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The Influence of Plate and Blanket Cylinder Packing on Print Quality and Plate Wear in Sheet-Fed Lithographic Offset Machines

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ABSTRACT

To guarantee image quality transfer in the lithographic offset printing process, there are some parameters that can be considered as direct influences, including dot gain, slurring, density, and plate wear. Today, there is a problem in many printing presses in Egypt that many operators modify packing based on their experience. This study was designed to evaluate the impact of different impression values between the blanket and plate cylinders by studying the impact of plate and blanket packing, including registration, density, dot gain, slurring, and plate wear. The study was divided into two experiments to evaluate how variations in plate and blanket packing thickness affect impression value, print quality, and plate wear. The results exhibit the relationship between the increasing plate and blanket packing and the quality of the output. Whereas, at 0.4 mm plate packing, plate wear began to appear. Moreover, when blanket packing was increased to 1.6 mm, the plate wore. In conclusion, the experimental study exhibited that the accurate plate and blanket packing might be calculated by these formulas. (1) Accurate plate packing = (undercut plate cylinder – plate thickness) + 0.1 mm. (2) Accurate blanket packing = (undercut blanket cylinder – blanket thickness).

***Keywords**:* Impression value, Density, Dot gain, Plate wear, Plate and blanket packing.

Research problem

There is a problem in many printing presses in Egypt that many operators modify packing based on their experience, that may be causing direct influences on printing quality and plate life time.

Aim of research

This study was designed to evaluate the impact of different impression values between the blanket and plate cylinders to find the best plate and blanket packing to investigate the printing quality and saving the plate life time.

Research importance

The research attempts to reach the optimal level of plate and blanket packing.

1- Introduction

Several factors contribute to the stretching of the printed image length on the sheet, significantly affecting print quality and registration accuracy. These factors include ink characteristic and specifications, ink viscosity (Elwan, 2017), type of blanket (Dhirender, et al., 2018), the design specifications of the lithographic offset press, particularly the diameters of the plate, blanket, and impression cylinders, the impression value among these cylinders, and the type of printing substrate used (Gautam A. and Gautam A., 2021; Singh, et al., 2017). The plate and blanket cylinders feature undercuts, which are recesses between the cylinder body and bearers, serving as references for required packing thickness to achieve necessary impression value, ultimately influencing image quality. (Helmut, 2001; Lundstrom, et al., 2011)

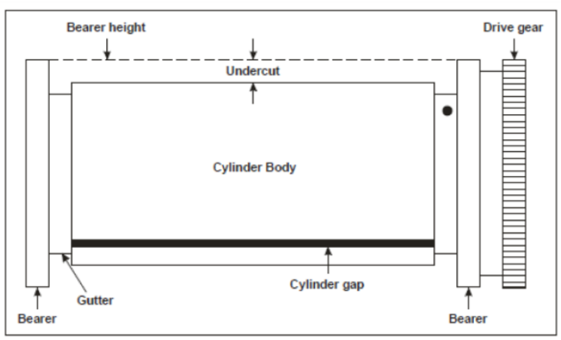

Fig. (1) Cylinder undercut (Hod, 2016)

The more common types of lithographic offset plate cylinder undercut 0.3 mm; the cylinders of every printing machine must be in contact with one another in order to transfer ink. For efficient ink transfer. The contact zone or nip needs a printing pressure of roughly 0.8 to 2.0 MPa (Dendge, 2019). Pressure distribution was taken into consideration while examining the effects of contact or nip area variations between the blanket and impression cylinder on the printed area (Shuqin, et al. 2009). However, the other studies have also examined the effects of compressible and incompressible blankets in order to determine variations in dot gain under various tensions

(Alexander, 1991). The impact of paper types and fountain solution pH on dot gain has also been examined in studies (Yung, 1997).

The printing machines cylinder configurations have different designs. One kind of cylinder has a contact bearer, such as the contact between the blanket and plate cylinders, which guarantees accurate pressure distribution; the other type does not, like the contact between the blanket and impression cylinders, which also has an impact on ink transfer and print quality. (Helmut, 2001; Berculescu, et al., 2017).

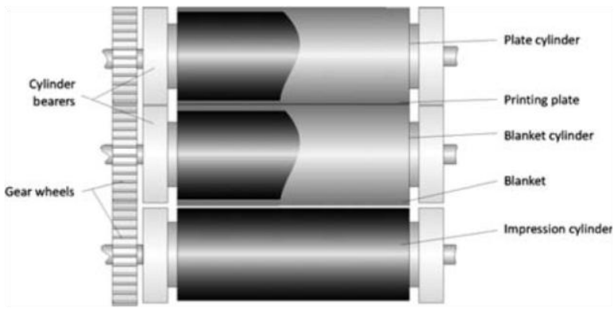

Fig. (2) Contact and without contact bearer (Pyryev Y. and Krzyzkowski J., 2012)

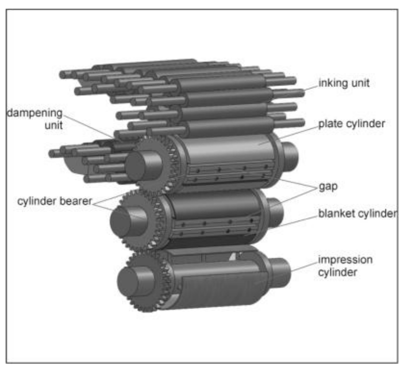

Fig. (3) Offset printing unit (Krzyzkowski J and Pyryev Y., 2012)

Operators frequently modify the packing underneath the plate and blanket in numerous printing presses according to prior procedures and experience. This method, however, may result in irregularities in the overall print quality as well as distortions in the form, gain, or loss of the dots. Inadequate packing can also lead to plate wear, which can alter the density fluctuations in printed ink and decrease print quality. The purpose of this study is to offer a scientific method for dealing with these issues.

The impression value between the blanket and plate cylinders in sheet-fed lithographic offset machines is the main topic of this investigation. As advised by manufacturers, the ideal impression values vary depending on the machine model. This pressure is influenced by a number of elements (Dendge, 2019; Helmut, 2001), such as:

1. Differences in blanket and plate thickness, which are determined by manufacturing requirements.
2. The blanket and plate cylinders' undercut, which varies according to the machine model.
3. Modifications to cylinder diameters through packing redistribution across cylinders.

Therefore, the study was aimed at evaluating how plate and blanket packing affected plate wear and print quality at various impression values. Some printing quality factors were examined, such as registration, slurring, density, and dot gain.

2- Materials and methods

Materials, and Equipment

This study was conducted using the SHOTS sheet-fed offset training simulator, developed in collaboration with Sinapse Graphic and the Technical Authority for Graphic Arts (Gatf). The simulator replicates a 6-color press and includes detailed assessments of print quality characteristics such as density, dot gain, slurring, registration, and plate wear. The experiment employed 70 g/m² uncoated sheet paper with specific environmental conditions: 60% humidity and 20°C temperature for the press room. The ink sequence followed K, C, M, and Y, with Cyan being tested. (https://www.sinapseprint.com/SheetSim-SHOTS-Description).

Printing parameters included a damping solution pH of 5.15, alcohol concentration of 2%, additive levels of 2.5%, and a conductivity of 1250 micro Siemens. The plate used had a thickness of 0.3 mm with an undercut of 0.5 mm, while the blanket thickness was 1.95 mm with a 3.25 mm undercut and a tension of 9 KP. A GATF test form color bar was utilized for measurement and evaluation.

3- Methodology

The current study involved adjusting the plate packing thickness while maintaining other factors constant, measuring its effect at machine speeds of 3000 sheets/hour. Additionally, another set of experiments focused on altering the blanket packing thickness while keeping other variables unchanged, evaluating its influence at the same machine speeds. The experiments were conducted using the SHOTS sheet-fed offset training simulator program to ensure precise and controlled assessments.

Therefore, two experiments were designed to evaluate how variations in plate and blanket packing thickness affect impression value, print quality, and plate wear. According to Hod, (2016), the first experiment was designed depending on the nip area between the plate and blanket according to the undercut of each cylinder. The plate packing was calculated according to the formula: plate packing = undercut of plate cylinder – plate thickness. Thereafter, we were fixed blanket packing with the bearer according to the formula: blanket packing = undercut of blanket cylinder – blanket thickness while increasing plate packing thickness, whereas the experiment started with the plate packing with the bearer and then increased plate packing above the bearer. Oppositely, the second experiment examined the increase of blanket packing thickness above the bearer with fixed plate packing. During the experiments, the mechanical dot gain, which includes both directional (slur and doubling) and non-directional (dot size increase) gains, was assessed. Moreover, directional dot gain is typically influenced by some factors such as speed differences between plate and blanket cylinders. Also, low-tack ink, excessive pressure, defective paper, and insufficient blanket tension as described by Milošević, et al. (2014a) and Milošević, et al. (2014b).

4- Results

In the first experiment, the Cyan blanket packing remained constant with the bearer at 1.5 mm, while the adjusted plate packing with the bearer at 0.20 mm. So, data in Fig. (4) Exhibited that the printed sheet on which Cyan color didn't appear and didn't transfer or print well.

Fig. (4) Cyan ink didn't transfer or printed good

Meanwhile, when the plate packing was increased to 0.25 mm in Fig.(5), it showed that Cyan appeared weak in the printed sheet.

Fig. (5) Weak Cyan was appeared in printed sheet

Concerning the plate packing, the increase to 0.30 mm in Fig.(6) Displayed that accurate registration, appearance, and the density were 1.10.

Fig. (6) Accurate Cyan registration, appearance, and density.

When the plate packing increased to 0.325 mm in Fig.(7), it represented that the misregistration remained a simple change all over the printed sheet; dot gain and slurring increased moderately; it had recorded (50% and 90%); therefore, the standard shape of the dots of half-tone (40% and 80%) in Cyan patches in the color bar, Fig. (8) Represents the density; it was recorded as 1.0. The plate exhibited no wear.

Fig. (7) missregistration of Cyan

Fig. (8) Cyan Density

When plate packing increased to 0.35 mm, as shown in Fig.(9) which shows more irregular smudging and misregistration. For halftone dots, dot gain rose to 56% and 92%, while density rose to 1.07.

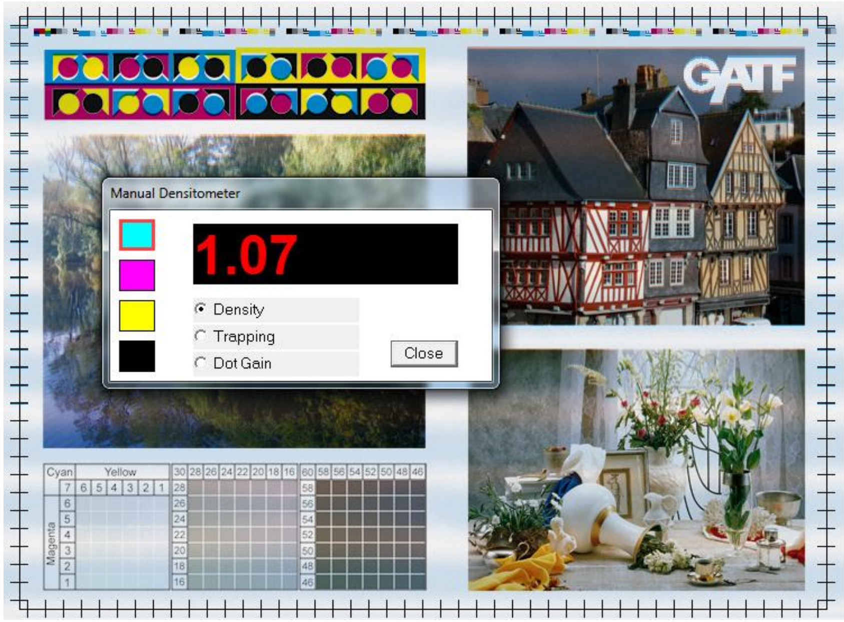

Fig. (9) more misregistration and irregular smudging of Cyan color

At 0.375 mm plate packing, registration errors and smudging intensified, which appeared in Fig.(10) Dot gain increased to 58% and 93%, with density recorded at 1.08. No plate wear was observed.

Fig. (10) More miss registration and more irregular smudging appeared

At 0.4 mm plate packing, plate wear began to appear as shown in Fig. (11), along with increased dot gain (60% and 95%) as shown in Fig.(12), Fig.(13) represents more miss registration and irregular smudging; also, the density recorded was 1.09.

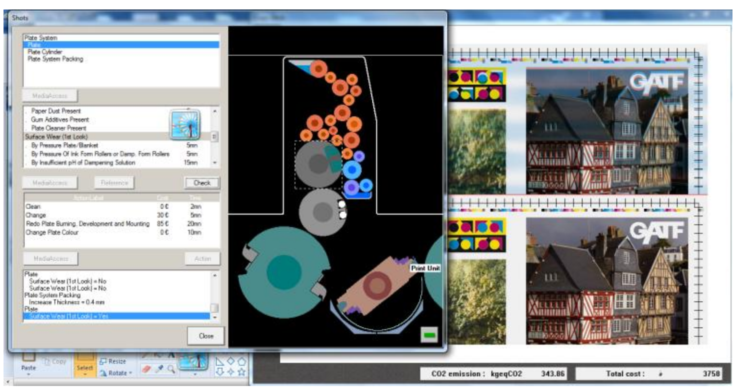

Fig. (11) The Cyan plate wear

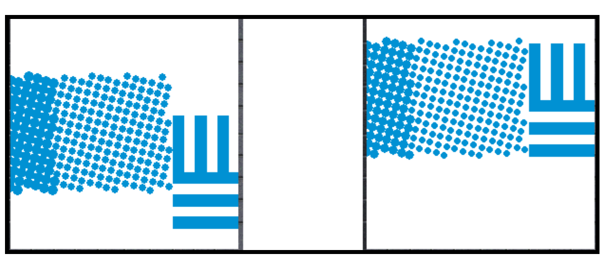

Fig. (12) Cyan density

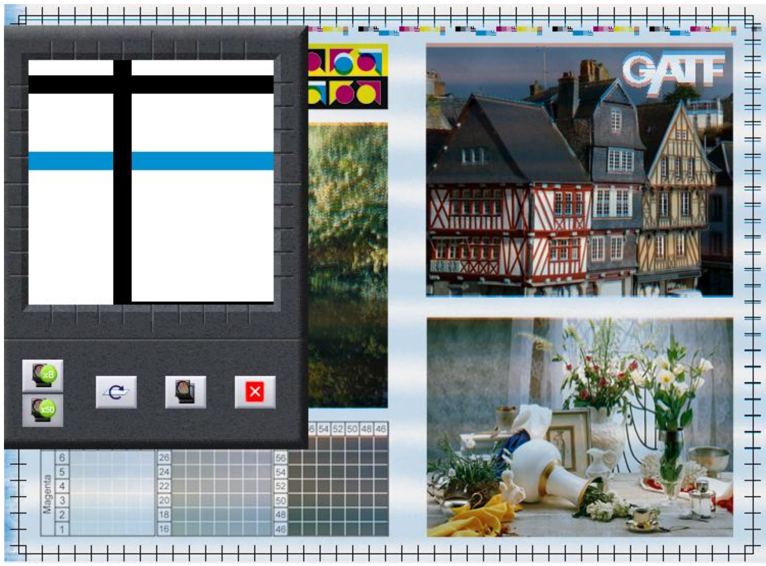

Fig. (13) More miss registration and more irregular smudging appeared

The results of the second experiment exhibited that the Cyan plate packing remained constant at 0.3 mm, which recorded the best result, while blanket packing increased to 1.55 mm. Fig. (14) Represents the miss registration and irregular smudging that remained a simple change all over the printed sheet; Fig.(15) Represents dot gain and slurring that increased moderately; it had recorded (50% and 90%); therefore, the standard shape of the dots of half-tone (40% and 80%) in Cyan patches in the color bar, Fig. The density recorded 1.0. The plate exhibited no wear.

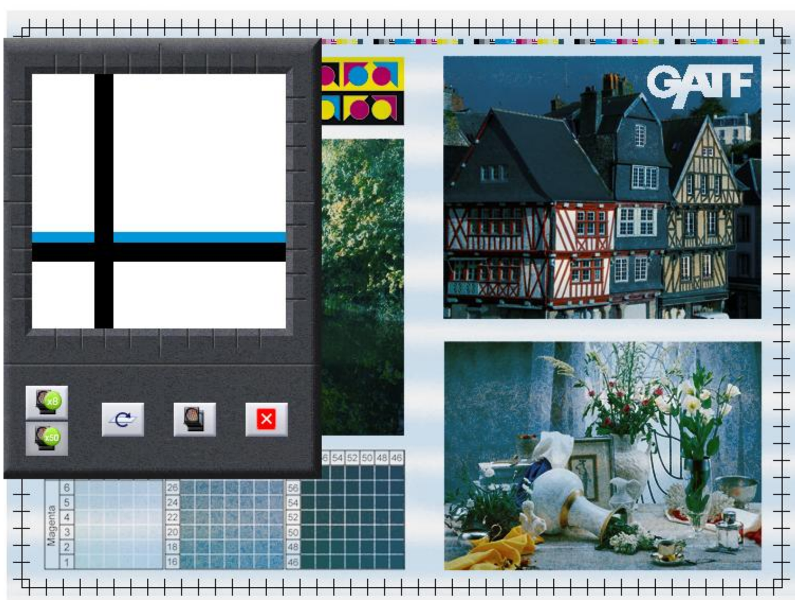

Fig. (14) Missregistration direction to the top

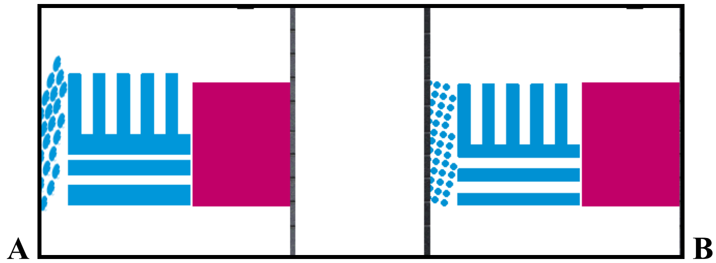

Fig. (15-A) Dot gain and slurring shape , **Fig.(15-B)** Standard shape of the dots of half tone

When blanket packing increased to 1.6 mm, Fig.(16) represents missregistration and smudging worsening, and Fig.(17) represents more slurring and also dot gain rose to 62% and 97%, and density remained at 1.0. Plate wear was recorded at this level, indicating that exceeding this threshold leads to mechanical deterioration.

Fig. (16) Missregistration direction to the top and irregular smudging

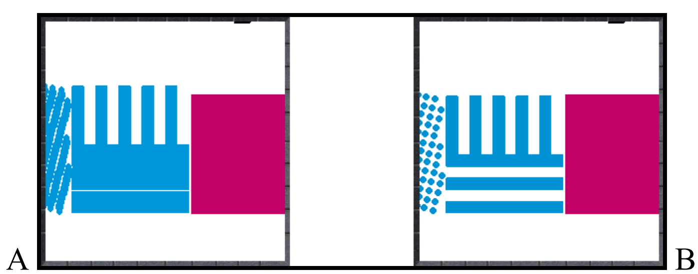

Fig. (17-A) Dot gain and slurring shape, **Fig. (17-B)** Standard shape of the dots of halftone

5- Discussion

Impression values between the blanket and impression cylinder affect a number of print properties, such as slurring, dot gain, and registration correctness (Dendge, 2019). In this study, excessive packing for all plates and blankets decreases or raises pressure, which causes variances in ink density and dot-form distortions. The experimental results showed that print quality deformation happens prior to plate wear; when the Cyan plate and packing were with the plate cylinder bearer, the Cyan color was not transferred well. When the Cyan plate packing increased until 0.3 mm, the printed image was accurate, and the density was the best result as recommended by ISO 12647-2. When the plate packing is more than 0.3 mm, print quality deformation happens prior to plate wear, and the plate wear was noticeable at 0.4 mm plate packing thickness. Additionally, prior research suggests that over packing may wear down the plate surface and shorten its longevity. So, maintaining print accuracy and plate durability depends on managing plate packing.

Additionally, blanket packing has a big impact on ink transfer and print registration. Variations in blanket impression values can affect dot gain and blurring, according to research by Yung (1997). In our study, excessive packing for blanket cylinder investigated demonstrates that plate wear starts at 1.6 mm blanket packing, which will corroborate the findings that mechanical degradation is accelerated by high pressure.

Since various materials react differently to changes in pressure, blanket compressibility also plays a crucial role (Alexander, 1991; Shuqin, et al., 2009). It is clear from our study that, when blanket packing is adjusted properly, it minimizes flaws like slurring and miss registration and guarantees uniform ink distribution.

Print quality varies because many press operators modify packing based more on their experience than on calculated parameters. Using experimental changes instead of manufacturer-recommended settings can lead to higher operating costs and mechanical inefficiencies. Standardized techniques, such as measuring dot gain and registration shifts, can offer a more dependable way to maximize print conditions.

6- Conclusion

The important effects of plate and blanket cylinder packing on print quality and plate wear in sheet-fed lithographic offset machines are highlighted in this study. The tests showed that when the plate was packed with the bearer cylinder, there was no recording printing quality; therefore, increasing plate packing causes deformation in print quality, but the plate wear only starts at a plate packing thickness of 0.4 mm. Print quality is also impacted by blanket packing, although plate wear is only noticeable at 1.6 mm of blanket packing. Therefore, in order to maximize printing performance, the study recommended that accurate calculations be made while determining plate and blanket undercut and packing.

Maintaining print accuracy and reducing flaws like dot gain, slurring, misregistration, and uneven smudging and reducing the longevity of printing components like mechanical plate wear require careful modifications to packing thickness. Additionally, print quality and machine efficiency can be greatly increased by adhering to accurate recommendations for plate and blanket packing from these formulas:

1) Accurate required plate packing = (undercut plate cylinder – plate thickness) + (Required plate height over the bearer = 0.1mm, according to the study).
2) Accurate required blanket packing = undercut blanket cylinder – blanket thickness

Recommendation

It should be prevented operators modify packing based on their experience to investigate the printing quality and saving the plate life time, but they can be calculate the plate and blanket packing from this formulas:

1) Accurate required plate packing = (undercut plate cylinder – plate thickness) + (Required plate height over the bearer = 0.1mm, according to the study)
2) Accurate required blanket packing = undercut blanket cylinder – blanket thickness

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