Section A-Research paper
ISSN 2063-5346

ANALYSIS OF VERIOUS PRINTING DEFFECTS OCCURING IN HIGH SPEED GRAVURE PRINTING PRESSES

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Published: 25-June-2023 Accepted: 23-May-2023

ABSTRACT

Gravure printing process is one of the dominant forms of printing processes being used for high quality flexible print products although, the printing process is capable of printing with 450 lpi, still a number of printing defects may happen during the print production. Objective of this paper is to through light on various printing defects happening in high-speed production-based Gravure printing presses. The data related to printing defect was collected on Rotomac printing press and printing defects were analysed on day-to-day basis for three months. The data was collected in observation basis the results indicated that mis-registration, doctor blade lines, shade variation (Each half tone and full tone) and grounding are the most frequently occurring defects and viscosity, continuity of track line, proper tension, impression roller pressure, temperature of heating zones, use of lay-on roller and use of inks are the least occurring printing defects. Over all print wastage found 6% because of various printing defects.

KEYWORDS: - Gravure printing press, printing defects, flexible printing, substrate, doctor blade line, grounding, viscosity, image career, doctor blade, liquid ink.

INTRODUCTION

Gravure printing process is a printing process which imparts higher in print quality on flexible substrates among all the printing processes. This printing process is preferred for long run jobs or productions. In Gravure printing process liquid ink is used which set on the substrate by evaporation drying mechanism although the substrate surface energy is enhanced by corona treatment by which

ink is well attached on the surface of the substrate.In Gravure printing process the image career is an engraved cylinder made of a metal having the image area in recess and non-image in relief form. Liquid ink is filled in the engraved (image) area and directly transferred on to the substrate. A doctor blade is used for wipe excess ink from the surface of the image career before it transferred on to the substrate (Gravure Association of America, 1997).

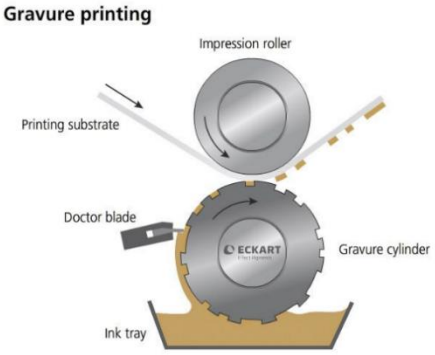

Figure 1. Principle of Gravure Printing Process (Adams, 2001)

Gravure printing process is higher in print quality so the applications of the Gravure printing process are also high. Gravure printing process has a wide range of print applications for flexible packaging products i.e., pouches, wrappers, laminates, food packaging, gift wraps etc.

RESEARCH OBJECTIVE

The aim of this paper is to shed light on the different printing defects that occur in high-speed production-based Gravure printing presses. The data regarding these printing defects was collected from the Rotomac printing press over a period of three months, and a day-to-day analysis was conducted. The findings revealed that the most commonly occurring defects were misregistration, doctor blade lines, and shade variation (both in half tone and full tone). Additionally, grounding issues were also prevalent. On the other hand, the least occurring printing defects were related to viscosity, continuity of track lines, proper tension, impression roller pressure, temperature of heating zones, use of lay on roller, and the use of inks. Overall, the study found that approximately 6% of print wastage was attributed to various printing defects.

RESEARCH METHODOLOGY

Gravure printing process is a popular printing technique which is used in the packaging, publication, and decorative industries. Gravure printing involves engraving an image onto a cylindrical surface, which is then used to transfer ink onto the substrates. The data was collected on Rotomac 4000 series gravure printing machine on the observation method.

On the base of occurrences of defects, quantitative data was collected on the most and least frequent of defects and their impact on the total production. Some of the frequent defects are;

Misregistration- when the printed colours or images do not align accurately with each other on the substrate. This misalignment can lead to blurred images, overlapping colours, or gaps between colours, resulting in poor print quality and a visually unappealing final product.

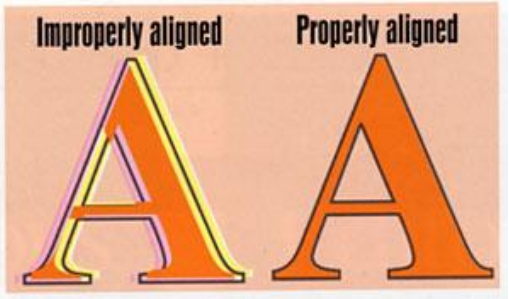

Figure 2. Misregistration (Jane, 2015)

Doctor blade lines- Lines occurs when fine lines or streaks appear in the printed image due to the improper or uneven contact between the doctor blade and the engraved cylinder. Doctor blade lines can negatively impact print quality and appearance, leading to customer dissatisfaction and potential rejections of printed material.

Shade variation (Each half tone and full tone)- Shade variation is a most frequent defect that results in inconsistent colour appearance across the printed material. It occurs when there are noticeable differences in colour density or hue within a printed image, leading to an uneven or mottled appearance

Scumming- when the ink is applied on the non-image areas instead or with image area during the production is denoted by scumming which is most common and frequently occurring defect during the production. In gravure printing process it is occurs when ink viscosity is not appropriate and not dry on the surface of the substrate or the doctor blade is not working so well and not proper wipe off the excessive inks from the image career.

Viscosity- Viscosity refers to the thickness or resistance to flow of the ink used in the gravure printing press. If the ink's viscosity is not within the desired range, it can lead to various issues and a viscosity defect can have significant impacts on print quality.

Continuity of track line- The track line refers to the path followed by the engraved cells on the printing cylinder as they transfer ink to the substrate during the printing process. A continuity defect in the track line can lead to visible issues in the printed image, affecting its overall appearance and quality.

Proper tension- Tension refers to the amount of force applied to the substrate as it passes through various rollers and processes in the printing press. A tension defect occurs when the substrate tension is not controlled appropriately, leading to various issues during the printing process.

Impression roller pressure- The impression roller is responsible for applying pressure to the substrate as it passes through the press, ensuring that the ink from the engraved cells on the printing cylinder is transferred effectively. If the impression roller pressure is not properly controlled or adjusted, it can lead to various defects in the printed output.

Temperature of heating zones- Heating zones are used in gravure printing presses to control the temperature of various components, such as the printing cylinders, ink, and drying units. When the temperature of heating zones is not properly controlled, it can lead to various defects in the printing process.

Use of lay-on roller- The lay-on roller is positioned after the impression roller, and its primary function is to apply gentle and consistent pressure to the substrate as it passes through the press. lay-

on roller is an essential component in gravure printing presses that helps achieve a smooth and even ink transfer from the engraved cells on the printing cylinder to the substrate.

Use of inks- In gravure printing, the use of inks is a critical aspect that directly impacts the print quality and final output. Various defects can arise if the inks are not chosen, handled, or applied correctly in the printing process.

DATA COLLECTION & ANALYSIS

Table 1. Printing defects and wastage data for consecutive three months

Defects	M-I		M-II		M-III	
	TP = 210 Tones		TP = 217 Tones		TP = 207 Tones	
	Wastage	Wastage %	Wastage	Wastage %	Wastage	Wastage %
Shade Variation	2.268	1.08%	2.387	1.10%	2.1528	1.04%
Misregistration	2.205	1.05%	2.2351	1.03%	2.1942	1.06%
DB Lines	2.058	0.98%	2.0615	0.95%	1.9872	0.96%
Scumming	1.869	0.89%	1.9964	0.92%	1.8837	0.91%
Ink Issues	0.861	0.41%	0.9765	0.45%	0.8901	0.43%
Web Tension	0.735	0.35%	0.7378	0.34%	0.7452	0.36%
Uneven Pressure	0.714	0.34%	0.6944	0.32%	0.6417	0.31%
Temperature	0.651	0.31%	0.6076	0.28%	0.5382	0.26%
Lay-on Roller	0.546	0.26%	0.5425	0.25%	0.5589	0.27%
Barcode	0.525	0.25%	0.5425	0.25%	0.4347	0.21%
Track Line	0.462	0.22%	0.5208	0.24%	0.5175	0.25%
Total	**12.894**	**6.14%**	**13.3021**	**6.13%**	**12.5442**	**6.06%**

In table 1, M-I is representing 1st month had 30 days and the total production (TP) in this moth was 210 Tones. Total eleven common defects are taken or measured which are occurred during the production and it was found that four of them are most occurred or having a large impact on the total production. In M-I the total production was 210 Tones and the wastage was 12.89 Tones which approximately 6.14% of the total production, when sort the wastage according to the or on the basis of defects it was found that four most occurring defects i.e., shade variation, misregistration, DB lines and scumming are impacts approximately 4% wastage of the total production and remaining the least occurred defects i.e., Ink issues, web tension, uneven pressure, temperature, lay-on roller, barcode, and track lines impacts approximately 2.14% wastage of the total production. Same pattern was found in M-II (2nd month) and M-III (3rd month) had 31 and 30 days respectively. In M-II the total production (TP) was 217 Tones and the most occurring defects impact approximately 4% on the total production and the least occurring defects wastage was found approximately 2.13%. In M-III the total production was 207 Tones and it was found that the total wastage was 6.06% in which the most occurring defects having the weightage of 3.97% and the remaining was because of the least occurring defects.

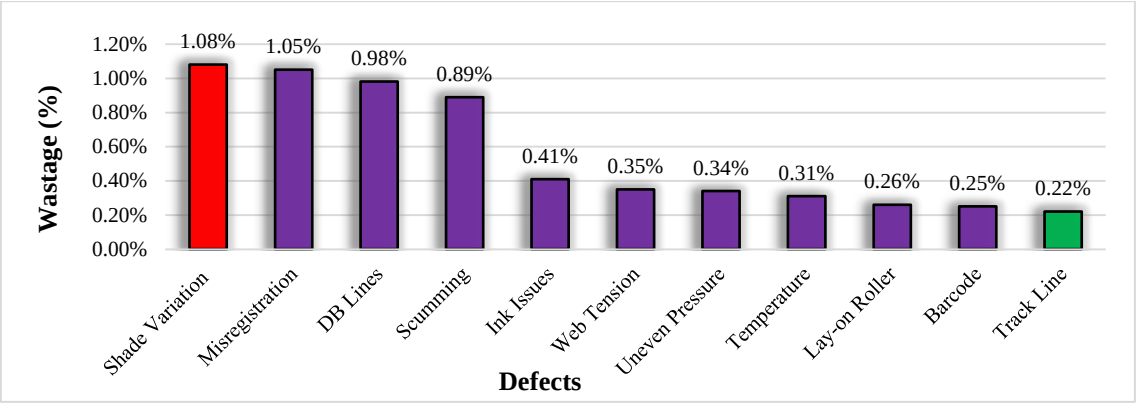

Figure 3. Printing defects and wastage analysis for Month-I

In figure 3, it is represented that shade variation (represented by red bar) have most impact on the total production (1.08%) and track line (represented by green bar) have least impact (0.22%). Four most occurring defects i.e., shade variation, misregistration, DB lines and scumming having the most percentage of the wastage i.e., 1.08%, 1.05%, 0.98% and 0.89% respectively, and the least occurring defects impact approximate 2.14% wastage on the total production.

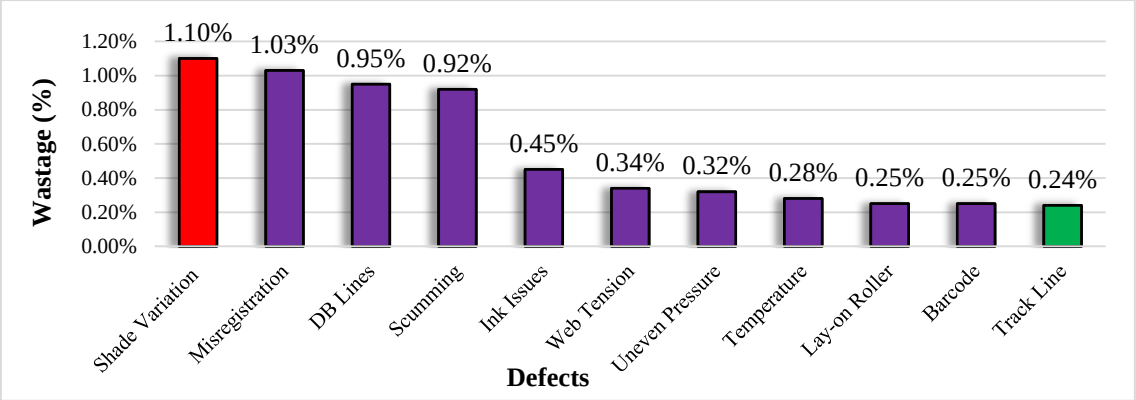

Figure 4. Printing defects and wastage analysis for Month-II

Figure 4 is the representation of the defects data for M-II (2nd month) had 31 days. In this month the highest wastage percentage because of shade variation i.e., 1.10% and the least wastage percentage was by track lines (0.24%). Every most occurring defect had wastage percentage approximately more than 0.85% and the least occurring defects had approximately less than 0.55%.

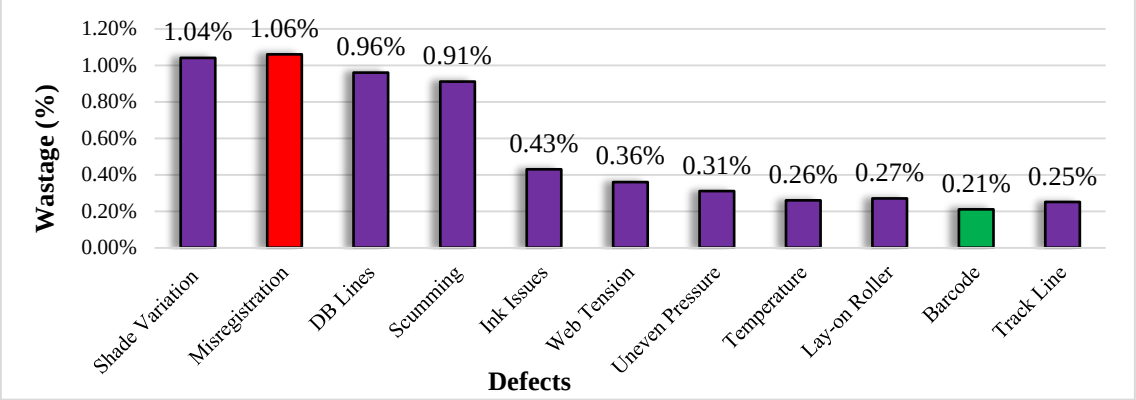

Figure 5. Printing defects and wastage analysis for Month-III

For the representation of M-III (3rd month) data there is figure 5, M-III had 30 days and the total production was done 207 Tones in which 12.54 tonnes was wastage which is approximately 6.06% of the total production. In this month the highest percentage of wastage was because of misregistration (represented by red bar) i.e., 1.06% and the lest percentage of wastage was by barcode (represented by green bar) i.e., 0.21% printing defect.

RESULTS & DISCUSSION

Various printing defects happening during the production become the reason for the higher wastage. During the defects data collection on Gravure printing press, it was found that the four defects are the most occurred during the production i.e., shade variation, misregistration, DB lines and scumming. In all three months the highest wastage percentage was just because of among of these defects. These four most occurring defects had approximately more than 60% of wastage weight. It was represented in table 1 that the shade variation was 1.08% in M-I, 1.10% and 1.04% was in the M-II and M-III

respectively. Same results were found with the misregistration, DB lines and scumming. The wastage percentage of these defects on the higher sides in each month.

Least occurred defects are the defects which are rarely happening during the production or had least impact on the total production. During the data collection on Gravure printing press for three months, it was found that ink issue, web tension, uneven pressure, temperature, lay-on roller, barcode and track line are the least occurred defects which are approximately less than 50% of the total wastage.

CONCLUSION

Some of the points which are concluded on the basis of the result and discussion;

1. The overall print wastage in gravure printing press was found 6.11% taken as average of three consecutive months.
2. Shade variation, misregistration, DB lines and scumming are found to be most frequently occurring defects in gravure printing press which resulted to approximately 4% wastage.
3. Ink issues, web tension, uneven pressure, temperature, lay-on roller, barcode, and track lines are found to be least frequently occurring defects in gravure printing press which resulted approximately 2.12% wastage.

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