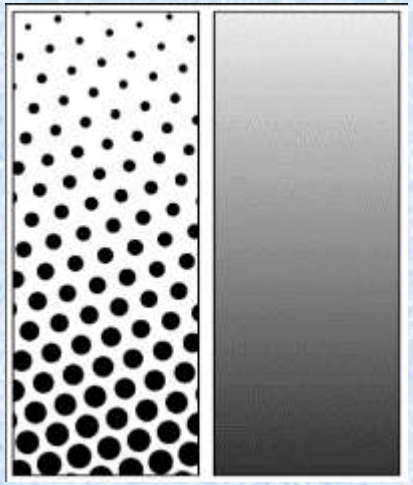
Dot gain is a phenomenon that dots size of printed matter by press is larger compared with that of press plate. The larger the dot gain is, the higher the printing density is. The dot gain is classified into optical dot gain and mechanical dot gain due to the mechanism. Optical dot gain is an apparent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





Lateral light scattering difference in dark and light part of print mottle in halftone dots





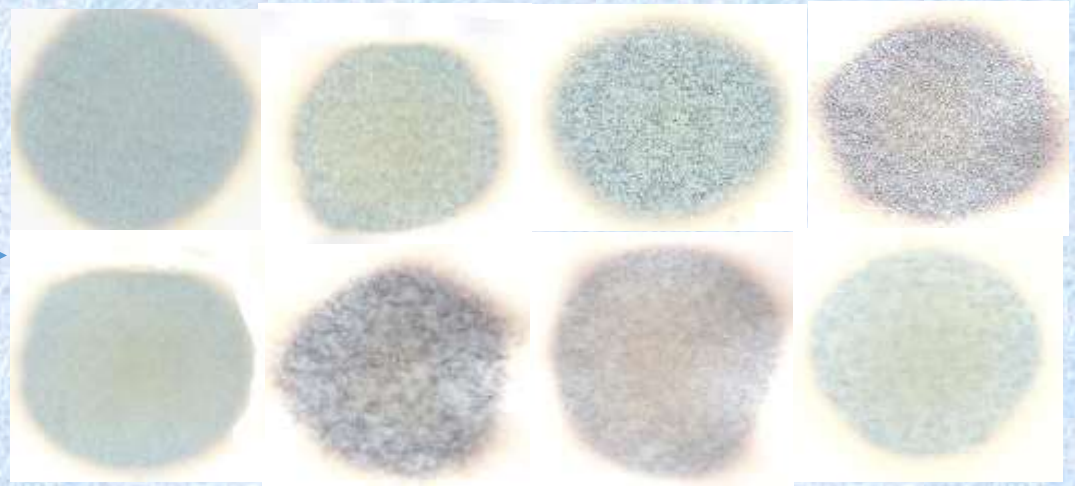
Lab Experiment -1

(Burn Out Test)

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

tested burnout samples of coated paperboard →

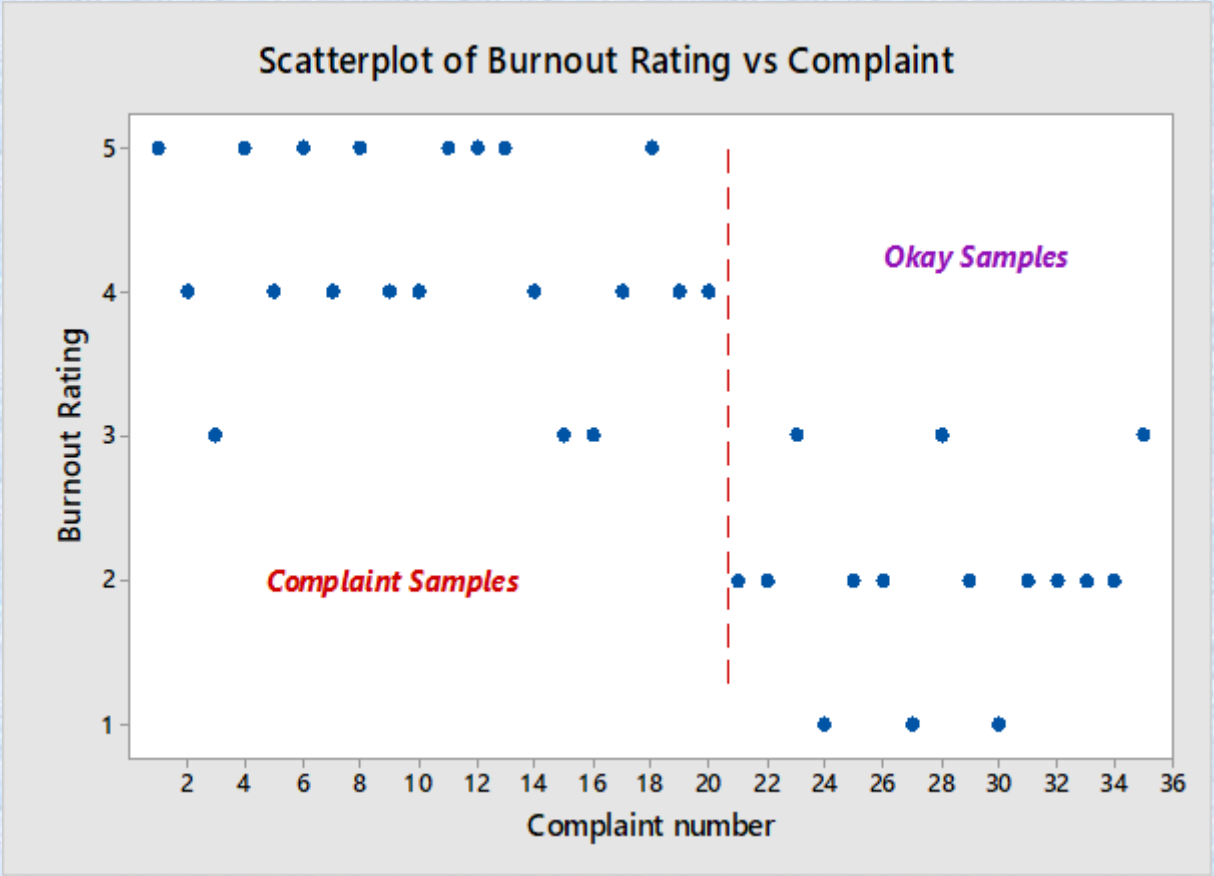


Lab Experiment -1

(Burn Out Test)

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.

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.



Okay ant complaint samples were assessed for burnout test and plotted

Burnout test Vs Customer Complaint

Scanned Images of Printed Sample

100 X Magnified Images of the Dots

Burn Out Test on the unprinted portion of Printed Samples.

Mottle is evident in the Grey Scale Halftone Print

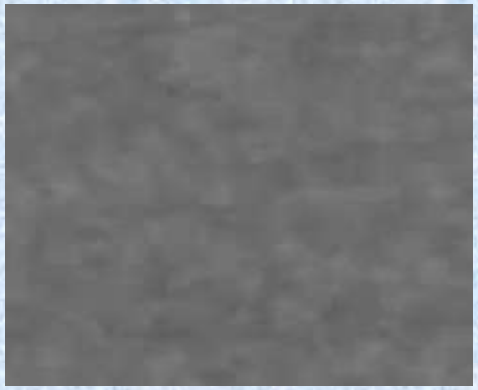
No physical Dot Distortion observed in the samples exhibiting Severe Mottle. The physical Dot Reproduction is comparable both for Good and Bad Print Samples.

Poor Coating coverage is seen in the samples demonstrating severe Mottle; whereas the samples demonstrating no Mottle have extremely good coating coverage.

Lab Experiment -2

(Back Trap Mottle)

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



Lab scale test Method :

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.

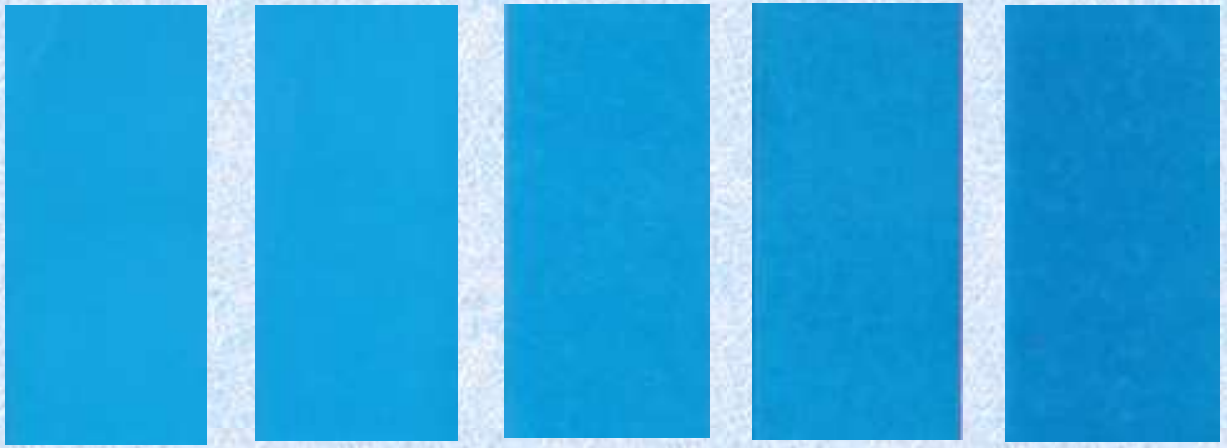
Lab Experiment -2

(Back Trap Mottle)

Sample substrate of size 230 mm / 47 mm to be taken. Cyan and magenta ink with precise weight is 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.

(Prufbau Instrument)



(Various intensities of back trap mottle)

Attribute Agreement analysis

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 patchy printing. 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).

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

Kappa Statistic and Kendal Statistic are >0.75, indicating there is good co-relation in ratings between appraisers and appraiser Vs standard.

Results

Post study, the burnout and mottle rating scale (1 is being best and 5 is being poor) is developed 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 and Half tone area.

(iii) Print quality validation is being done by using this tool for any process and product development 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 complexity, various types of patchiness are expected.

- ✓ As the aim here is to determine the contribution of the paper surface alone towards mottle, precise control over printing variables is very important. On a commercial offset machine there are a number of printing variables which may introduce their own impact upon mottle and could make it difficult to discriminate paper induced mottle from print related mottle. This issue has been overcome in the current study by using a Prüfbau printability tester, where the printing variables are limited and it is relatively easy to control them.

- ✓ 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.

Way forward

Rating scale (rating 1-5) is developed based on the attribute analysis of the print image which would be further studied through image analysis of the print hence indexing can be done to avoid the Observer (human) errors.

She can live without us, we cannot

Thank you