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Prevention of Flap Opening after Pasting of Mono Carton: A Case Study of Kumar Printer's, Manesar.

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Abstract

This research study delves into the intricate process of transforming flat materials into finished products, particularly focusing on mono cartons such as boxes and envelopes. The critical aspect under investigation is the flap opening of these cartons and the multifaceted factors that influence it. Through a comprehensive examination of these influencing factors, a thorough understanding was gained, enabling the identification of viable remedies. The study further implemented these remedies within the production machinery, resulting in a noticeable and gradual reduction in flap-opening occurrences. This research contributes valuable insights and practical solutions to enhance the quality and functionality of mono-carton packaging.

***Keywords*:** Folding, Gluing, Carton, Folder-gluer, Cold glue, Hot-melt adhesive.

Introduction

Packaging stands as an indispensable facet of product presentation and preservation in contemporary commerce. Its role extends beyond mere containment, encompassing both protection and information dissemination, crucial for efficient material handling, storage, and transportation (Handbook of Packaging, 2005). Over time, the evolution of packaging has been profound, witnessed in the transition from handcrafted cartons fastened with tacks and string, primarily reserved for valuable items like jewelry in the 1840s, to the sophisticated processes and materials of the modern era.

One such pivotal advancement is the advent of folding and gluing technology, specifically applied to mono-carton manufacturing. Mono cartons, crucial components in the packaging industry, are crafted from flat blanks, which are then transformed into functional forms like tuck-in flaps, reverse tuck-in cartons, lock bottoms, and more (Printing Technology, Understanding Print Finishing Techniques, 2023, in GSASP). This transformation is orchestrated through a process involving meticulous folding along pre-creased lines and the strategic application of adhesives that bind the product into its final structural shape.

Understanding the adhesive aspect of mono-carton production is critical, as it significantly influences the functionality and integrity of the packaging. Adhesives, whether natural or synthetic, are fundamental in adhering to the flaps of the mono carton, ensuring its structural integrity and durability (Binding and Finishing, 2015). However, challenges arise during this process, manifesting as issues related to flap openings. This article undertakes a comprehensive exploration into the factors contributing to flap opening during and after the adhesive application process, aiming to identify root causes and effective remedies. By doing so, this research endeavors

to enhance the efficiency and effectiveness of mono-carton production, addressing a crucial aspect of modern packaging techniques.

Review Of Literature

Print finishing, encompassing various processes applied to materials post-printing, plays a significant role in enhancing the visual appeal and functionality of printed materials (Understanding Print Finishing Techniques, 2023, in GSASP). In particular, the folding and gluing process stands as a critical step in the transformation of flat materials into finished products like boxes, envelopes, and promotional items (Folding Gluing Process, 2023, BOBST). Achieved by folding along pre-creased lines and adhesive application, this process finds extensive application in the packaging industry, where it converts flat blanks into diverse box configurations (Folding Carton Production, 2023, In Jhonsbyrne).

The folding carton process, commencing after die-cutting and denotching, involves folding, pre-breaking, and gluing of the die-cut pieces (The Folding Carton Manufacturing Process, 2023, In Jhonsbyrne). However, tuning a folder-gluer is a craft-like task, not easily automated, demanding meticulous adjustments to achieve optimal production and consistency (What is Folder-Gluer Machine, 2023, In Impack). Challenges arise during tuning, often resulting in imperfectly folded or glued boxes, necessitating skilled workforce and automation integration (Folding Carton Production, 2023, In Post Pressmag).

The UV-based coating is emerging as a popular technique for achieving a smooth finish in carton-based packaging applications (Hitesh, G., Amit, K., Gaurav, S., Dhirender, 2017). However, the application of UV coating can hinder adhesive adhesion during side pasting, prompting the use of grinding mechanisms to enhance functionality and adhesion strength (Hitesh et al., 2017). This points to the need for exploring innovative approaches to maintain adhesion quality in the presence of modern finishing techniques. Furthermore, the use of adhesives in packaging is a critical aspect, with both natural and synthetic adhesives finding diverse applications in the industry (A. Emblem, 2012). Understanding their specific applications and market share provides valuable insights into the adhesive landscape within the packaging domain.

In summary, the existing literature underscores the importance of print finishing, particularly the folding and gluing process, in the packaging industry. It highlights the challenges associated with tuning folder-gluers and emphasizes the need for a skilled workforce and automation to overcome these challenges. Additionally, the emergence of UV-based coating necessitates innovative solutions to maintain adhesion quality, emphasizing the dynamic nature of the packaging industry and the evolving role of adhesives.

Research Problem

The traditional approach to folding and gluing in the packaging industry is characterized by repetitive procedures, resulting in challenges such as flap opening during or after the manufacturing process. Flap openings can compromise the structural integrity of the packaging and hinder overall efficiency. Understanding the diverse factors contributing to flap opening and identifying effective preventive methods are imperative for enhancing the functionality and reliability of packaging. Therefore, this research aims to investigate the underlying causes of flap opening during the folding and gluing process. Furthermore, it seeks to propose alternative approaches for folding and gluing, leveraging technological modifications and advancements. The central objective is to devise efficient methods that minimize flap opening occurrences and optimize the folding and gluing process for superior product packaging.

Research Objective

The objectives of this study are:

1. To find out various reasons for flap opening in mono cartons.
2. To provide the possible remedy for various reasons for flap opening.

Materials And Methodology

Through a daily study of various mono cartons running on different machines, this research aims to examine several key factors influencing flap opening. The study takes into account factors such as the types of adhesives used to adhere to the flap, the types of machines involved, and the methods used for different types of jobs. Additionally, it seeks to find the best possible remedy for addressing the root cause.

Table 1, Daily data collection carton rejections

S.NO.	PASTING TYPE	CARTON CATEGORY	MACHINE NAME	GLUE USED	Percentage of Rejection
1	SIDE PASTING	METPET JOB	EXPERT FOLD	FR156	3.00%
2	LOCK BTM	UV JOB	MEDIA 100	FR156	4.80%
3	SIDE PASTING	AQS JOB	ADGM	FR156	1.20%
4	LOCK BTM	UV JOB	AMAZON	FR156	4.80%
5	SIDE PASTING	LAMINATION JOB	MANUAL	PIDILITE 282	2.00%
6	SIDE PASTING	METPET JOB	EXPERT FOLD	FR156	4.00%
7	LOCK BTM	UV JOB	MEDIA 100	FR156	10.00%
8	SIDE PASTING	AQS JOB	ADGM	FR156	1.20%
9	LOCK BTM	ICE CREAM CARTON JOB	AMAZON	FR156	4.00%
10	SIDE PASTING	UV JOB	MANUAL	PIDILITE 282	5.00%
11	SIDE PASTING	METPET JOB	EXPERT FOLD	FR156	6.00%
12	LOCK BTM	UV JOB	MEDIA 100	FR156	4.00%
13	SIDE PASTING	AQS JOB	ADGM	FR156	2.00%
14	LOCK BTM	UV JOB	AMAZON	FR156	8.00%
15	SIDE PASTING	LAMINATION JOB	MANUAL	PIDILITE 282	6.00%
16	SIDE PASTING	METPET JOB	EXPERT FOLD	FR156	3.00%
17	LOCK BTM	UV JOB	MEDIA 100	FR156	8.00%
18	SIDE PASTING	AQS JOB	ADGM	FR156	4.00%
19	LOCK BTM	AQS JOB	AMAZON	FR156	6.00%
20	SIDE PASTING	LAMINATION JOB	MANUAL	PIDILITE 282	5.00%
21	SIDE PASTING	AQS JOB	ADGM	FR156	2.50%
22	LOCK BTM	ICE CREAM CARTON JOB	AMAZON	FR156	4.80%

23	SIDE PASTING	LAMINATION JOB	MANUAL	PIDILITE 282	5.00%
24	SIDE PASTING	METPET JOB	EXPERT FOLD	FR156	3.00%
25	LOCK BTM	UV JOB	MEDIA 100	FR156	5.00%

Data Collection And Analysis

Daily, data is collected through a comprehensive examination of each folder-gluer machine. This involves determining the most suitable type of machine for a particular job. Subsequently, an analysis is conducted on the adhesive utilized for flap pasting, considering the methodology of pasting, which can vary based on factors like job quantity, job type, and job size. The rejection data attributed to the flap opening is then recorded daily. Additionally, the research encompasses remedial analysis aimed at preventing flap opening, addressing each problem and its respective causes.

Adhesive Used and Its Application Methodology

During the daily analysis, it was observed that cold glue is used to adhere to the flap, whether in manual or machine-based pasting.

1. Folder gluer machine Adhesive-

For the folder-gluer machine, Chemitech FR-156 cold glue is utilized, which has a slightly lower viscosity compared to manual adhesive. Refer to the image below.

Figure 1, The image of the cold glue used by the folder-gluer machines

2. Adhesive for manual pasting -

For lower quantity jobs, manual pasting is done using Pidilite Fevicol 282, which has a higher viscosity compared to FR 156. It also requires manual pressure for proper application.

Figure 2, Manual carton flap pasting adhesive "Fevicol 282"

Table 2, Average Rejection Percentage of Glue Used

S. No.	Glue Used	Average Percentage of Rejection
1	FR 156	4.47%
2	PIDILITE 282	4.60%

Table 2 represents the average percentage of rejection of both glues i.e., FR 156 and Pidilite 282 and it was found that the average percentage of rejection in Pidilite was a little bit more (4.60%) when compared with the FR 156 (4.47%).

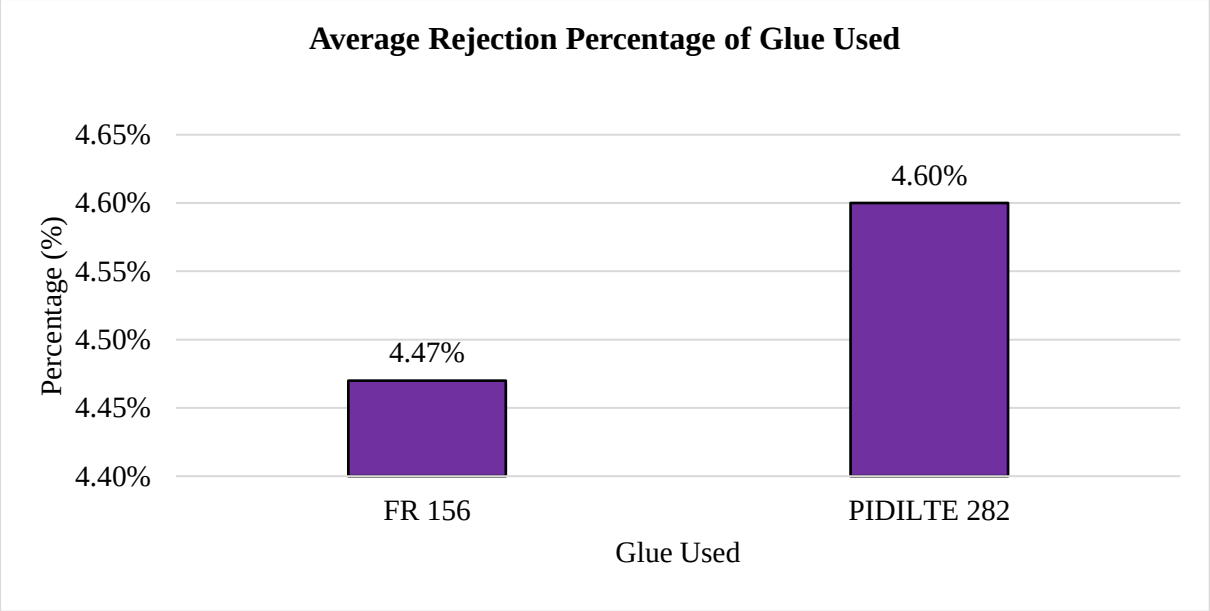

Figure 3, Comparative analysis of Average Rejection Percentage of Glue Used

Figure 3 shows a graphical representation of the average percentage of rejection of both glues (FR 156 and Pidilite 282) and it was clearly shown in Figure 3 that Pidilite 282 had more average percentage of rejection as compared with FR 156.

Viscosity data

Viscosity is resistance to the flow of liquid.

The ideal range of water-based glue is 35 to 40 poise while 25 to 30 is idle for Hot melt glue.

Table 3, Viscosity data for glue with various cartons

S.No.	Glue Used	Carton Type	Viscosity Range
1	Pidilite 282	Manual pasting carton	48 Poise
2	FR 152	Side pasting carton	30 Poise
3	Hot melt glue	Ice cream carton	25 Poise
4	FR 152	Metpet carton	35 Poise
5	Pidilite 282	Manual pasting carton	38 Poise

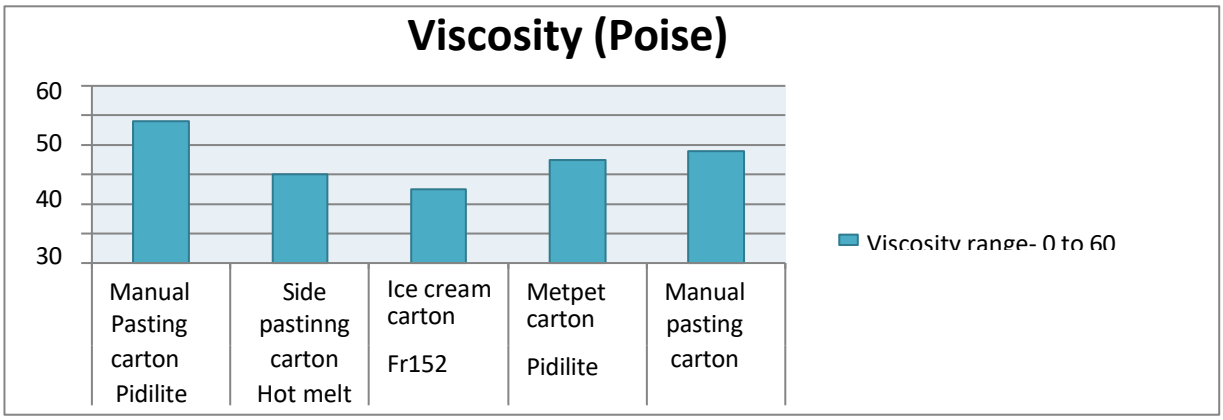

Figure 4, Viscosity data of different cartons and glue

Daily rejection data

The collected data indicates that, for analysis purposes, MetPET jobs are the most suitable. Additionally, it is noted that in UV jobs, the rejection rate is higher compared to non-UV jobs.

Figure 5, Percentage of carton rejection

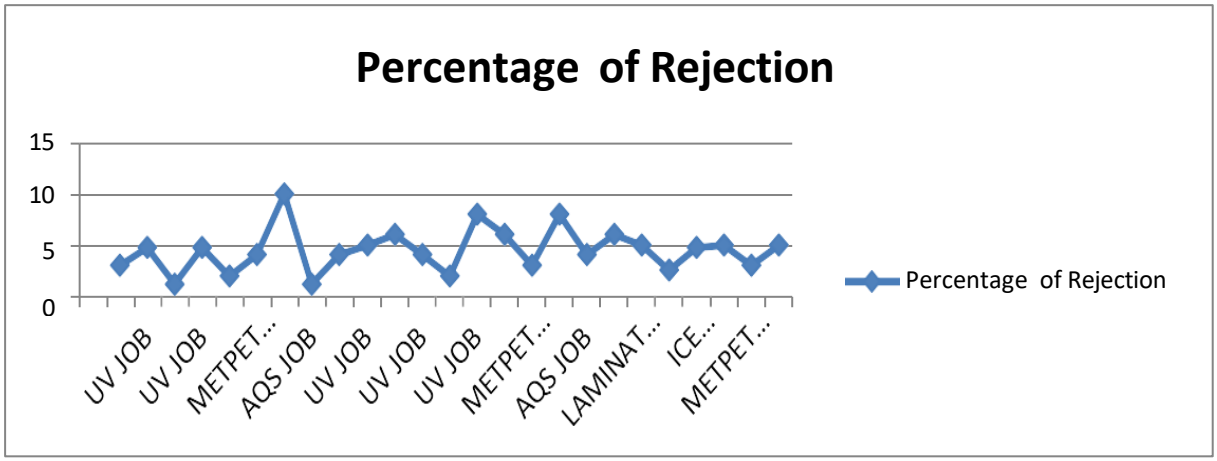

Table 4, Average Rejection Percentage of Pasting Type

S. No.	Pasting Type	Average Percentage of Rejection
1	Lock BTM	5.94%
2	Side Pasting	3.53%

Table 4 represents the average percentage of rejection of pasting types i.e., Lock BTM and Side Pasting. It was found that the Lock BTM had a higher average of rejection percentage (5.94%) as compared with Side Pasting (3.53%).

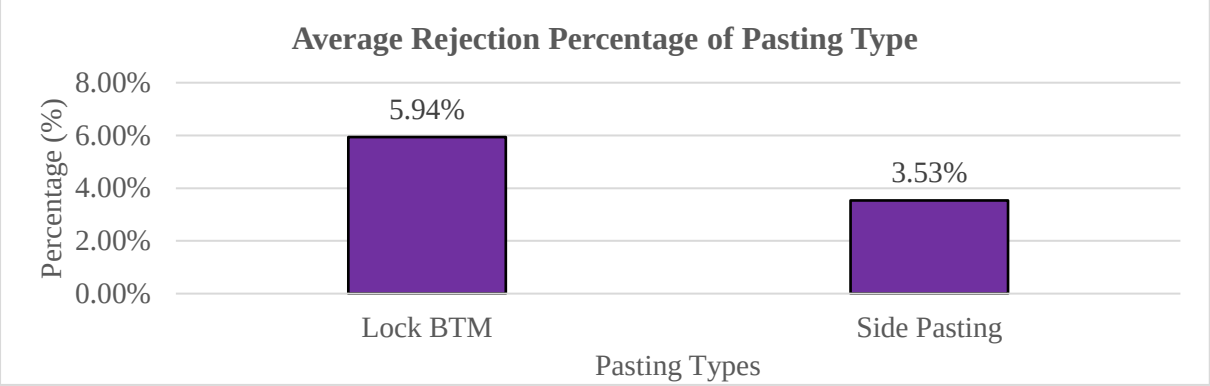

Figure 6, Comparative analysis of Average Rejection Percentage of Pasting Type

Figure 6 shows a graphical representation of the average percentage of rejection of Lock BTM and Side Pasting and it was represented in Figure 6 that Side Pasting had a lower average percentage of rejection than Lock BTM.

Table 5, Average Rejection Percentage of Cartons

S.No.	Carton Category	Average Percentage of Rejection
1	AQS Job	2.82%
2	Ice Cream Carton Job	4.40%
3	Lamination Job	4.50%
4	METPET Job	3.80%
5	UV Job	6.20%

Table 5 represents the average percentage of rejection based on the carton category used i.e., AQS Job, Ice Cream Carton Job, Lamination Job, METPET Job, and UV Job. It was found that the average percentage of rejection in UV Job was on the higher side i.e., 6.20%, and the average percentage of rejection in AQS Job was on the lower side i.e., 2.82%.

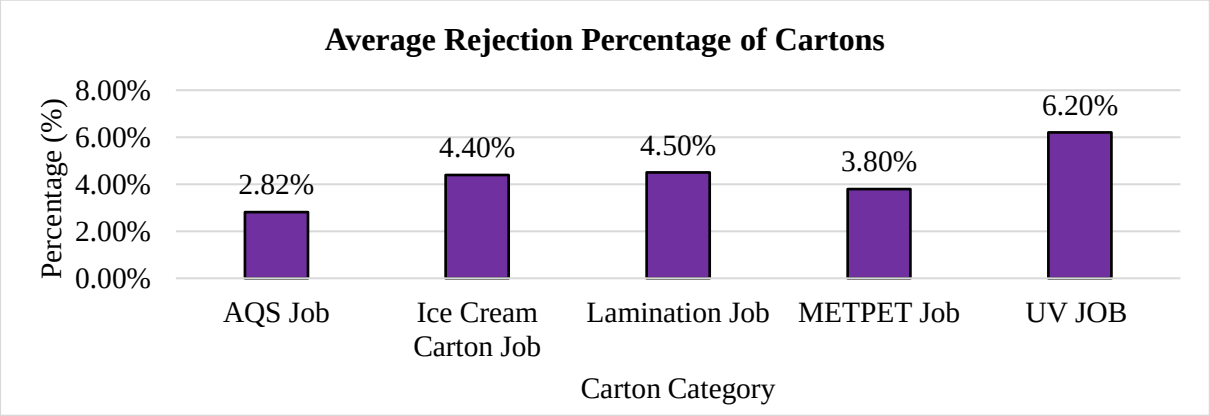

Figure 7, Comparative analysis of Average Rejection Percentage of Cartons

Figure 7, is a graphical representation of the Average Rejection Percentage based on Carton Category and it was shown in the representation that the ARP (Average Rejection Percentage) in the UV Job was on the higher side i.e., 6.20% on the other hand in the case of AQS Job the ARP was found on the lower side i.e., 2.82%.

A case study outlining specific problems

Table 6- Viscosity data for glue with various cartons

S. No.	Problem	Cause	Remedy	Result
1	Two or more cartons got stuck with each other	s glue was applied	ced the area of glue	Able to prevent flap opening of the mono carton
2	In-sufficient Pressure time	Insufficient pressure after glue application	Increased the pressure time in manual pasting jobs	Able to prevent flap opening of the mono carton
3	mproper fiber tear in laminated jobs	Plastic film comes between pasting flap and glue	started using plasma to burn out areas of lamination	Able to prevent flap opening of the mono carton
4	Pasting flaps got opened at the customer's end	ver solid content of glue	Changed the glue with higher solid content	Able to prevent flap opening of the mono carton
5	mproper fiber tear in laminated jobs	The coating comes between pasting the flap and glue	ted using grinder	Able to prevent flap opening of the mono carton
6	Improper bonding of pasting flaps and glue	ısing cold glue	started using hot melt glue, it's having 100% solid content	Able to prevent flap opening of the mono carton
7	om pasting flaps getting open	erforation depth	decreased the depth of perforation by correcting the die	Able to prevent flap opening of the mono carton
8	Bottom pasting flaps getting open	Extra Perforation depth	Increased the depth of perforation by correcting the die	Able to prevent flap opening of the mono carton

Glue Application

1. APPLICATION OF GLUE VIA MACHINE

Glue application on a machine for larger quantity jobs, including lock bottom pasting, side pasting, reverse tuck cartons, A-type carton pasting, as well as B-type carton pasting. The machine is capable of pasting 15,000 to 20,000 cartons per hour.

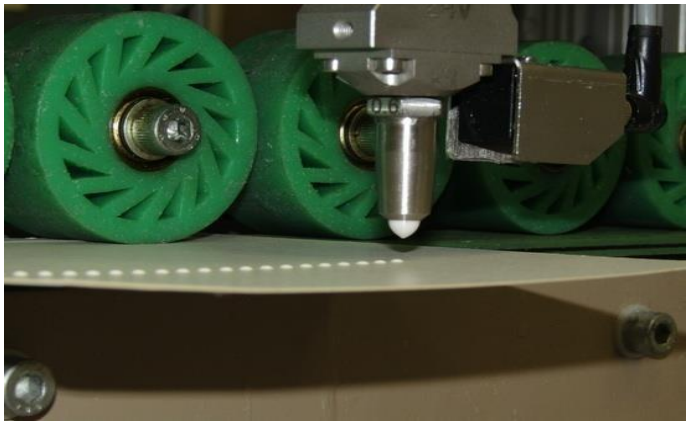

Figure 8, Adhesive application by glue gun

2. GLUE APPLICATION VIA MANUAL PASTING

For short-quantity jobs, especially those involving side pasting or larger-sized cartons that exceed the machine's capacity, most cartons are pasted manually. In this method, glue is applied manually using a bottle with a nozzle. After the glue application, the cartons should ideally be stacked on top of each other with a heavy weight for at least one hour. Following this, they are packed in a shipper for further dispatch.

Figure 9, Manual carton pasting

Table 7, Average Rejection Percentage of Machine Type

S.No.	Machine Name	Average Percentage of Rejection
1	ADGM	2.18%
2	AMAZON	5.52%
3	EXPERT FOLD	3.80%
4	MANUAL	4.60%
5	MEDIA 100	6.36%

Table 7 represents the average percentage of rejection based on types of Machines i.e., ADGM, AMAZON, EXPERT FOLD, MANUAL, and MEDIA 100. It was found that the average percentage of rejection in MEDIA

100 was on the higher side i.e., 6.36%, and the average percentage of rejection in ADGM was on the lower side i.e., 2.18%.

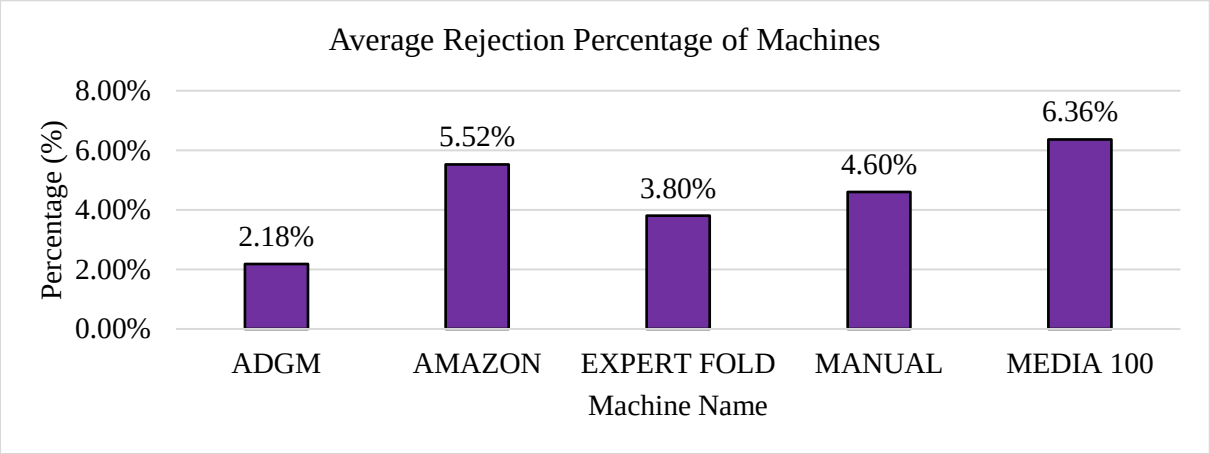

Figure 10, Comparative analysis of Average Rejection Percentage of Machine Type

Figure 9, is a graphical representation of the Average Rejection Percentage based on machine type and it was shown in the representation that the ARP (Average Rejection Percentage) in the MEDIA 100 was on the higher side i.e., 6.36% and after MEDIA 100 at the second highest ARP was in AMAZON i.e., 5.52% on the other hand in the case of ADGM the ARP was found on the lower side i.e., 2.18%.

Results & Discussion

The opening of the pasting flap presents a significant challenge for mono-carton manufacturers, impacting customer expectations, manufacturer profits, committed delivery schedules, and incurring costs and time associated with rework. This research focused on understanding the factors influencing this challenge and identifying effective strategies to mitigate its impact on packaging quality and efficiency.

Research findings underscore the critical role of various factors in pasting flap integrity. The application of glue over a larger area was identified as a key factor contributing to flap opening, often resulting in the unwanted adherence of two cartons. This observation highlighted the necessity of optimizing the glue application process to avoid excess glue.

Furthermore, in the context of manual pasting during pre-dispatch inspection, it was evident that the provided dry time of 30 minutes was insufficient. This revelation emphasized the need for an extended dry time, ensuring the glue sets effectively, thereby preventing flap opening during inspection. For MetPET jobs, achieving proper fiber tear was a persistent challenge due to overlapping lamination on the pasting flap. This issue was particularly prevalent, resulting in significant flap openings, especially in lamination jobs. Implementing plasma technology proved highly effective, ensuring 100% fiber tear by eliminating excess lamination.

Intriguingly, even in non-laminated jobs, achieving 100% fiber tear remained a challenge. Introducing the use of a grinder, equipped with an abrasive outer surface, enhanced the accuracy of fiber tear by removing excess fiber from the pasting flap.

Moreover, the depth of perforation was identified as a critical factor affecting flap opening.

Striking a delicate balance by ensuring the perforation depth was neither too deep nor too shallow proved crucial in preventing flap opening during production.

In conclusion, this research highlights the multi-faceted nature of the pasting flap challenge in mono-carton manufacturing. The identified factors and implemented remedies underscore the importance of precision and adaptability in manufacturing processes. Tailoring solutions to job-specific requirements and optimizing glue application, dry time, fiber tear, and perforation depth are key to achieving superior pasting flap integrity,

ultimately enhancing the overall quality and efficiency of mono-carton packaging. These insights serve as a valuable foundation for advancing the field and addressing the challenges faced by the industry.

Conclusion & Recommendations

In this study, we delved into the factors influencing the opening of pasting flaps on various types of cartons in the mono-carton industry. These factors encompassed the carton types, including lock bottom, side pasting, false cavity, reverse tuck, self-lock, A-Type, and B-Type cartons, as well as the pre-operations such as coating, post-lamination, and pre-lamination. The choice of glue with adequate solid content was also identified as a critical factor impacting flap prevention. Moreover, online operations like Braille embossing were observed to influence flap opening.

Based on our research, maintaining an ideal glue area, approximately 2.5mm from both sides, emerged as a crucial practice to prevent flap opening. Additionally, allowing a drying time of 45 minutes after manual glue application before packing was found to be effective. When employing a folder gluer for carton pasting, the automatic application of sufficient pressure through a pressure belt was identified as a valuable practice.

Our study strongly advocates achieving 100% fiber tear to prevent flap opening. This can be accomplished by incorporating external accessories like plasma in lamination jobs and grinders in non-lamination jobs. Furthermore, ensuring the proper perforation depth is vital, as even slight variations can lead to significant flap opening issues, spanning from machine operation to pre-dispatch inspection.

In the broader context of the mono-carton industry, addressing the challenging problem of flap opening requires strategic decisions by manufacturers. Choosing appropriate machines for folding and gluing operations tailored to the processes their cartons undergo is of paramount importance. To thrive in this competitive market, manufacturers should proactively embrace innovative methodologies, invest in cutting-edge technology and enhanced infrastructure, and stay informed and adaptable to the latest industry trends. Through these concerted efforts, the prevention of flap opening in mono cartons can be effectively achieved, significantly enhancing the industry's overall efficiency and customer satisfaction.

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