Images Rosette Occurrence Eradication on Corrugated Carton Packages printed by Flexographic Post-Printing

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Abstract:
Printing depends on halftoning to simulate shades of gray, color, and image detail. In four color process printing, four halftones – one for each of the cyan, magenta, yellow, and black inks are overlaid to produce the image. The problem is when overlapping two or more halftone grids can create an objectionable pattern called a rosette. With using flexographic printing on corrugated board, it must use coarse screenings for printing because of the nature of corrugated board; the occurrence of rosette is growing increasingly with these coarse screenings. The occurrence of rosette is one of the most important phenomena that affect the final appearance of an image and its details, which make it easy to distinguish rosette with the naked eye. This research is interested in finding a new approach of processing in pre-press stage during the preparation of the digital file which eradicates the rosette formed during the printing using the potentials from processing software to control the screen dots diameter produced of three process colors (C, M, and Y) and uses the same screen angle. With this approach the black color is eliminated and its compensation with C, M, Y colors accordingly saves fourth ink, reduces the printed layers and maintains the strength and hardness of corrugated board as well as provides significant economic value.

Keywords:
- ***Rosette, screen angle,***
- ***chromatic composition,***
- ***bump up, flexography,***
- ***pre-press,***
- ***post –printing,***
- ***corrugated carton.***

Paper received 16th of August 2015, Accepted 19th of September 2015 Published 1st of October 2015

Introduction
Packaging is an advertising media that not only carries the product, but also provides self-promotion and offers an opportunity for brand recognition. To make products more attractive to customers, a higher quality of packaging is critical. Therefore, increasing resolution and print quality are methods used to improve print products. Screening technologies play a role in improving print quality and decreasing production cost (Polischuk, T., 2004).

Pre-press process is main key in the print quality because of its role to accurate transfers all the details of the design on flexographic plates. One of the most essential decisions to be made when preparing a file for post printing by flexographic process on corrugated board is the choice of the proper halftone attributes. Some of the considerations that must be took into account halftones include type (amplitude- or frequency-modulated), dot shape (elliptical, square, round, and so on), screen angle(s), and screen frequency. Although screen frequency, halftone type and dot shape are important concerns, but with screen angles, there is a problem with patterns form the screen angles especially in four colors process printing from halftones. The patterns are called rosette and are caused because of superposition of the halftone screens especially with coarse screens that suitable with nature the surface of corrugated board. This rosette affects the appearance the image details. The gradation tones of full color images are produced by arranging each of the color dots along straight lines at different screen angles. The screen angle of each color (cyan, magenta, yellow, and black) must be set carefully in order to lessen the appearance of moiré patterns. Rosette dots will appear properly if the dots of every color align in their appropriate angles (Hardesty M.,2002).

Literature Review
The Color Black
The color black has a constituent of the CMYK color system, but no concrete data was given for determining the color separation of black.

Essentially, black is used in multicolor printing to reduce the technological expense of printing three chromatic colors to create black or a gray value by the direct use of black ink, to cut down on the use of expensive high-quality chromatic inks and also, primarily, in order to stabilize the printing process, that is, to make it less sensitive to variations in the

individual colors.

Chromatic Composition.

In chromatic composition all the hues (color tones) are built up from the chromatic base colors (process colors) cyan (C), magenta (M), and yellow (Y). Black (K) may possibly be used, if at all, to support the image shadows and to improve the contours. Dark hues are created by the appropriate mixing of the three chromatic base colors. If cyan, for example, is to be printed darker, equal portions (via changing the tone values) of magenta and yellow are added according to the desired blackness value, but these portions must be less than the portion of cyan. These portions of magenta and yellow mix with the correspondingly equal portion of cyan to form black, thus darkening the remaining portion of cyan. This will be made clear by means of an example. The brown shown in figure 1was built up in chromatic composition from 70% cyan, 80% magenta, and 90% yellow, a total area coverage therefore of 240%. Black was not used. But because of the high portions of chromatic colors, the color balance is not easy to maintain. The chromatic composition of the brown shown in figure 1 comprises a chromatic portion and an achromatic one. The achromatic portion consists of 70% cyan, 70% magenta, and 70% yellow, which create a hue very close to gray when overprinting (Helmut, 2001).

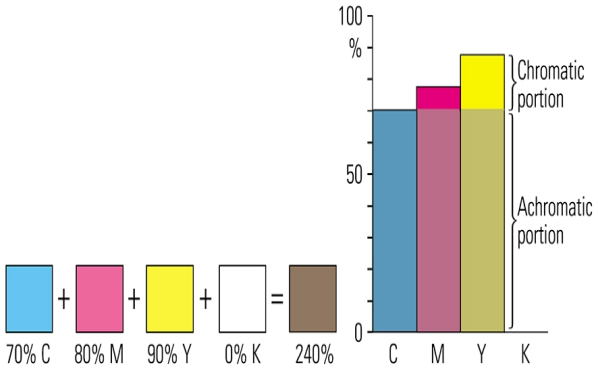

Figure 1: chromatic composition

Screen angles

All screens consist of dots arranged in a regular pattern or matrix. The vertical and horizontal distance between successive dot centers is constant and is a function of the screen frequency. When the screen is aligned parallel to the paper edges, the screen angle is said to be 0° or 90°. The rotation angle away from the vertical axis is known as the screen angle. The screen can only be rotated up to 90° before it repeats itself. For example, a screen rotated 15° is at the same angle as 105°, 195°, and 285°.

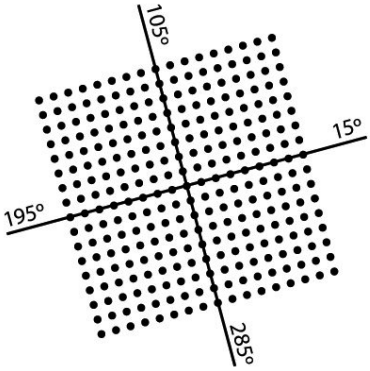

Figure 2: screen angle can be rotated up to 90°

A set of standard screen angles has been established that is based on a combination of theory and experience. First the least visible color, yellow, is placed at the most visible angle 0° (90°). Then the most visible color, black, is placed at 45°. The cyan and magenta are then placed between these two. Cyan at 15° (105°) and magenta at 75°. These angles represent a best all-around compromise for most pictures and represent the standard, most commonly used screen angles. They also form the least objectionable moiré – the rosette pattern (more on rosettes here) (http://the-print-guide.blogspot.com.eg/2009/05/halftone-screen-angles.html).

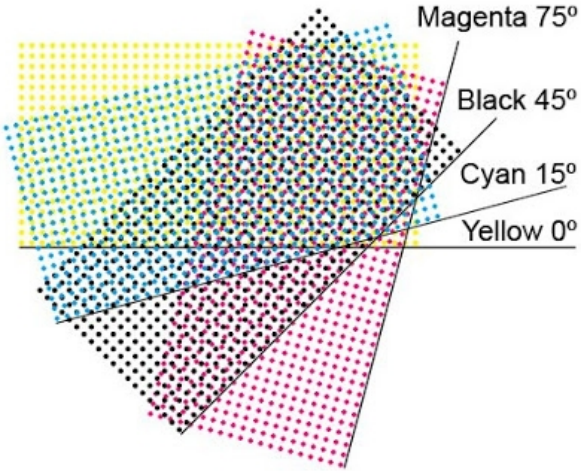

Figure 3: standard screen angles

In flexographic printing the basic angles are:
Y at 7.5 degrees, C, M and K at 22.5, 52.5 or 82.5 degrees depending on the application.
Or
Y at 82.5 degrees, C, M and K at 7.5, 37.5 or 67.5 degrees depending on the application.
Flexo angles are different from offset angles due to the anilox roll used in flexo presses (a cylinder which is engraved with millions of small cells that carry a thin film of ink which is deposited on the plate). Putting the flexo screens on angles based

on a 7.5° offset is needed to prevent interference effects (moiré) between the screen and the pattern of the inking cells of the anilox roll (EskoGraphics, 2003).

Screen Rosettes

When the screen angles used in printing are well registered, the resulting print has a rosette-like pattern. If you look closely at a printed image, this rosette pattern is more or less visible to the naked eye, depending on the ink coverage and the color combination of the print. Although rosettes might be distractingly obvious in some parts of a printed image, this is considered a normal screen phenomenon, unlike moiré. In general, the lower the screen frequency, the more visible the rosettes. Today, it is common to not use traditional screen angles with traditional halftone screening to avoid the problem of halftone screen rosettes. All analog proofs, and some digital ones, allow for a sharp reproduction of halftone dots, and rosette patterns can be very evident as a result, even though they may not appear that way in a final print. For example, if you want to do an analog proof of a new paper advertisements at 85 lpi(a low screen frequency) , the rosette pattern might be distracting when reproduced in sharp detail on the fine paper of the proof (Kaj Johansson., et al 2012).

Rosette basics

Printing depends on halftoning to simulate shades of gray, color, and image detail. In four color process printing, four halftones – one for each of the cyan, magenta, yellow, and black inks are overlaid to produce the image. Unfortunately, overlapping two or more halftone grids can create an objectionable pattern called a "moiré" which, interestingly is the basis of the rosette.

The figure no.4 shows the overlaid halftone grids are 5 degrees and 10 degrees apart and in figure no.5 shows the overlaid halftone grids are 15 degrees and 20 degrees apart:

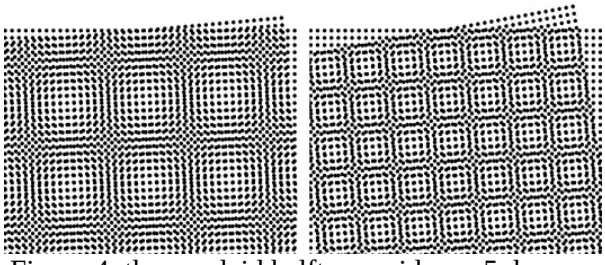

Figure 4: the overlaid halftone grids are 5 degrees and 10 degrees

The greater the difference in angle between overlapping grids, the smaller the resulting moiré and the less apparent it is.

Figure no.6 shows the overlaid halftone grids are 30 degrees and 45 degrees apart.

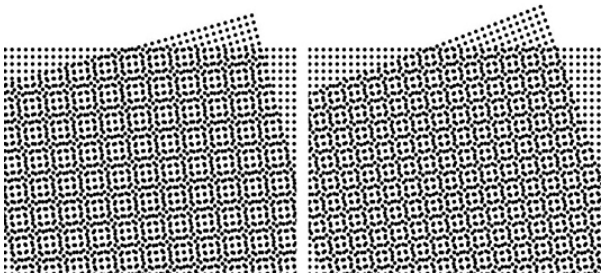

Figure 5: the overlaid halftone grids are 15 degrees and 20 degrees

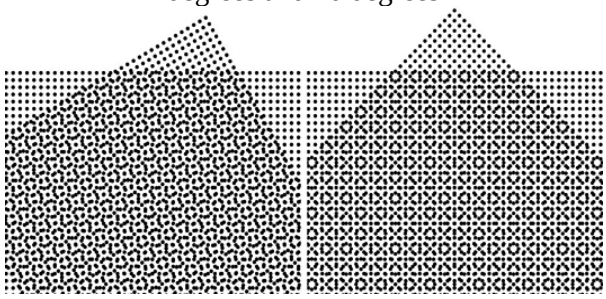

Figure 6: the overlaid halftone grids are 30 degrees and 45 degrees

The two kinds of rosettes

When screens of cyan, magenta, and black are overlaid at their respective angles (105, 75, 45) they form a moiré pattern called a "rosette." The yellow screen is not included since, because of its higher frequency, it does not form part of the rosette. This type of rosette is called a "dot-centered" or "closed-centered" rosette because each of the patterns has a dot in its center.

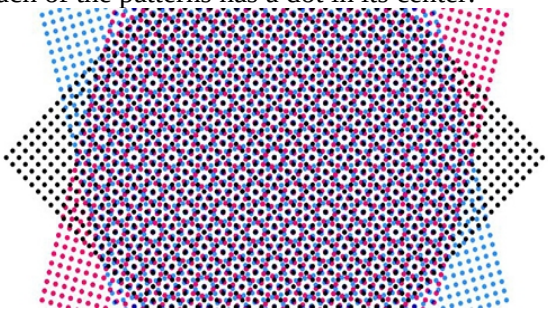

Figure 7: closed-centered" rosette

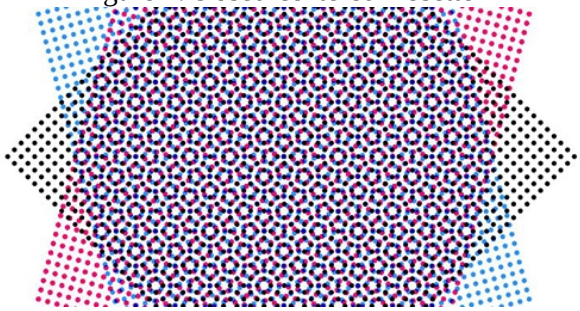

Figure 8: open -centered" rosette

The second type of rosette is called a "clear-centered" or "open -centered" rosette. It is created by shifting one of the process colors one half row of dots from the other two colors (http://the-print-guide.blogspot.com.eg/2009/04/rosettes-everything-you-didnt-realize.html)

Objective

This study aims to improve the appearance of printed image details by benefiting from the potentials of processing software during the preparation of the digital file in pre-press stage to control the screen dots diameter produced of process colors which leads to eradicate the rosette occurrence in images.

Methodology

This study employed the true experimental method in order to eradicate the occurrence of rosette using the approach of processing in pre-press stage. The experimental design employed experimental confirmation to investigate differences in the printed image details on corrugated board before and after processing. The measured data was recorded and organized so as to facilitate subsequent analysis.

Materials and Procedures

The printed test form was printed on a white American Kraft double wall B type corrugated board substrate by a flexographic printing machine with the following specifications:

- Type: Goepfert flexographic Printing machine.
- Speed: 220 sheet/min.
- Plate Type: nyloflex ACT digital plate from Flint group.
- Plate thickness: 2.54 mm.
- Plate hardness: 50 shore A.
- Adhesive tape: hard type from Tesa, thickness: 0.38 mm.
- Anilox type: ceramic anilox.
- Anilox line screen: 160 l/cm.
- Cell volume: 8 cm^3/m^2.
- Cell depth: 20 micron.
- Ink type: water base ink.
- Ink viscosity: 25 # 2 Zahn Cup.

The printed test form consisted of two same images; one was produced by four process colors and used flexo angles Y at 82.5° degrees, C, M and K at 7.5°, 37.5° or 67.5°. The second image was produced by three process colors(C, M, Y) with new processing for image and one angle 37.5° with three halftone strips starting from 5%-100% for C, M, and Y colors .Both images were printed at 40 l/inch; figure no.9, after printing the results were evaluated and analyzed using X-Rite densitometer and digital microscope.

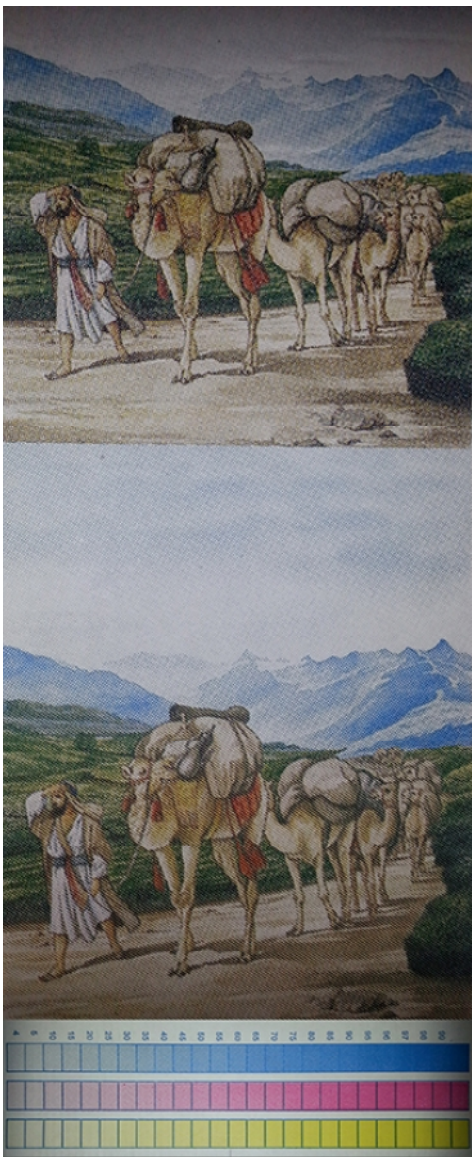

Figure 9: test form

To eradicate the occurrence of rosette, there are two procedures to apply:

The first procedure*: converting the image from 4 to 3 process colors:*

Some options of Photoshop software were used to deal with the images processing, one of these options was chromatic composition, as following:

1- "Color settings" command has been chosen from "Edit" menu.

2- In the "Working Spaces" section, "Custom CMYK" option has been chosen from "CMYK" pop-up menu.

3- In "Separation options" section, which appears in the opened dialogue box, it was easy to convert the image from four process colors to three process colors which black color was compensated

through C, M, and Y colors by choosing "GCR" in separation type options and setting Black generation to "None".
4- Black Ink Limit: 95%, Total Ink Limit: 290% and UCA Amount: 25%, these values were inserted to get accurate translation for halftones.
5- Finally, Image mode converted to CMYK from RGB, (Image Menu>Mode>CMYK).

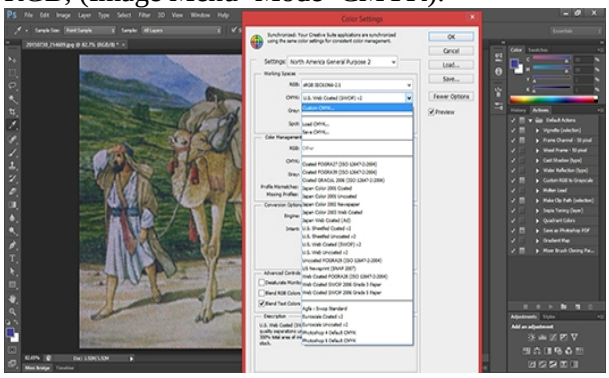

Figure10 : color settings window

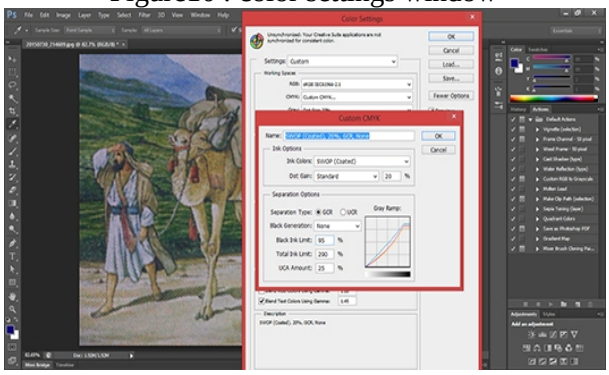

Figure11 : custom CMYK

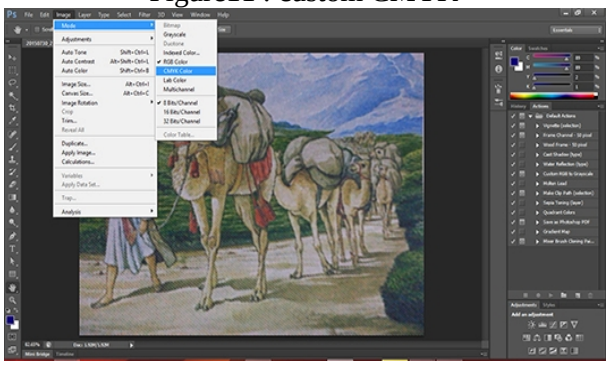

Figure12 : changing mode from RGB to CMYK

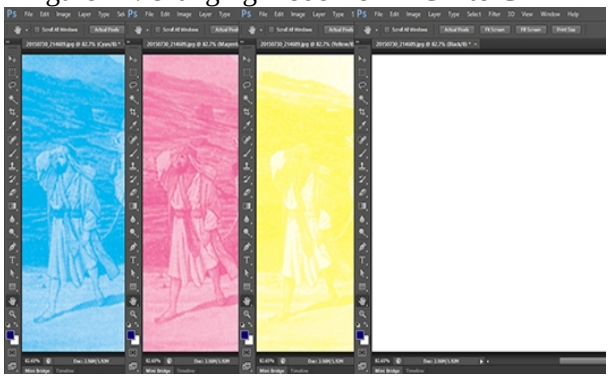

Figure13: final color separations CMY

***The second procedure**: avoiding the rosette formation in Pre-Press stage:*
With using flexographic printing as post printing method on corrugated board, it must use coarse screenings for printing because of the nature of corrugated board, by using these coarse screenings the rosette will generate that initially it can be avoided in pre-press stage before printing. After converting the image to three process colors and using IntelliCurve software from Esko Company, to control the colors especially in highlights areas using bump up curve from DGC (Dot Gain Compensation) window. The tonal values from 5-100% were inserted in bump up curve; these values were achieved through the finger printing of machine. Then these values were processed Dot Gain Compensation window in full image areas specially from 5-10% area. The resulted image was printed at one angle 37.5° at 40 l/inch.

Results and discussion

Figures 14 and 15 show the dot areas from 5-100% after applying bump up curve that were used for processing the dot gain compensation and the dots areas after final printing. As a result the higher dot gain with yellow color then magenta and the lower is with cyan color and resulting of the processing it can be controlled the diameters of dots, that means the diameter of dot for yellow color is bigger than magenta color, and the diameter of dot for magenta color is bigger than cyan color (Table 1). The occurrence of rosette was eradicated using the same angle 37.5° for three process colors (C,M,Y) and the various of the diameters of dots for each dot area. When evaluating the image printed using the conventional angles and composites of four process colors, it's easy to see the rosette with naked eye and easy also to determine the type of rosette that is open -centered" rosette type. The same image printed in three process colors(C,M,Y) and processed in pre-press stage during preparing the digital file is clear without any appearance of rosette and all dots of three colors are in the same angle direction (37.5°) figure no.16.In this image , the details are obvious and keeping on the highlight areas without picking up any ink. Also in this processing for the image, the smallest screen dots can be able to print and gives added value to keep the strength and hardness of corrugated board resulting of converting the image from four to three colors particularly when the corrugated board is made from feeble material or has thin thickness or when laying thick and wide inks layers on the whole of

the package, there is an economical benefit because of saving the fourth ink (black color).

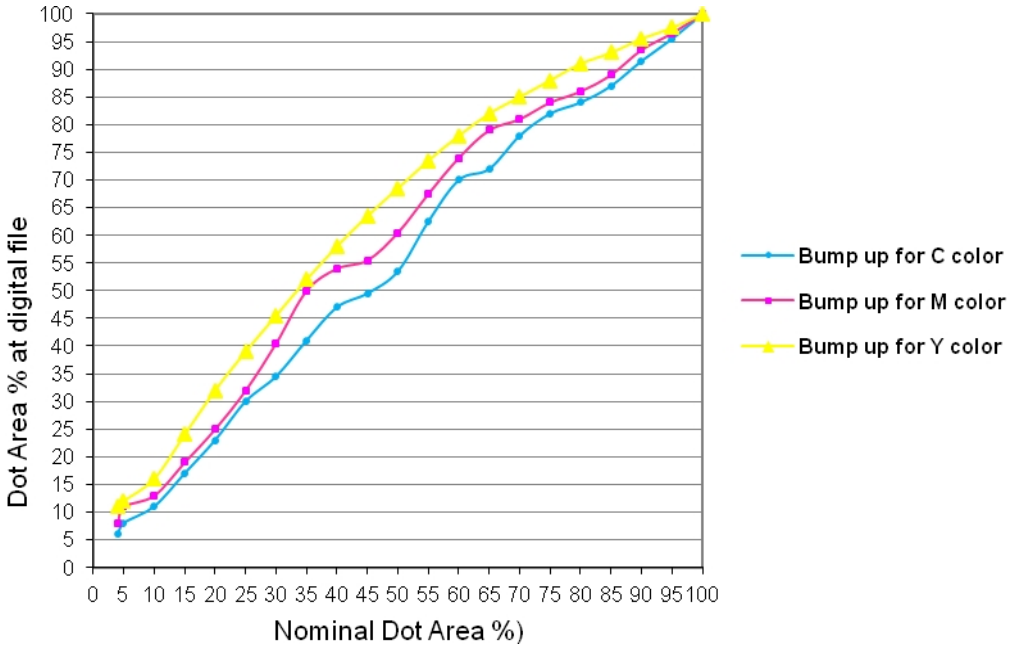

Figure14: the dot areas from 5-100% at digital file after bump up curve for C,M,Y colors

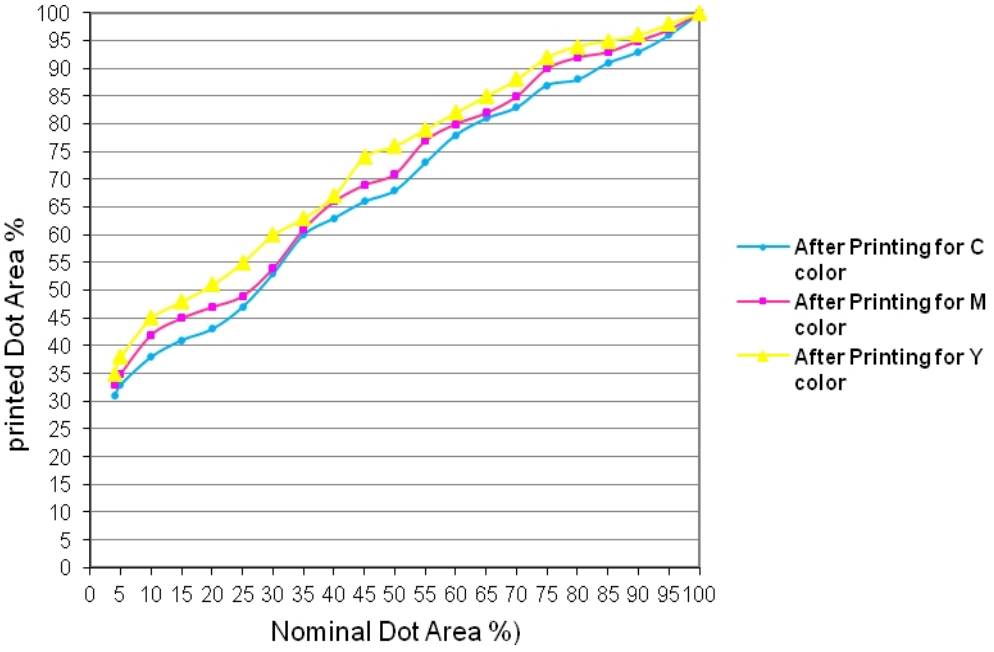

Figure15: the dot areas from 5-100% after Printing C,M,Y colors

Table 1: the dots diameter (µm) for dot areas 5%,50%,80% with C,M,Y colors at 40 l/inch during preparing the digital file

	Dot Diameter µm		
Tonal Values%	**Cyan(C)**	**Magenta (M)**	**Yellow (Y)**
5	**15**	**20**	**24**
50	**41**	**45**	**52**
80	**53**	**57**	**60**

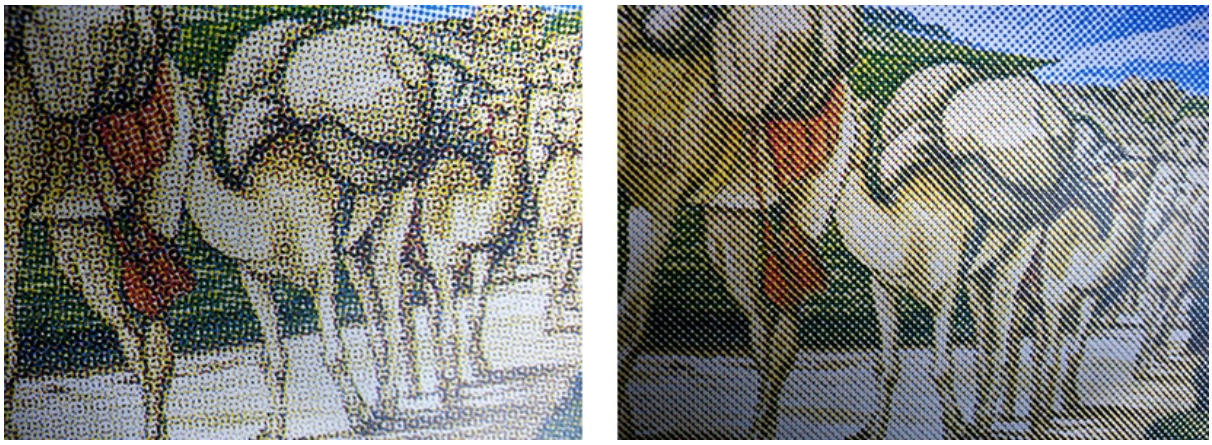

Figure16: enlarged images to compare between images printed using the conventional angles (left) and the same image after processing in pre-press stage (right

Conclusion

Images rosette occurrence eradication in post-printing on corrugated board is necessary, critical and easy to achieve the quality printing, finding a solution of rosette problem is very important because of the most of Egyptian presses in the field of corrugated carton are using screen ruling 40-50 line / inch or less for images and printed designs. With the lower screen rulings, the appearance of rosette can be noticed clearly with naked eye. The preparation of digital file with same angle (37.5°) for three process colors is a new technique in the flexographic printing especially with the control of the screen dots diameter that means the diameter of dot for yellow color is bigger than magenta color, and the diameter of dot for magenta color is bigger than cyan color which eradicates the influence of rosette. Converting an image from four to three process colors is the key and the first procedure to eliminate of rosette as it contributes to keep the strength of corrugated board material, particularly with weak and cheap materials and gives a significant economic advantage of eliminating the cost of printed color.

Acknowledgement

Sincere appreciation is expressed to Mr. Waleed Ezzat who supported the experimental study.

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