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EFFECT OF COLOR SEQUENCE ON PROCESS PRINT GAMUT

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ABSTRACT
This document gives information about multicolor offset printing process, color reproduction and color sequence used on printing machine. It also represent the effect of different color sequence on color gamut reproduced by print process. The effect of different color sequence used on printing machine is observed by a test form.

KEYWORDS: Offset printing, Color reproduction, Test Form

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.

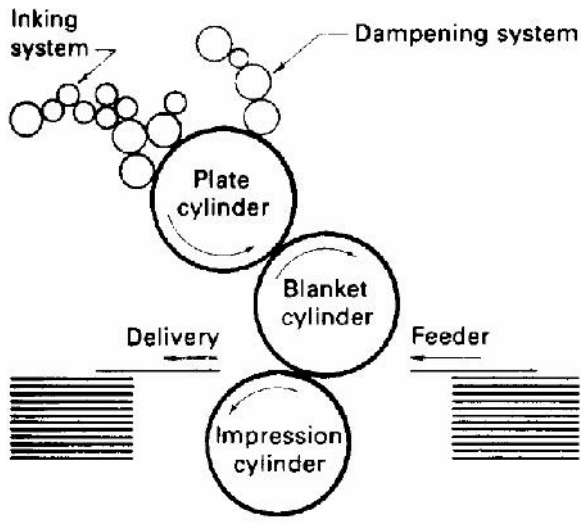


Fig 1. Conventional Offset printing Machine

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.

MULTICOLOUR OFFSET PRINTING

Based on the construction; image carrier in offset printing is aluminium plate coated with oliophiolic light sensitive coating which response to positive or negative of image exposed by suitable illuminent. To produce multicolour image on offset process it need to be get converted to Halftone image. Halftone mince the continues gradation of color are converted to dot pattern, it is necessary because image carrier of Offset process in lies on one plane having image as well non image area. Multicolor printing starts from image conversion in halftone and colour separation of image to printing primaries. Any image is get separated in four printing primaries as Cyan, Magenta, Yellow and Black. These color primaries are defined on the basis of Light theory of human vision, as it explain that human eye sense a colour of any object by light reflected from object as it is combination of different light colour primaries i.e. Red, Green, Blue. So to view these colour in is need to print complimentary colour of Light Primaries i.e. as

a) Red = Magenta + Yellow
b) Green = Cyan + Yellow
c) Blue = Cyan + Magenta.

Fig. 2 Continues tone image and Halftone image

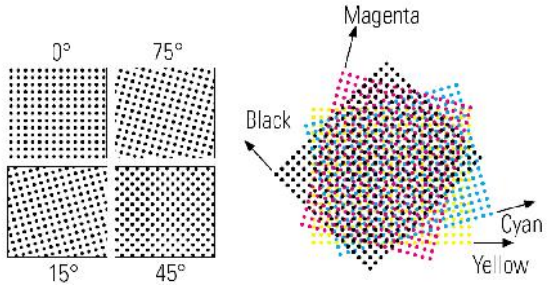


Fig 3. Color angles used in offset printing

These print primaries are reproduced by converting them in to halftone pattern. To convert image in halftone i.e. in dot pattern it is based on Lpi (line per inch). The

intersection of lines creates a dot and the frequency of lines defines the sharpness of image. The dot pattern of line creates a dotted image of different colour and these colour dot are placed on different angles. This angle is nothing but the line pattern (Lpi) creates with horizontal axis, this same angle is referred to dot pattern. The angle of dots and overlapping of dot creates the all visible colour combination in visual gamut. The angles for different colour are, Cyan, Magenta – 15^0 or 75^0 Yellow - 90^0 and Black - 45^0 Difference between to colour angle is kept 30 or above it to avoid unrequired interfering pattern i.e. Moire pattern. Color reproduced by combination and overlapping of CMYK have the significant effect of colour sequence on reproduced colour gamut by process. To analyse this effect imperical test are performed using test chart having 724 no. patches and different visual graphics for observation of color reproduction. Using spectrophotometer these colour values are calculated.

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.)In accordance with their perceptibility, the color location differences can be classified as follows:

- ΔE between 0 and 1 in general, this deviation cannot
- be perceived.
- ΔE between 1 and 2 very small deviation; only perceivable by an experienced eye.
- ΔE between 2 and 3.5 medium deviation; perceivable
- ΔE between 3.5 and 5 large deviation
- ΔE exceeding 5 massive deviations even by an inexperienced eye.

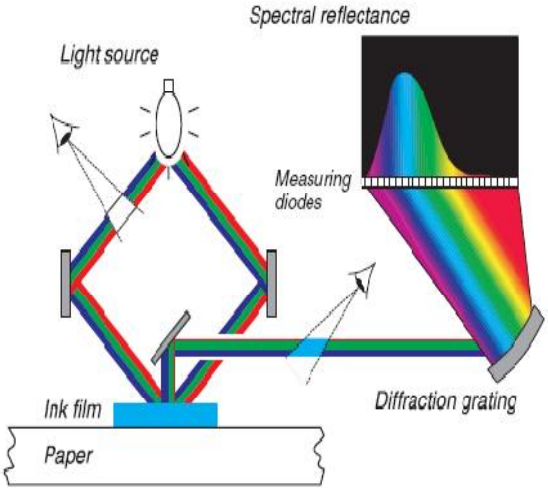


Fig 4. Principle of Spectrophotometer

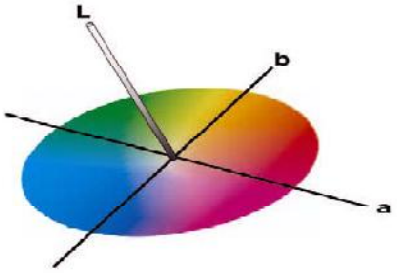


Fig 5. Lab color space

EXPERIMENTAL SET UP

A customised 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.

S.No	Parameters	Detail
1	Machine 1	Heidelberg speed master (4 color Offset m/c)
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
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

Registration mark – with overprints

PROBLEM STATEMENT

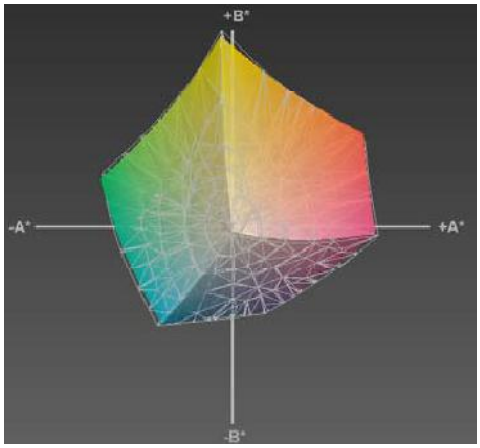
Analysis of effect of colour sequence on Print gamut of Offset printing.

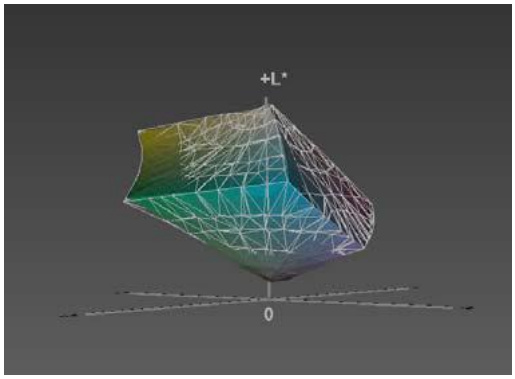
ANALYSIS

From the combination of CMYK we get 24 color sequences, from these combinations we select;

1. Cyan-Magenta-Yellow-Black (CMYK)
2. Magenta-Cyan-Yellow-Black (MCYK)
3. Yellow-Cyan-Magenta-Black (YCMK)
4. Black-Magenta-Cyan-Yellow (KMCY)
5. Black-Cyan-Magenta-Yellow (KCMY)

And analysis of gamut is performed to find our max gamut volume with min. Delta variation.





The 3d visual gamut comparison between visual gamut and gamut printed by sequence of KCMY, showing min. Delta E and Max. gamut volume.

1st Run

Sr. No.	Sequence	No. of Print	Delta E	Profile Gamut Steps
1	CMYK	500	4.7 -6.4	3,56,389
2	MCYK	500	4.5 - 5.9	3,76,129
3	YCMK	500	4.3 - 6	3,12,893
4	KMCY	500	4.2 -5.6	3,42,178
5	KCMY	500	3.6 - 4.8	3,84,251

2nd Run

1	KCMY	500	2.3- 2.8	3,81,486

CONCLUSION

- The Delta E which has been derived is within the acceptable range for Black Cyan Magenta and Yellow Color Sequence as compared to that of Digital Print which is 2.3 to 2.4.
- KCMY, sequences shows more no of gamut steps as compared other four sequences, which indicates higher gamut volume of KCMY sequence.

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