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ANALYSIS OF PRINT CHARACTERISTICS SHEETFED LITHOGRAPHIC OFFSET PROCESS & DIGITAL PRINTING PROCESS IN INFLUENCE OF COLOR REPRODUCTION

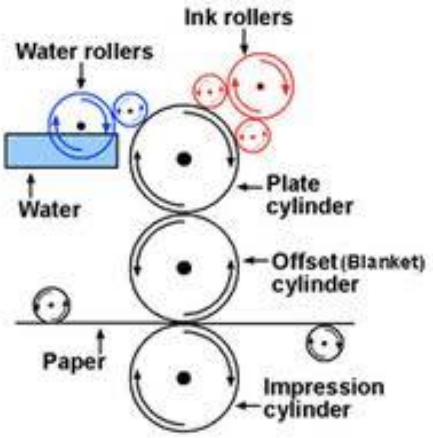
***Lubdha S. Lade & Kaduskar**
Pune University, India

ABSTRACT
This document gives information about color reproduction in Digital Printing and Offset Printing. We also discuss about color matching in-between Digital Printing to Offset Printing, color attributes, color gamut produced by individual process.

KEYWORDS: Offset printing, Digital Printing, Color Gamut, Color Spectrum, Test form, Spectrophotometer.

INTRODUCTION

Offset printing is Indirect printing process, which means the image caring surface doesn't get in physical contact of Substrate. It works on principle that Oil and Water not mixed-up with each other readily. Offset printing have metal plate which carries image area made up of Oliophilic material and contain photosensitive nature in process's initial stage. To generate printing image on plate it is expose to Thermal laser or UV light which expose image on plate with micro difference with plate surface and coating solution. This Coating is Oliophilic (Oil loving material) in nature. On the other side non image area on plate have grained surface and because of that it holds water on surface and acts as Hydrophilic area while printing. Any color image which have other than primary color of printing is printed with combination of 2 or more primary colors. Multicolor image is break in combination of colors and screen of Dots. To generate continuous vignette of any color we have to break it in the form of screen dots. It have relation as more finer the screen dots more smooth changes in vignette gradations. On combination of four primary colors of printing i.e. Cyan, Magenta, Yellow, Black we get all printable colors in limits of process.



Basic Offset Machine section.

Digital Printing refers to the direct printing on substrate through digital image i.e. temporary image generated on image carrying coding in electronic form in case of inkjet or in charge exposure form in case of Laser Printing. Inkjet printing print image is get printed in response to electronic signal which triggers flow of ink from cartridge to substrate. Because of regular ink flow and uncontrolled flow of ink drop image does not give précised output. In laser printing (Electrophotography) wax base powder toner are get transfer to substrate through charge cylinder on which image is exposed by controlled laser light source. Laser diode is connected to Image RIP station. At this stage image is fragmented to Color primaries and individual image is exposed on cylinder, exposed area carries the charge opposite to toner particles The image carrying cylinder or drum is coated with photoconductive coatings:

- Coating with arsenic triselenide (As2Se3) or similar compounds containing selenium,
- Organic photoconductor (OPC),
- amorphic silicon (termed as a-Si or *a*-Si).

The laser printing sequence proceeds as following stages.

Imaging

It is achieved by charging photoconducting surface and subsequent imaging via a controlled light source. For digital imaging, exposures are usually carried out in the wavelength range of around 700 nm.

Inking

Powder or Liquid toners are used. The major element determining the printed image is the colorant contained in the toners in the form of pigments or dyes Inking takes place by means of systems (inking units) that transfer the fine toner particles in a noncontact manner to the photoconducting drum through electric potential differences (electric fields). The toner charge is configured in such a way that the charged regions of the photoconducting surface take on the toner. After inking, the latent charge image on

the photoconducting drum becomes visible due to the toner applied.

Toner transfer

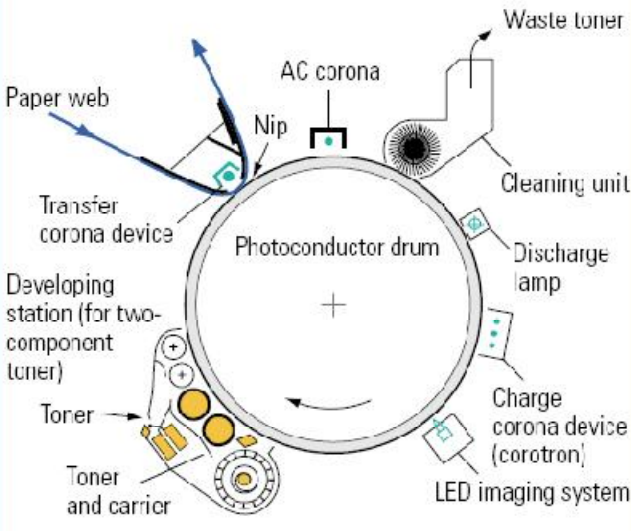
Generally toner are directly transferred to substrate directly but in few systems intermediate drum or belt also used as it refers as Non Tip Printing. To transfer charged toner particle from drum to substrate there should be potential charge difference which achieved by corona charger.

4.Toner fixing - A fixing unit is required in order to anchor the toner particles and thus generate a stable printed image on the paper. This is generally designed in such a way that the ink is melted and thereby anchored onto the paper using a *heat supply* and *contact pressure*.

Cleaning (conditioning)

After transferring toner from drum to substrate, there might be few residual of toner on drum so to prepare drum for next print run removal of all toner particle are necessary. For this mechanical cleaning with the use of rotary brush or by electronics means with neutralizer can be achieved. After cleanings drum is made ready for next print sequence.

As the Electrophotography does not have physical image area so it allows the variable image print option in every print run. Due to modern technology in RIP and color management the light exposing on image drum is calibrated to fine image resolution and sharp image generation. Color management techniques , fine toner particle size up to 8 microns and advancement in toner range we can achieve the print most nearer to original image. Still the digital printing is advisable for short run, variable data printing option for short quantity because of rate for per print remains same for digital as compared to offset printing as you have mass production it give more cheaper rates. But for instant proofing digital printing is advisable which give fast output, rapid change and result analysis in color reproduction and give actual visual idea of product not exactly but more closer to original one. And this so called accepted proof is need to be mass produced with offset printing, so need arise to match color of digital printing and offset printing.

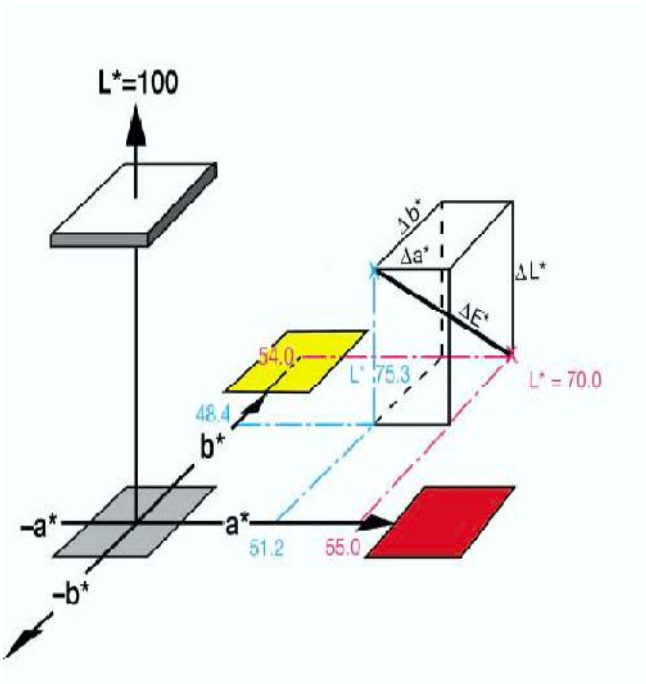


Basic Diagram of Electrophotography

SPECTROPHOTOMETER

Spectrophotometer

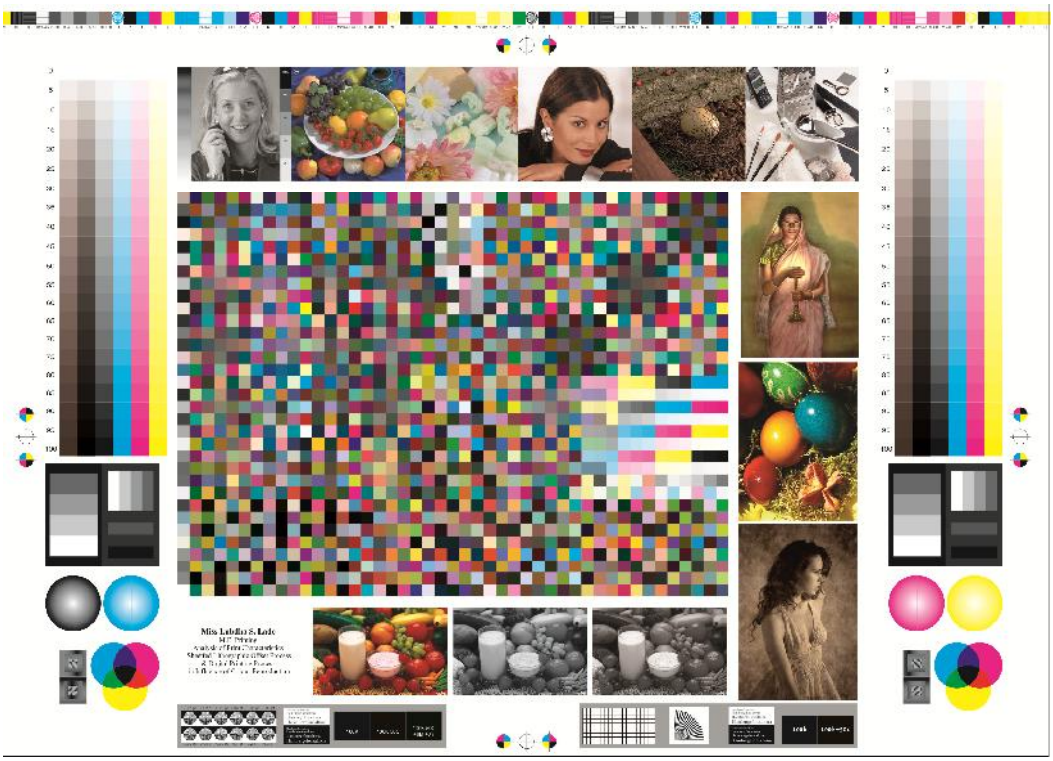
In the spectral measuring process the total visible spectrum from 380 to 780 nm is measured. The light reflected from a printing ink is separated into its spectral components by means of a diffraction grate and measured by an array of sensors. With spectrophotometer it is possible to exactly describe the measured color. Then color difference is calculated i. e. Delta E. The color difference is a measure of the distance between two color locations in the color space .(e.g. between original and printed sheet.) With color measurement function density of printed color can also be measured with spectrophotometer.



EXPERIMENTAL SETUP

A customized test chart comprising of different print targets is printed on multicolor offset printing machine and digital printing machine. The printed results are observed and analysed for Dot Gain and Density. The difference is measured using software based spectrophotometer. The differences are determined with halftone scale, colorimetric areas, trapping, gray scale etc. which are produced during plate making, positive making and printed out and then measured using a densitometer or spectrophotometer.

Sr.No.	Parameters	Detail
1	Machine 1	Heidelberg speed master (4 color Offset m/c)
2	Machine 2	Konica Minolta (CZ 600)
3	Printing Seq.	K C M Y
4	Paper 1	120 gsm super sunshine Maplitho 170 gsm matt Art paper
5	Screen ruling	150 lpi and 1200 dpi
6	Screen angles	Offset (Y-90, K-45, C-15, M-75),
7	Ink	Toyo inks
8	CTP	Voilet CTP (Technova)
9	Software	MS Excel for calculations & CorelDraw for design
10	Instruments	Xrite i1pro Spectrophotometer with ProfileMaker



TEST CHART

Test form consisted of following elements -

1. Dot gain scale with Trapping percentage scale.
2. Continuous scale Trapping percentage scale.
3. Image 1 – Halftone B/W image
4. Image 2 – Natural color
5. Image 3 – High-key image
6. Image 4 – Skin tone
7. Image 5 – Low-key image
8. Image 6 - Gray tone
9. Natural color, Full color, 4c gray, B/W
10. Image 7 – Oil Painting
11. Image 8 – High contrast with reach colours
12. Image 9 – Sophia tone
13. Image 10 - True color - Full color, 4c gray, B/W
14. Color patches – for gamut mapping
15. Text – font size
16. Line – 0.01 to 0.2 pt
17. Reverse lettering and lines
18. Registration mark – with overprints

PROBLEM STATEMENT

Every printing process have it's own printable color gamut with use of Color Primaries as CMYK. To achieve proofing result of product colors in Production output i.e. to match Digital printed proof with Offset printed actual product we need to manipulate the Digital color gamut to how it is reproduced in Offset printing color range. Print characters like density , dot gain trapping have major role in color reproduction by printing process mainly in Offset printing.

ANALYSIS

Test Run carried on offset and digital printing

Density (Art paper)

	K	**(1.9-2.2)**	**C**	**(1.35-1.45)**	**M**	**(1.35-1.45)**	**Y**	**(0.9-1.1)**
Sr. No.	D	O	D	O	D	O	D	O
1	1.87	1.13	1.42	1.11	1.49	1.05	1.09	0.66
2	1.89	1.07	1.36	1.17	1.52	1.09	1.09	0.67
3	1.86	1.14	1.42	1.04	1.49	0.99	1.11	0.73
4	1.9	1.21	1.42	1.15	1.46	1.01	1.16	0.72
5	1.85	1.14	1.39	1.04	1.48	1.02	1.11	0.7
6	1.82	1.05	1.36	1.13	1.57	1.04	1.06	0.66
7	1.77	1.07	1.32	1.2	1.6	1.11	1	0.61
8	1.89	1.13	1.38	1.16	1.48	1.07	1.1	0.7
1 (100)	2.08	1.25	1.47	1.1	1.42	0.99	1.19	0.77
2 (100)	2.02	1.2	1.48	1.15	1.47	1.07	1.14	0.78
AVG.	**1.9**	**1.14**	**1.4**	**1.13**	**1.5**	**1.04**	**1.11**	**0.7**

Test Run carried on offset and digital printing

Density (Maplitho paper)

	K	**(1.9-2.2)**	**C**	**(1.35-1.45)**	**M**	**(1.35-1.45)**	**Y**	**(0.9-1.1)**
Sr. No.	D	O	D	O	D	O	D	O
1	2.19	1.55	1.22	1.19	1.33	1.09	1.11	0.74
2	2.14	1.49	1.19	1.13	1.35	1.12	1.1	0.76
3	2.24	1.64	1.32	1.21	1.38	1.16	1.12	0.84
4	2.22	1.67	1.42	1.21	1.43	1.23	1.15	0.82
5	2.2	1.57	1.27	1.17	1.37	1.16	1.1	0.77
6	2.18	1.42	1.11	1.14	1.27	1.08	1.06	0.69
7	2.12	1.42	1.02	1.11	1.27	1.1	1.01	0.66
8	2.19	1.59	1.25	1.17	1.38	1.15	1.1	0.76
1 (100)	2.28	1.7	1.45	1.23	1.43	1.24	1.18	0.85
2 (100)	2.23	1.68	1.37	1.23	1.42	1.2	1.17	0.83
AVG.	**2.2**	**1.57**	**1.26**	**1.18**	**1.36**	**1.15**	**1.11**	**0.77**

CONCLUSION

Different printing processes gives different ink deposition that results in considerable difference in densities. Ink densities are directly logarithmic values of ink deposition on substrate surface. Analysis shows coated substrate give higher densities values with respect to the absorbent surface. It also states that parameter in relation to ink deposition and ink absorbance in substrate also affected in this trial i.e. dot gain, trapping. These parameter are have significant effect on printable colour range i.e. colour gamut of Printing and those are also need to consider while manipulating two different process out puts.

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