

Analysis of Dot Gain in Various Halftone Dot Shapes on Print Quality Using Dry Toner Electrophotography

Anil Sharma^{*1}, Dr. Rajesh Mishra² & Priya Rathi³

^{1, 2&3} Department of Printing Technology, University of Arts & Technology, Jaipur, Rajasthan, India

ABSTRACT

Electrophotography is a non-impact printing process. Printing of an image in continuous tone is not possible by printing machine. Therefore, image has to break in halftone dot to print through any printing process. Digital printing is not exceptional. There are different halftone dot shapes available like square, elliptical, diamond etc. This leads a curiosity in mind to study the effect of different dot shape on print quality. In this paper, we considered the impact of various dot shapes of halftone on print quality (dot gain) in dry toner electro photography printing process in which different halftone shapes are used for printing. The sheets were printed with different halftone dots (diamond, elliptical, square). Dot gain is measured at different locations of different halftone dot shapes. The collected data is represented in a meaningful way so that clear difference can be seen.

Keywords: Electrophotography, Non-Impact, Halftone Dot, Dot Gain, Diamond, Elliptical, Square.

I. INTRODUCTION

The electrophotography printing process is done in five steps that start from (1) charging a photo receptor belt or drum with a coroton or scorotron.; (2) exposure with light a laser beam is used; (3) development the latent image is converted in the real image with the help of the series of black and colored toner cartridge; (4) Transfer the toner on substrate Corotrons rollers are used to transfer the toner on the photoreceptor to the paper electrostatically using the opposite charge of toner; (5) fusing the image on substrate and last step is (6) cleaning of the photoreceptor drum or belt. Halftone is the reprographic system that recreates continuous tone imagery using the dots, differing either in size or in dispersing, in this manner producing an inclination like impact. "Halftone" can likewise be used to refer explicitly to the picture that is created by this procedure.

This propagation depends on an essential optical illusion: the small halftone dots are mixed into smooth tones by the human eye.

Dot gain is increase in the diameter of the halftone dot. There are two types of dot gain (1) Mechanical dot gain, (2) Optical dot gain.

1.1 Mechanical dot gain:- It is a physical growth or loss of the dot. It comes from the presses is called mechanical dot gain.

1.2 Optical dot gain:- Its the illusion of the dot area it means how the dot appears to the eye on the page is called optical dot gain.

II. RESEARCH OBJECTIVE

To study & analyze the effect of different halftone dots (Elliptical, Square & Diamond) on print quality factor of Dot Gain in multi-colour Dry Electrophotography digital press.

III. RESEARCH METHODOLOGY

The master chart is with the help of suitable tools and images according to the requirement of the research. The sheet was printed with dry toner electrophotography with different dot shapes (diamond, elliptical, square). The sheet is printed in the "Xerox® Versant® 80 Press" Dry Toner Electrophotography with suitable conditions and used coated paper.

3.1 Specification of Xerox® Versant® 80 Press: -

Speed	Up to 80ppm
Media Weight	52gsm to 350gsm
Media Sizes	Up to 13" *19.2"
Duty Cycle	460000
Dimensions	840mm(W) * 831mm(D) * 1212mm(H)
Weight	295kg
Copy with single-pass duplex scanning	200 images per minutes
Media Types	Coated, Uncoated, Tabs, Envelops etc.

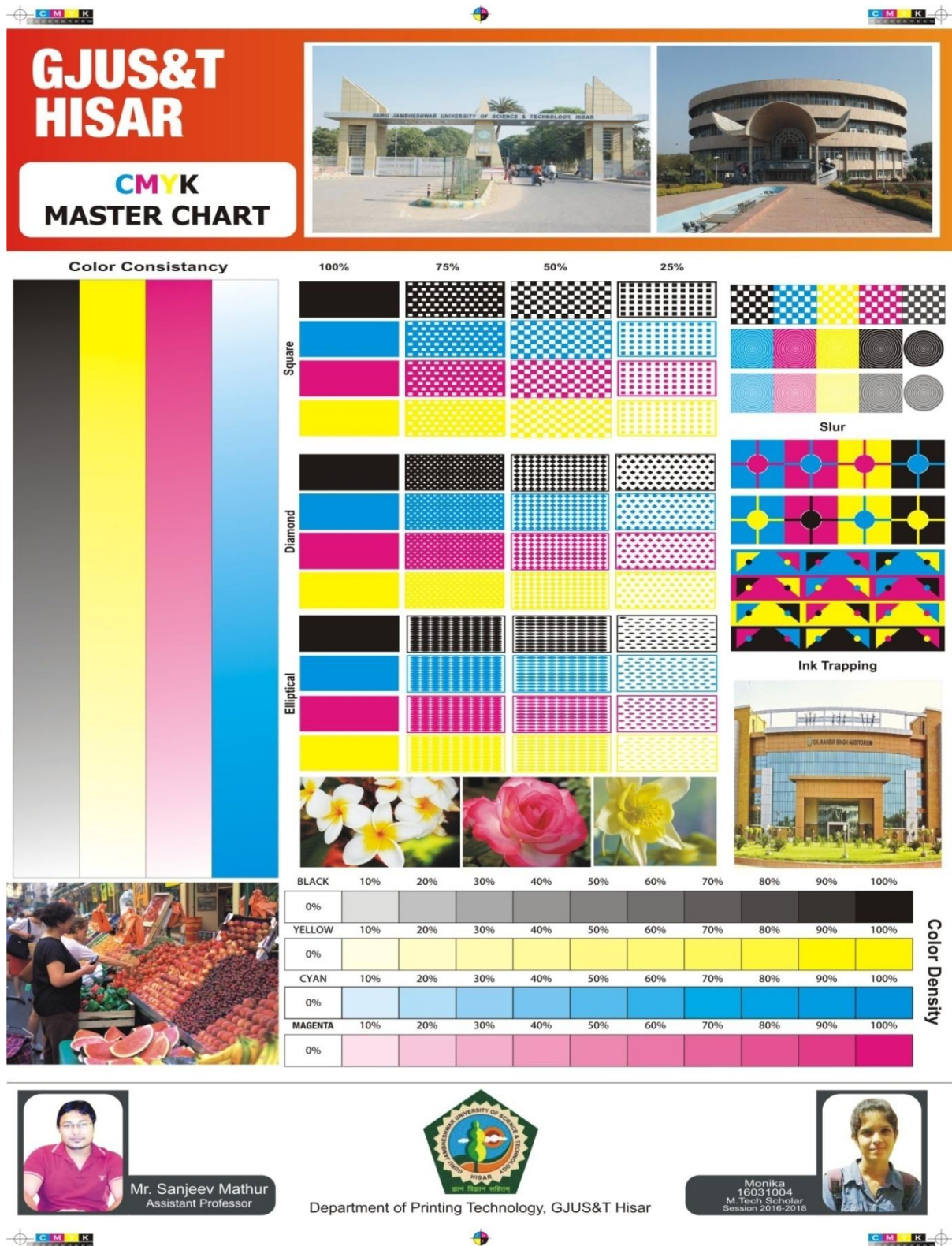


Fig. Master Chart

IV. DATA COLLECTION AND ANALYSIS

Data collection is the main work of the research. The whole research was carried out at **Shree Bala Jee Graphic, Hisar**. The sheet was printed with electrophotography printing process with the different dot shapes (diamond, elliptical, square). Data collection is based on the find out the dot gain value of every 5th sheets which is printed with different halftone dot shape (diamond, elliptical, square) with the X-Rite spectrophotometer.

4.1 Dot Gain: - It is increase in the diameter of the halftone dot.

$$\text{Dot gain} = a_{\text{print}} - a_{\text{form}}$$

Where a_{print} is the ink area fraction of the print

a_{form} is the prepress area fraction to be inked.

Dot gain is measured of black, yellow, cyan and magenta color at 70%, 50% and 20%.

Table.1 Dot Gain in Diamond, Elliptical and Square Dot Shapes

	DIAMOND					ELLIPTICAL					SQUARE				
	K	Y	C	M		K	Y	C	M		K	Y	C	M	
70%	72.2	53.3	75.4	80.8		70.9	56.3	76.4	82.5		73.8	54.6	75.8	85.3	
50%	56.1	30.2	50.4	62.5		51.1	33.6	55.6	63.4		53.7	34.3	55.2	62.2	
20%	22.6	10.4	20.5	25.3		28.1	11.3	21.5	22.9		29.3	9.9	21.4	26.4	

4.2 Data Analysis

Data is obtained from the printed sheets.

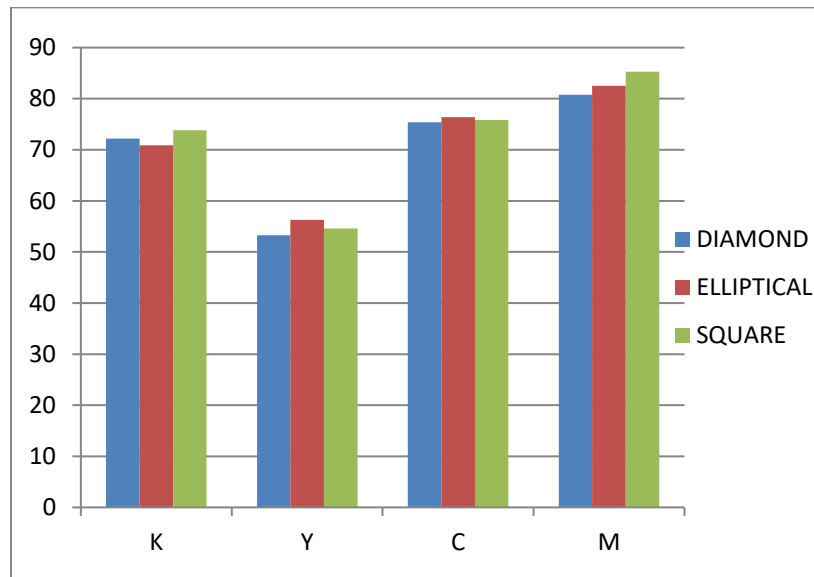
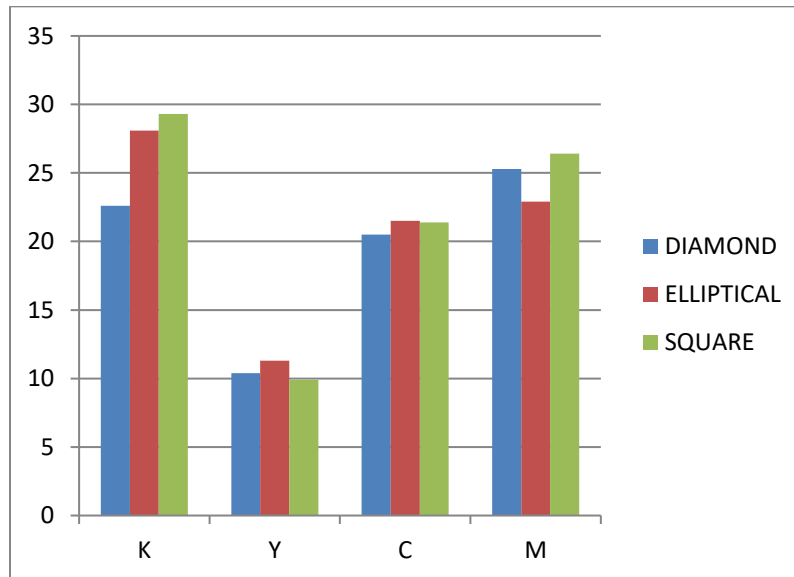
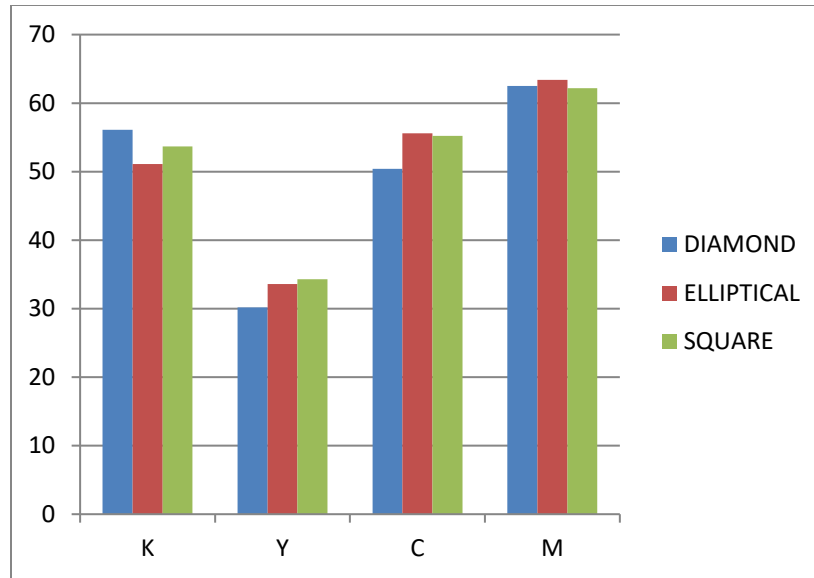


Chart.1 Dot Gain at 70%



V. RESULT AND DISCUSSION

Chart.1 shows that dot gain of black (K) color is high at 70% of square dot shape as compared to diamond and elliptical dot shapes. The dot gain of yellow (Y) color is high of elliptical dot shape at 70% as compared to diamond and square dot shapes. The dot gain of cyan (C) color is high of elliptical dot shape at 70% as compared to diamond and square dot shapes. And the dot gain of magenta (M) color is high of square dot shape at 70% as compared to diamond and elliptical.

Chart.2 shows that dot gain of black (K) color is high at 50% of diamond dot shape as compared to elliptical and square dot shapes. The dot gain of yellow (Y) color is high of square dot shape at 50% as compared to diamond and elliptical dot shapes. The dot gain of cyan (C) color is high of elliptical dot shape at 50% as compared to diamond and square dot shapes. The dot gain of magenta (M) color is high of elliptical dot shape at 50% as compared to diamond and square dot shapes.

Chart.3 shows that dot gain of black (K) color is high at 20% of square dot shape as compared to diamond and elliptical dot shapes. The dot gain of yellow (Y) color is high of elliptical dot shape at 20% as compared to diamond and square dot shapes. The dot gain of cyan (C) color is high of elliptical dot shape at 20% as compared to diamond and square dot shapes. The dot gain of magenta (M) color is high of square dot shape at 20 % as compared to diamond and elliptical dot shapes.

VI. CONCLUSION

In this research we found that the different halftone dot shapes affect the print quality of the printed sheets. In the dot gain in diamond, elliptical, square dot shapes the value of c, m, y, k is different at 70%, 50% and 20%. The dot gain of square dot is maximum at 70% in most of the colors and minimum of diamond dot shape. The dot gain of elliptical dot shape is maximum at 50% in most of the colors and minimum of square dot shape. The dot gain of square dot shape is maximum at 20% in most of the colors and minimum of diamond dot shape. If the dot gain is high it causes darker the image and loss of details.

REFERENCES

1. Damodar M. Pai and B. E. Springett; "Physics of electrophotography" Reviews of Modern Physics; Vol. 65, No. 1, January 1993.
2. Emmett Ientilucci, 1994; "Fundamentals of Xerography" February 22, 1994.
3. Charles B. Duke a, *, Jaan Noolandi b, Tracy Thieret c; "The surface science of xerography", ELSEVIER; page no. 1005-1023.
4. Oittinen, P., AL-Rubaiey, H., Sipi, K. And Vikman, K.; "Research on Paper-Ink-Process Interactions in Electrophotographic and Ink Jet Printing", International Conference on Digital Production, Printing and Industrial Applications; page no.327-330, 2001.
5. Vince Cahill; "Introduction to Digital Printing Technology", 2003.
6. Seung-Jin Ryu, Hae-Yeoun Lee, Dong-Hyucklm, Jung-Ho Choi, Heung-Kyu Lee; "Electrophotographic Printer Identification by Halftone Texture Analysis", 2010.
7. Vikas Sindhu, MDU, Rohtak; "A Review on Image Halftone Processing", Journal of Information, Knowledge and Research in Electronics and Communication; ISSN 0975-6779; Vol. 2, No. 2, page no.914-919, 2013.
8. Mahzhar Namedanian, Daniel Nystrom, Paula Zitinski Elias, and Sasan Gooran; "Physical and optical dot gain: characterization and relation to dot shape and paper properties", International Society for Optical Engineering; January 2014.
9. Vikas Jangra, Abhishek Saini, Anil Kundu; "Relationship of solid ink density and dot gain in digital printing" International Journal of Engineering and Technical Research; ISSN: 2321-0869, Volume-2, Issue-7, July 2014.
10. Rossitza Sardjeva, Todor Mollov; "Study of Color Quality Uniformity in Digital Dry Toner Electrophotographic Printing", International Journal of Modern Communication Technologies & Research; ISSN: 2321-0850; Volume-2, Issue-9, September 2014.
11. Aman Bhardwaj, Krishan Kumar; "Effect of paper gloss on solid ink density printed with digital printing process", International Journal for Technological Research in Engineering; ISSN: 2347 - 4718 Volume 3, Issue 10, June-2016.
12. Ivan Pinčjer, Dragoljub Novaković, Uroš Nedeljković, Nemanja Kašiković, Gojko Vladić; "Impact of Reproduction Size and Halftoning Method on Print Quality Perception", Acta Polytechnica Hungarica; Vol. 13, No. 3, page no. 81-100, 2016.
13. Masayuki Kawasaki, Masaya Ishisak; "Investigation into the Cause of Print Mottle in Halftone Dots of Coated Paper: Effect of Optical Dot Gain Non-uniformity", Pulp & Paper Research Laboratory.