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Research Article

The Effect of Flexographic Printing Plate Micro Patterning On the Visual Appearance of Solid Areas Printed On Flexible Packaging Materials

Tamer Ali Abdelmageed Khaleel*

Publishing and Packaging Department, Helwan University, Egypt

***Corresponding Author**: Tamer Ali Abdelmageed Khaleel, Lecturer, Printing, Publishing and Packaging Department, Faculty of Applied Arts, Helwan University, Egypt.

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Abstract

One of the important factors affecting on the quality of printed flexible packaging materials is the Poor visual appearance of solid areas using Flexographic printing plates. The primary goal of this study is to improve the visual appearance of solid areas printed on Flexible packaging materials by adding micro patterns to the flexographic printing plates that can enable the optimum ink film thickness for printing of solids on flexible packaging materials, hope to ensure the highest possible maximum density (D - Max) for solids, as measured by a densitometer. Also to overcome the physical problems of fluids and flat surfaces by moderating hydrostatic forces and surface tension of the ink film.

Keywords: *Solid Areas; Micro Pattern; Flexographic Printing Plates; Anilox Roll; Density; Surface Tension; Flexible Packaging Materials.*

Introduction

Flexography is the predominant printing method for decorating packaging substrates. As a printing method, flexography has seen tremendous quality improvements in the past two or three decades. This process is capable of printing on a wide-range of substrates from corrugated liner to label stock, to films and foils. Advancements in ink metering systems predominantly anilox roll technology combined with improved plate, ink and press systems, have made high-quality flexo printing not only possible [1], but also common place. What was once known as a low-quality printing process is now seen as comparable, and in some cases, superior to offset and gravure. But one of the most important elements in any printed design is the visual appearance of solid areas printed on Flexible packaging materials.

One of the best ways to increase ink density is to screen solids. By simply changing solid areas to 90% screen tints, the effective ink density can be enhanced. This practice has been demonstrated to make solid areas darker, and in some cases, may allow tones and solids to be printed on the same plate. Solid screening provides the greatest benefit with traditional photopolymer plate materials printing on very smooth substrates like films or coated papers [2]. In these situations, improvements are seen by replacing solids with a high percent screen tint. The ink gathers on each dot, including small amounts on the edges of the dot. The ink is loaded better on the plate and more ink is released to the substrate. Density increases, as does ink uniformity. Because less impression is needed, halos around type can be improved. And in many cases, because the ink is applied more smoothly to the substrate, less ink is actually used. Screening solids is achieved by either placing a dot in solid areas at the RIP, or by using one of three commercially - available products. Individuals can screen solids without purchasing additional hardware or software by simply calibrating their plate imager to render 100% areas as some lower percentage screen tint. One can also manually select solid areas and tint them in their vector application. However, this may impact other image areas so care is needed. Easier yet, and more reliable, is to use one of three commercial solutions: Artwork Systems, Plate Cell Patterning, Kodak DigiCap, or Esko - Graphics Groovy Screens.

In this Research Kodak DigiCap will be used. Whether DigiCap can improve the print quality of solid areas depends on many variables, including:

1. Type of substrate
2. Type of ink
3. Type of polyester plate mounting tape
4. Plate durometer

All of these factors have a large influence on the quality with which solids will print.

Fluid Dynamics and Printability of Solids

Due to ink's surface tension and the flat surface of the flexographic printing plate, causes ink to pool. Ink pooling can cause undesirable artifacts - sometimes referred to as worm tracks.

The primary goal of printing plate micro patterning is to improve the visual appearance of solids. In some cases, it can also enable the optimum ink film thickness for printing of solids. This will ensure the highest possible maximum density (D - Max) for solids, as measured by a densitometer [3].

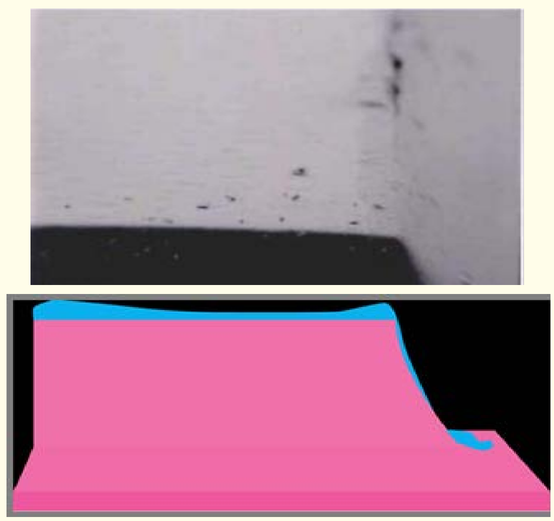

Figure 1: *On solid flat surfaces, surface tension causes ink to pool.*

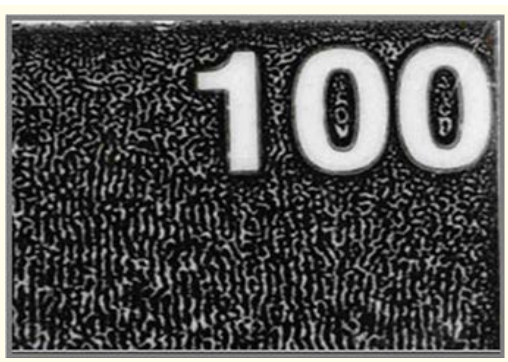

Figure 2: *Solid area on poly shows undesirable artifacts, and a halo effect around reverse type, as a result of pooled ink.*

printing plate micro patterning helps to overcome the physical problems of fluids and flat surfaces by moderating hydrostatic forces and surface tension of the ink film. So, the application of printing plate micro patterning on the surface of solids, improves the physics of ink transfer.

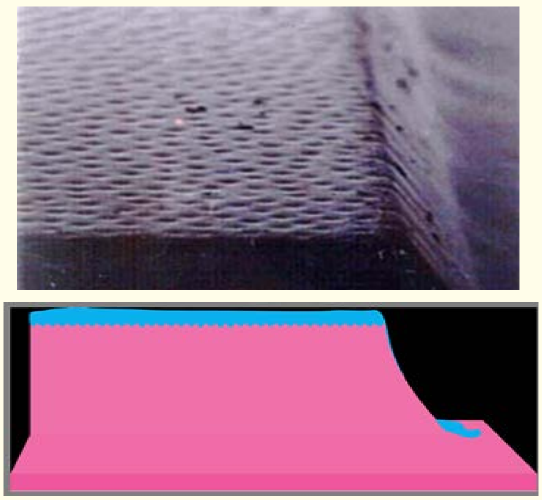

Figure 3: *The printing plate micro patterning of solid areas with DigiCap can equalize hydrostatic forces, leading to better ink laydown on the surface of the plate.*

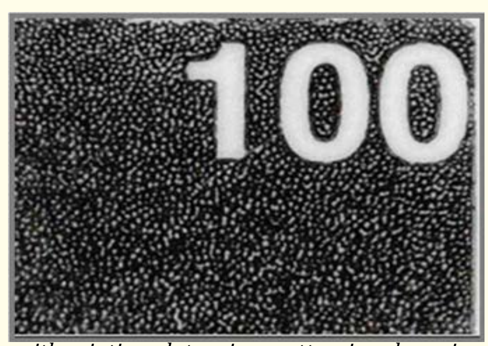

Figure 4: *Solid area with printing plate micro patterning shows improved ink laydown.*

Note: The size of the artifacts is much smaller, with noticeable lessening of halo effect around reverse type. At normal viewing distance, these solids look smoother.

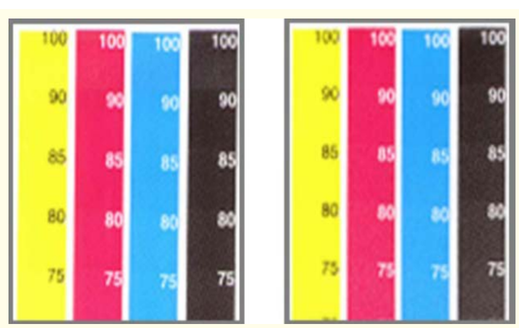

Figure 5: *Left: 100% Black tone patch without DigiCap is actually printing lighter than 90%, and has a density of 1.25; right: application of DigiCap shows 100% printing darker than 90%, and now has a density of 1.4.*

There is no way to determine optimum settings for printing plate micro patterning by examining plates. Printing plate micro patterning settings can only be determined by fingerprinting on press.

Reproduction of solids is a combination of specific print conditions that exist only at one specific printing plant, the result of different plate durometer and chemical composition, type of sticky back used, composition of ink, press impression, and other factors. There is no way to avoid systematic press tests on a specific press, to determine printing plate micro patterning settings. Printing plate micro patterning (DigiCap) is specified at a specific feature size, in pixels, and is applied at a certain intensity, specified by percentage.

However, shadow tones will often start to print as solids at some point. By visual inspection you might determine this to be at 93%. Additionally, by using a densitometer, you may determine that maximum density is reached at 95%.

Using the same Kodak Dotsize_Calculator.xls spreadsheet used to calculate Maxtone size, it can calculate a starting point for DigiCap. It can consider a 95% shadow dot to be equivalent to a 5% white dot. Using Dotsize_Calculator.xls, It can see that the average dot area of a 5% dot at 150 line, in pixels, is 12.8. If this is the case, we could start by making DigiCap equivalent to 12 pixels (for example, 3x4 pixels). This feature size would be applied at 95%.

A texture is created in the surface of solids, which should reduce ink pooling. It is also reducing the amount of surface available to transfer ink, effectively reducing the ink film thickness in these areas.

Note: A 95% reverse dot can be considered equivalent to a 5% positive dot [4].

The resulting feature size is applied at the percentage determined to give the maximum density on the linear press test. At 150 line, a 5% dot average dot area is just over 12 pixels. This can be used to specify a DigiCap feature size of 4 x 3 pixels.

Figure 6: *Process template showing DigiCap settings 3x4 at 95%.*

DigiCap works by bracket this starting point by creating test images with a range of feature sizes and percentages. Start at 3x4 pixels, at 95%, but also create alternate tests with the same feature size but with intensity changed from 90% to 99%. Continue to bracket feature sizes close to this, also in a range. appearance and the highest density [5].

Methodology

This study utilized the experimental method to determine the Effect of flexographic Printing Plate Micro Patterning on the best visual appearance and the highest density. The experimental design utilized experimental confirmation to investigate differences in a range of feature sizes and percentages printed on Pearlized Bopp. The measured data was recorded and organized so as to facilitate subsequent analysis.

Materials and Procedures

The digital test form in this research was produced on Kodak Prinergy Evo 5.3, it was composed of a solid plain area and 4 groups with different feature size, No.1 (2 x 3), No.2 (3 x 3), No. 3 (3 x 4), and No. 4 (4 x 4) and each group with intensity changed from 90% to 99%.

The Test form is printed on Pearlized Bopp with thickness 20 microns, using 5 different anilox rolls:

AFP TOP digital plate from Asahi (1.14 mm - hardness 77 shore) was used. The adhesive tape of plate from Tesa, its thickness 0.50 mm and medium soft type. The test form was printed on Uteco flexographic Printing machine. The type of ink is Solvent base ink, process Black and its viscosity is 18 /s using Ford viscosity cup 4 mm.

	Anilox Screen Ruling	Anilox Cell Volume
1	300 L/cm	5.6 bcm
2	260 L/cm	6.3 bcm
3	180 L/cm	6 bcm
4	140 L/cm	7.7 bcm
5	140 L/cm	11.4 bcm

Table 1: *The test form was printed out via flexographic process, the output plate was one color (Black).*

The Printed Results was measured using an X-Rite densitometer to reach to the highest density, and the best visual appearance as well.

Figure 7: *The digital test form was composed of a solid plain area and 4 groups with different feature size, No.1 (2x3), No.2 (3x3), No. 3 (3x4), and No. 4 (4x4) and each group with intensity changed from 90% to 99%.*

Results and Discussion

As Shown in the Figure 8 The anilox roll with screen ruling 300 L/cm and cell volume 5.6 bcm the density of the solid plain area is 1.28, the feature size (3 x 4) achieved higher densities at intensities range (93%:99%) and densities range (1.3:1.31), and the feature size (4 x 4) achieved higher densities at intensities range (97%:99%) and densities range (1.3:1.32).

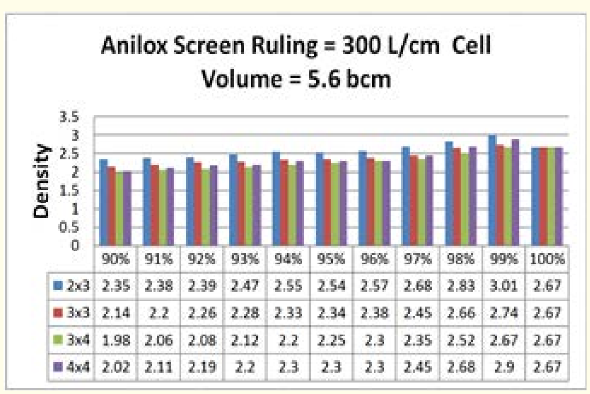

Figure 8: *Results of Anilox Screen Ruling 300 L/cm, and cell volume 5.6 bcm.*

As Shown in the Figure 9 The anilox roll with screen ruling 260 L/cm and cell volume 6.3 bcm the density of the solid plain area is 1.52, the feature size (3 x 4) achieved higher density at intensity (99%) and density (1.56), and the feature size (4 x 4) achieved higher densities at intensities range (97%:99%) and densities range (1.55:1.6).

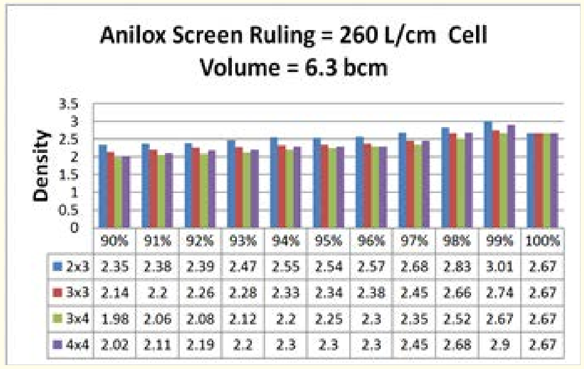

Figure 9: *Results of Anilox Screen Ruling 260 L/cm, and cell volume 6.3 bcm.*

As Shown in the Figure 10 The anilox roll with screen ruling 180 L/cm and cell volume 6 bcm the density of the solid plain area is 1.44, the feature size (3 x 4) achieved higher densities at intensities range (95%:99%) and densities range (1.48:1.53), and the feature size (4 x 4) achieved higher densities at intensities range (93%:99%) and densities range (1.46:1.51).

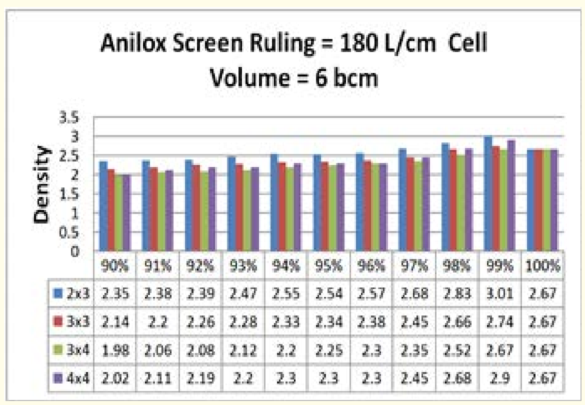

Figure 10: *Results of Anilox Screen Ruling 180 L/cm, and cell volume 6 bcm.*

As Shown in the Figure 11 The anilox roll with screen ruling 140 L/cm and cell volume 7.2 bcm the density of the solid plain area is 2.02, the feature size (3 x 4) achieved higher densities at intensities range (96%:99%) and densities range (2.1:2.25), and the feature size (4 x 4) achieved higher densities at intensities range (97%:99%) and densities range (2.22:2.27).

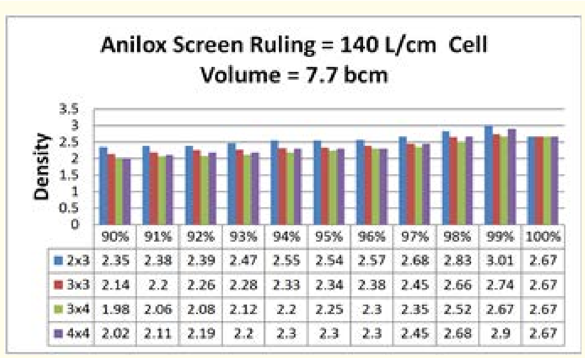

Figure 11: *Results of Anilox Screen Ruling 140 L/cm, and cell volume 7.7 bcm.*

As Shown in the Figure 12 The anilox roll with screen ruling 140 L/cm and cell volume 11.4 bcm the density of the solid plain area is 2.67, the feature size (2 x 3) achieved higher densities at intensities range (97%:99%) and densities range (2.68:3.01), the feature size (3 x 3) achieved higher density at intensity (99%) and density (2.74), the feature size (3 x 4) achieved higher density at intensity (99%) and density (2.67), and the feature size (4 x 4) achieved higher densities at intensities range (98%:99%) and densities range (2.68:2.9).

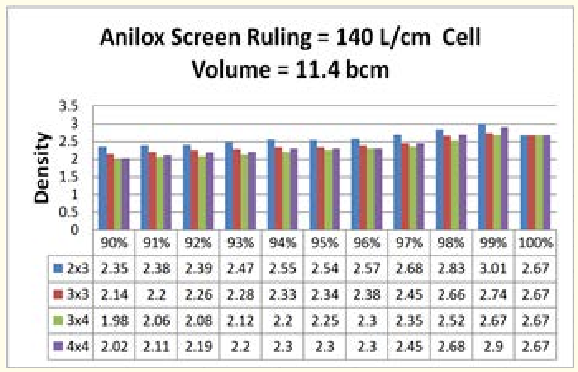

Figure 12: *Results of Anilox Screen Ruling 140 L/cm, and cell volume 11.4 bcm.*

Conclusion

As a result of the investigation, the following conclusions have been drawn to achieve the maximum density compared to the density of the plain solid area:

1. When using an anilox roll with screen ruling 300 L/cm and cell volume 5.6 bcm it's recommended to use the feature size (4 x 4) at intensity 99%.

2. When using an anilox roll with screen ruling 260 L/cm and cell volume 6.3 bcm it's recommended to use the feature size (4 x 4) at intensity 99%.

3. When using an anilox roll with screen ruling 180 L/cm and cell volume 6 bcm it's recommended to use the feature size (3 x 4) at intensities (98 and 99%).

4. When using an anilox roll with screen ruling 140 L/cm and cell volume 7.7 bcm it's recommended to use the feature size (4 x 4) at intensity 99%.

5. When using an anilox roll with screen ruling 140 L/cm and cell volume 11.2 bcm it's recommended to use the feature size (2 X 3) at intensity 99%.

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