Section A-Research paper
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Minimizing the Paper Wastage in Multi-colour Sheet-Fed Offset Printing Presses through Use of Varying Degrees of Press Automation

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Abstract

Offset printing is one of the widely used and accepted forms of printing in the whole printing industry. Conventional sheet fed offset printing technology has undergone drastic modifications and continues to evolve for enhancing the press speed of operation and optimizing print productivity. In the recent years, innovative practices are being adopted by the sheet fed offset press manufacturers towards reducing the press make-ready time, reducing wastages, and producing environmentally sustainable printing output. Besides the press configuration and operational procedures, printing substrate is a major component in the printing production systems.

Paper is one of the major printing substrates for the sheet fed offset press, as because of numerous benefits being offered by paper in comparison to the other available printing substrate. Due to its excellent surface characteristics and properties, it offers a better ink and substrate interaction for producing high quality printing output. Possible reduction of paper waste during the printing production cycle is highly crucial. Press automation has a big role to play, while discussing the paper wastage in multi-colour sheet fed offset press. In this research paper, the possible impact of press automation on the paper wastage in multi-colour sheet fed offset press is studied and analysed thoroughly.

Keywords

Offset press, Sheet fed offset, Paper, Wastage reduction, Press automation, Press set-up, Production cycle.

Introduction

Printing has a very unique, rich and long history and all the milestones on its journey have helped printing to evolve and grow with time (Prepressure, 2012). Printing is not a new concept, for thousands of years it has existed in various forms like; signet rings, seals by royal family and various designed punches being used by the goldsmiths and silversmiths. It has evolved with time and it came out each time with added features and facilities to cater a wide array of needs and requirements of the print end-users (Forrester, 2020). Printing has been playing a major role towards developing the human civilization in the form of favourite and effective form of mass communication and disseminating knowledge and information (Deshpande, 2011).

Although, invention of paper was centred around giving a momentum to writing and reading, but in the recent years packaging accounts for more than 41 percent applications of all global paper use. Packaging is one of the fastest growing fields in the recent times, and from the sustainability front, it is the need of the hour to shift towards paper-based packaging applications (Beckline et al., 2016).

When it comes to the printing substrates, paper is ranked one, as because of potential benefits it offers in comparison to other similar substrates. It is available in a wide variety of sizes, colours, thicknesses, basis weights, and surface and strength properties, to take care of the operational and process requirements of different printing processes. Due to the above characteristics, paper and paper-based substrates are highly suitable for printing of a wide range of printing products (Kew, 2018). The paper which is meant for printing, the surface and strength properties needs to be controlled critically as per the basic principles of the particular printing technique (Graphic Arts Collection, 2016).

After the World War-II, the market share of offset printing was around 50 percent, but gradually the market share is being replaced by other printing techniques like; gravure, flexography, screen and Different digital printing techniques (Offset printing technology, 2019).In order to take care of possible challenges posed by the digital printing, the new generation offset presses are equipped with advanced level technology and moreover, these machines are capable of handling the above challenges very effectively (Offset printing technology, 2019).

Some of the potential advantages of offset printing can be summarized as; high-end printing quality, simpler and fast method of preparation of offset plates with low/minimum use of processing chemicals, unit cost of printing is low especially in long run print jobs, longer plate life and high level of press productivity (Wikipedia, 2022).

Review of Literature

As per, Research and Markets, 2020, in 2019, the value of global commercial printing market was valued at USD 400.46 billion and is projected to touch USD 460.28 billion by 2025, with a compounded annual growth rate of 2.24 percent during the 2020-2025 assessment periods. There will be remarkable growth of commercial printing sector in the coming years, because of technological advancements and adoption process into the press environment is getting increased over the period of time. This will help to accelerate the demand of sheet fed offset presses with high level of press automation in coming years.

As per the author, Uribe, 2008, as most of the printing companies are either small or medium in nature, due to capital and resource constraints, it is not possible them to install modern automatic machines and equipment along with standardized work culture. For them to be in the marketplace means a lot and they should fine tune their work environment with focus on small changes in the work-culture to be productive.

As per the author, Subramaniam et al., 2014, press automation has certainly encouraged and helped the printing presses to handle and execute a wide variety of printing jobs, reacting and responding to the changing demands and requirements of the prospective consumers and moreover staying very much competitive in the printing market place.

Research Objective

Sheet fed offset printing technology has been successfully used in the printing market place since a long time and the growth and development of this particular printing segment is quite convincing. Sheet fed offset is characterized by its phenomenal printing quality and accommodating a wide range of printing substrates for printing endues applications. Over the years, it has established itself in the worldwide printing market and moreover it is a mature printing process catering a wide spectrum of printing applications staring from commercial, packaging, and security to specialized areas.

Paper is one of the major printing substrates for the sheet fed offset press applications and it constituted 50-60 percent of the final cost of print production. Paper being a major component of the printing output, special care must be observed to minimizing the possible wastage during the printing cycle, so that possible post of production can be lowered down.

The main aim of any printing process is to reduce the cost of production for maximizing the profit margin. Press automation is one of the major concerns for the sheet fed offset printing and over the last few decades, the sheet fed offset press manufacturers are putting utmost attention to produce multi-colour sheet fed offset presses with high levels of press automation for minimizing the press make-ready time and reduction of wastage during the press set-up and production cycle. The basic aim and objective of this research work is to find out the effect of press automation towards the paper wastage in a multi-colour sheet fed offset presses.

Research Methodology

In this research work, three multi-colour sheet fed offset presses; Machine-I (M-I), Machine-II (M-II) and Machine-III (M-III) were identified and selected with six colour printing units and having press speed of 15000, 15000 and 13000 sheets per hour respectively and they are equipped with high level to medium to low level of press automation. Day to day production data were collected with the job order quantity and the actual printed sheets for calculating the paper wastage being incurred during the particular job production. The job order quantities were categorized into, till 5000 job order quantity, job order quantity from 5001 to 10,000, job order quantity from 10,001 to 20,000, job order quantity from 20,001 to 50,000, and the job order quantity more than 50,000 for the research purpose.

Data collection & Analysis

Three machines namely, M-I, M-II and M-III were taken into consideration with different levels of technology included in to these presses for the print production process. Day to day basis production data of these three presses were collected for twelve months of all the above three presses, in suitable tables and are presented in various tables and graphs for further processing of data for the research purpose. Machine-I is equipped with 15000 SPH (Sheets per Hour), Machine-II with 15000 SPH and Machine-III with 13000 SPH.

Fig. 1 represents the paper wastage of Machine-I for the print jobs quantities till 5000. With 15 jobs falling under this particular print bracket indicates that the percentage of paper

wastage varies from 1.60 to 4.20 and the low percentage is attributed to the high level of press automation, which helps the press to save precious paper wastage during the printing cycle. Fig. 2 represents the paper wastage of Machine-I for the print jobs quantities in-between 5001 to 10,000. With 20 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 1.67 to 2.75 and the low percentage is attributed to the high level of press automation, which helps the press to save precious paper wastage during the printing cycle.

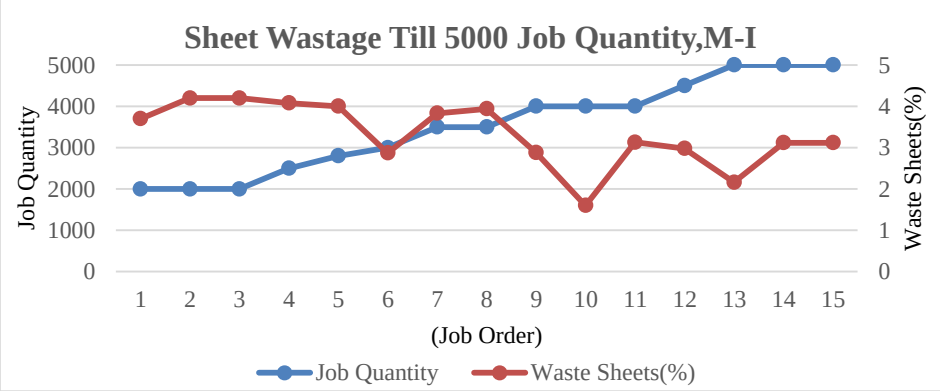

Fig. 1, Paper wastage of M-I with job quantities till 5000

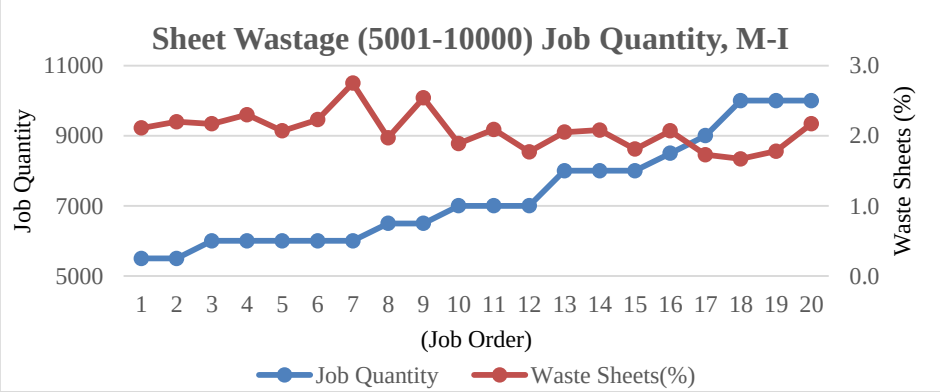

Fig. 2, Paper wastage of M-I with job quantities from 5001 to 10,000

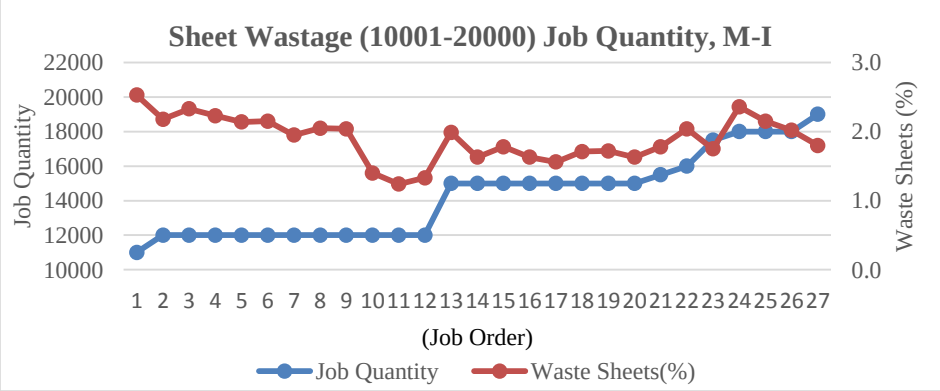

Fig. 3, Paper wastage of M-I with job quantities from 10,001 to 20,000

Fig. 3 represents the paper wastage of Machine-I for the print jobs quantities in-between 10,001 to 20,000. With 27 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 1.24 to 2.53 and the low percentage is attributed to the high level of press automation, which helps the press to save precious paper wastage during the printing cycle.

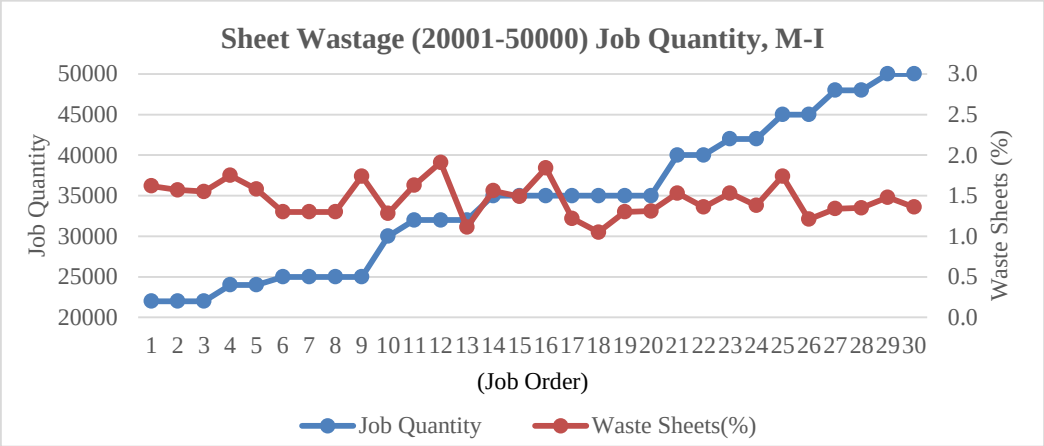

Fig. 4, Paper wastage of M-I with job quantities from 20001 to 50,000

Fig. 4 represents the paper wastage of Machine-I for the print jobs quantities in-between 20,001 to 50,000. With 30 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 1.05 to 1.91 and the low percentage is attributed to the high level of press automation, which helps the press to save precious paper wastage during the printing cycle. Fig. 5 represents the paper wastage of Machine-I for the print jobs quantities above 50,000. With 8 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 1.12 to 1.72 and the low percentage is attributed to the high level of press automation, which helps the press to save precious paper wastage during the printing cycle.

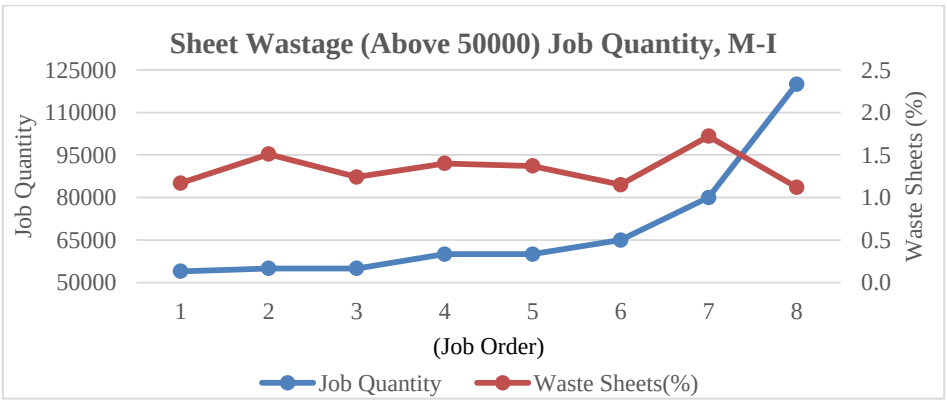

Fig. 5, Paper wastage of M-I with job quantities above 50,000

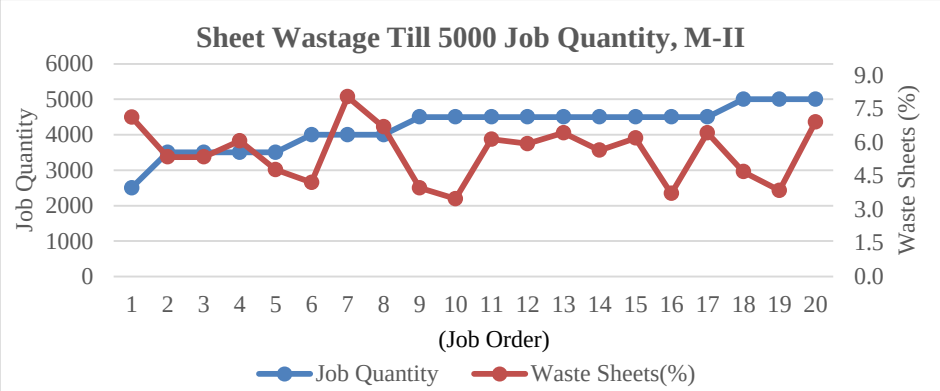

Fig. 6, Paper wastage of M-II with job quantities till 5000

Fig. 6 represents the paper wastage of Machine-II for the print jobs quantities till 5000. With 20 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 3.47 to 8.03 and the moderate percentage is attributed to the medium level of press automation, which helps the press to save precious paper wastage during the printing cycle.

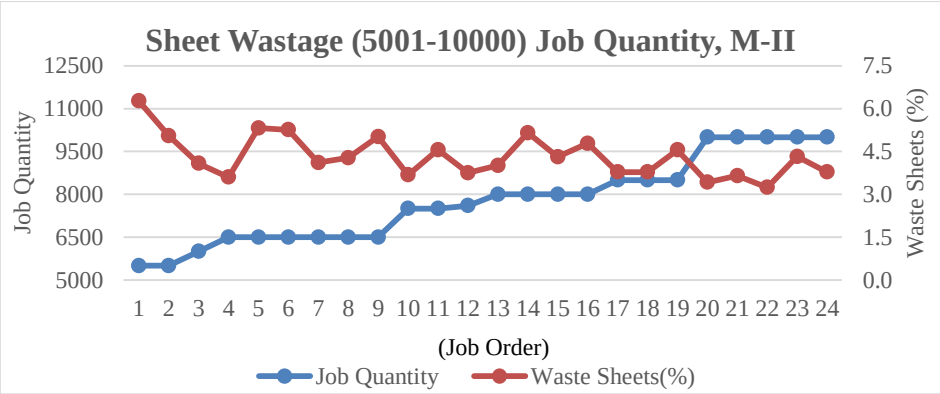

Fig. 7, Paper wastage of M-II with job quantities from 5001 to 10,000

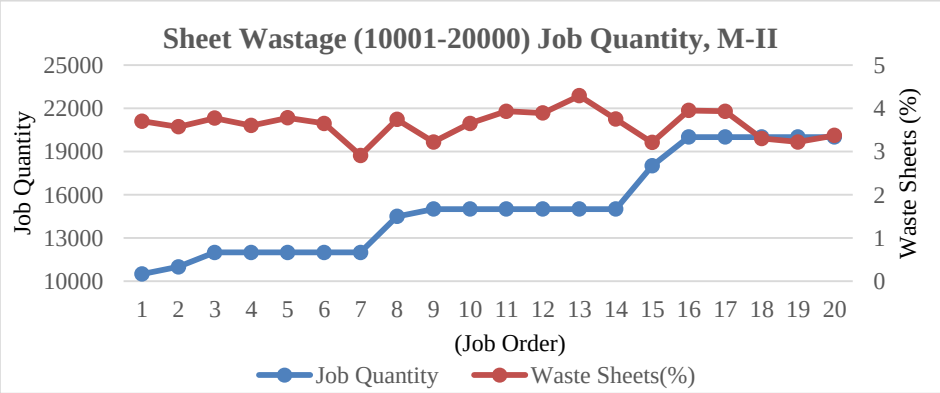

Fig. 8, Paper wastage of M-II with job quantities from 10,001 to 20,000

Fig. 7 represents the paper wastage of Machine-II for the print jobs quantities in-between 5001 to 10,000. With 24 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 3.24 to 6.27 and the moderate percentage is attributed to the medium level of press automation, which helps the press to save precious paper wastage during the printing cycle.

Fig. 8 represents the paper wastage of Machine-II for the print jobs quantities in-between 10,001 to 20,000. With 20 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 2.91 to 4.29 and the moderate percentage is attributed to the medium level of press automation, which helps the press to save precious paper wastage during the printing cycle. Fig. 9 represents the paper wastage of Machine-II for the print jobs quantities in-between 20,001 to 50,000. With 25 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 2.73 to 4.25 and the moderate percentage is attributed to the medium level of press automation, which helps the press to save precious paper wastage during the printing cycle.

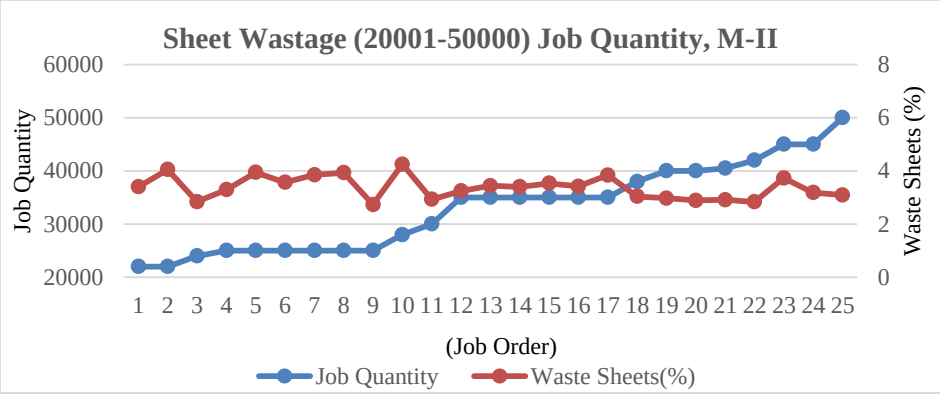

Fig. 9, Paper wastage of M-II with job quantities from 20,001 to 50,000

Fig.10 represents the paper wastage of Machine-II for the print jobs quantities above 50,000. With 11 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 2.20 to 3.23 and the moderate percentage is attributed to the medium level of press automation, which helps the press to save precious paper wastage during the printing cycle. Fig. 11 represents the paper wastage of Machine-III for the print jobs quantities till 5000. With 29 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 5.86 to 12.15 and the high percentage is attributed to the low level of press automation.

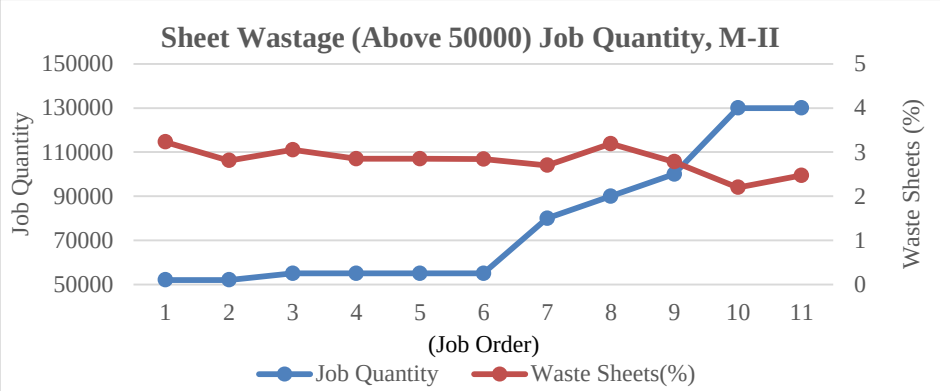

Fig. 10, Paper wastage of M-II with job quantities above 50,000

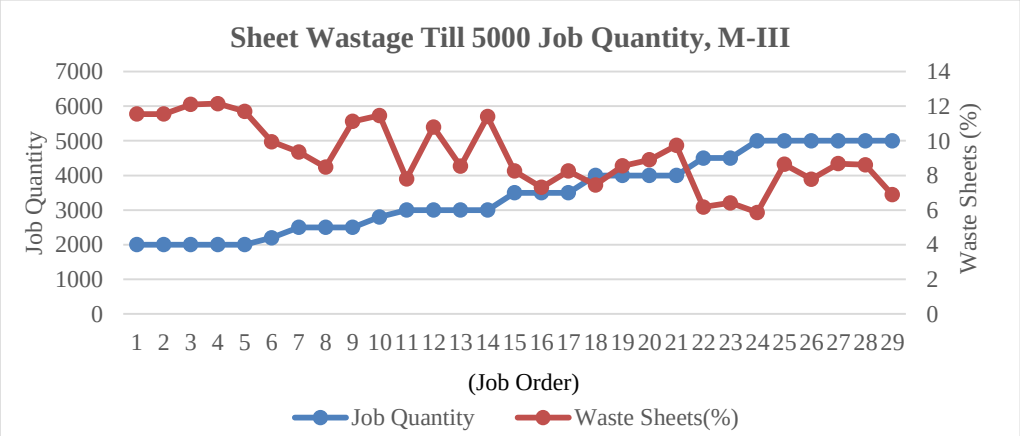

Fig. 11, Paper wastage of M-III with job quantities till 5000

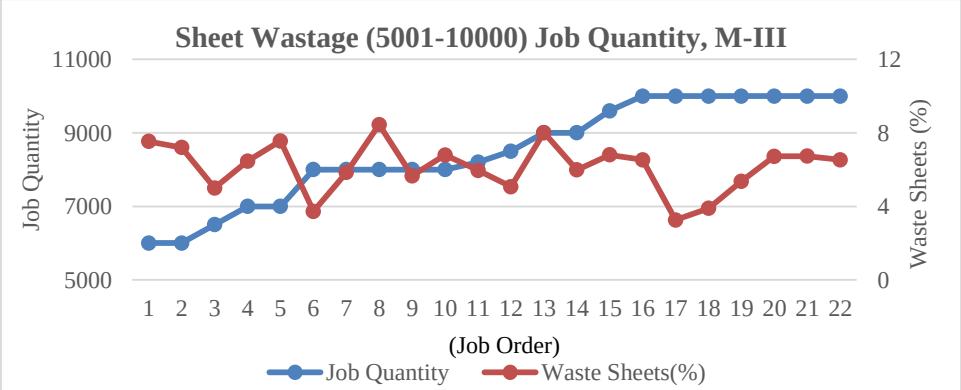

Fig. 12, Paper wastage of M-III with job quantities from 5001 to 10,000

Fig. 12 represents the paper wastage of Machine-III for the print jobs quantities in-between 5001 to 10,000. With 22 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 3.26 to 8.45 and the high percentage is attributed to the low level of press automation, which helps the press to save precious paper wastage during the printing cycle.

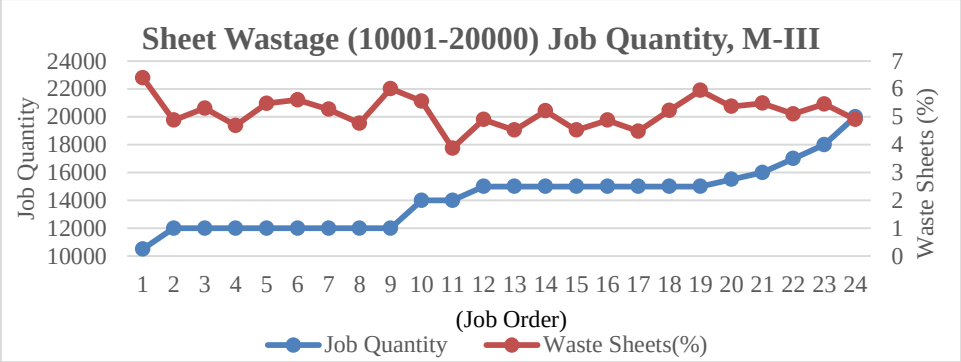

Fig. 13, Paper wastage of M-III with job quantities from 10,001 to 20,000

Fig. 13 represents the paper wastage of Machine-III for the print jobs quantities in-between 10,001 to 20,000. With 24 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 3.87 to 6.40 and the high percentage is attributed to the low level of press automation, which helps the press to save precious paper wastage during the printing cycle.

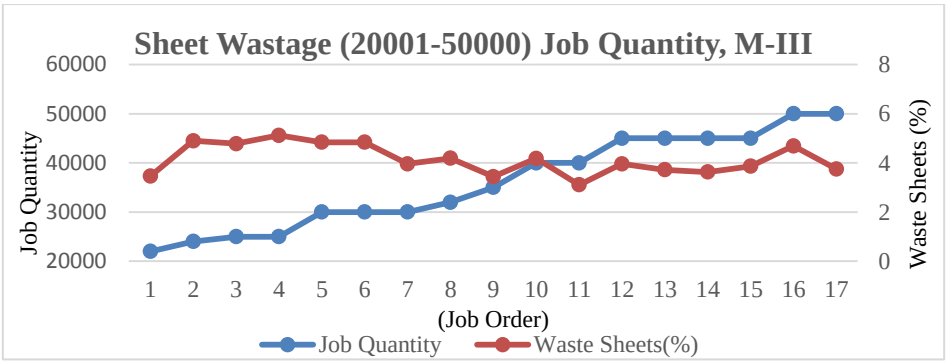

Fig. 14, Paper wastage of M-II with job quantities from 20,001 to 50,000

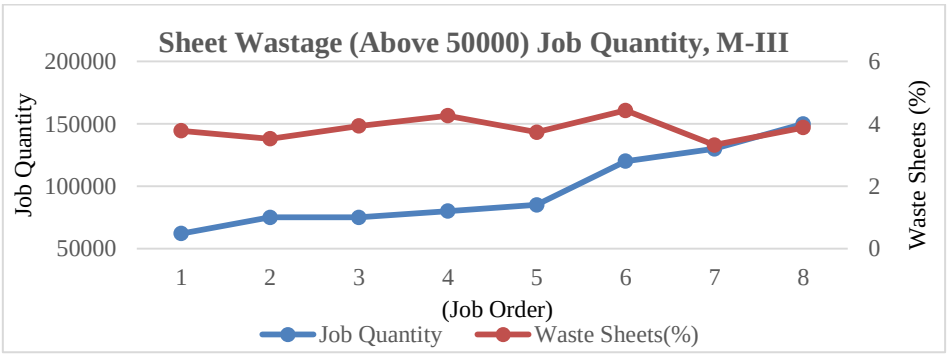

Fig. 15, Paper wastage of M-II with job quantities above 50,000

Fig. 14 represents the paper wastage of Machine-III for the print jobs quantities in-between 20,001 to 50,000. With 17 jobs falling under this particular print bracket indicates that the

percentage of paper wastage varies from 3.11 to 5.12 and the high percentage is attributed to the low level of press automation, which helps the press to save precious paper wastage during the printing cycle.

Fig.15 represents the paper wastage of Machine-III for the print jobs quantities above 50,000. With 8 jobs falling under this particular print bracket indicates that the percentage of paper wastage varies from 3.32 to 4.43 and the high percentage is attributed to the low level of press automation, which helps the press to save precious paper wastage during the printing cycle.

Table 1, Average Paper Wastage of M-I, M-II & M-III

Job Order Quantity	M-I	M-II	M-III
5000	3.32	5.54	9.15
5001-10000	2.07	4.32	6.14
10001-20000	1.89	3.62	5.16
20001-50000	1.46	3.37	4.14
Above 50000	1.34	2.82	3.86

Table 1, represents average paper wastage of Machine-I, Machine-II and Machine-III respectively for the various print run job quantities. The table clearly indicates that, press automation has a bigger role to play when the paper wastage is concerned for the particular print job in hand.

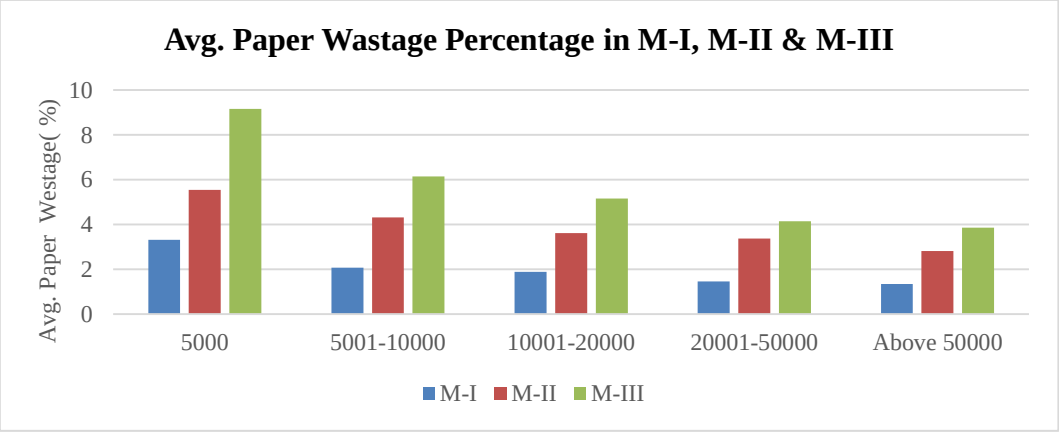

Fig. 16, Average Paper wastage percentage of M-I, M-II & M-III

Fig. 16 represents the average paper wastage of Machine-I, Machine-II and Machine-III respectively. Machine-I, that indicates low level of paper wastage for all the five brackets of

the print job order quantity, followed by Machine-II with moderate paper wastage and Machine-III with high average paper wastage percentage. From the above graph, it is observed that press automation plays a major role towards the final average paper wastage percentage of the particular multi-colour sheet fed offset press.

Results & Discussion

From the five job order quantity brackets for the machine-I, it clearly indicates that job order quantity plays a major role towards the paper wastage percentage for the particular offset printing press. In the recent times, higher emphasis is given to reduce the paper wastage percentage to the lowest level as possible, so that the final cost of the print job can be lowered to result into higher profit margins. This particular machine indicates the machine performs better when the job order quantity is above 10,000 and the average paper wastage is below two percent, which is certainly a very good sign.

From the five job order quantity brackets for the machine-II, it clearly indicates that job order quantity plays a major role towards the paper wastage percentage for the particular offset press. Wastage reduction needs utmost attention for any printing press and in the recent times high cost associated with the multi-colour sheet fed offset presses clearly demands to save money from the possible means of minimizing paper wastage during the print production cycle. This particular machine indicates the machine performs better when the job order quantity is above 10,000 and the average paper wastage is slightly more than three percent, which is certainly a very good sign.

From the five job order quantity brackets for the machine-III, it clearly indicates that job order quantity plays a major role towards the paper wastage percentage for the particular offset press. Ultimate goal of any sheet fed offset press is to print a particular job with less wastage of paper, so that more profit can be generated. This particular machine indicates the machine performs better when the job order quantity is above 20,000 and the average paper wastage is around four percent, which is certainly a very good sign.

For the Machine-I, that represent the multi-colour sheet fed offset press with high level of press automation in-comparison with the other two presses results into low paper wastage percentage in all the five print run brackets. Especially after the 5000-print run length, the average paper wastage falls in the range of 2.07 to 1.34 percent. The average paper wastage percentage is continuously getting reduced with the increase of the print run bracket.

For the Machine-II, which represents the multi-colour sheet fed offset press with medium level of press automation in-comparison with the other two presses results into moderate paper wastage percentage in all the five print run brackets. Especially after the 10,000-print run length, the average paper wastage falls in the range of 3.62 to 2.82 percent. The average paper wastage percentage is continuously getting reduced with the increase of the print run bracket.

For the Machine-III, which represents the multi-colour sheet fed offset press with low level of press automation in-comparison with the other two presses results into high paper wastage percentage in all the five print run brackets. Especially after the 20,000-print run length, the average paper wastage falls in the range of 4.14 to 3.86 percent. The average paper wastage percentage is continuously getting reduced with the increase of the print run bracket.

Conclusion

Optimum utilization of the resources is the basic aim of any manufacturing industry for its survival, growth, and development in the marketplace. Printing industry is a very complex natured industry, where the essential growth and continuity is highly dependent upon numerous factors. One of the possible factors in multi-colour sheet fed offset press is the optimum utilization of papers for printing the particular job in hand. Being one of the major components of the printing, minimization of paper wastage during press make-ready and printing cycle is highly crucial. Press automation of varying degree is highly important for the reduction of paper wastage for any printing job.

From the three multi-colour sheet fed offset presses taken into account with varying degree of press automation, it is highly visible that, Machine-I, with highest level of press automation in comparison with the Machine-II and Machine-III, results into lowest levels of paper wastage. Machine-II with medium level of press automation, is contributing moderate paper wastage and the Machine-III with low level of press automation is contributing highest levels of paper wastage. This clearly indicates that, the degree of press automation has a bigger role to play when it comes to minimizing the paper waste in multi-colour sheet fed offset presses. Care must be given to select sheet fed offset press with high level of press automation, so that paper waste can be minimized to the lowest possible level for resource savings and maximizing profit margins.

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