

Efficiency in Sheet-Fed Offset Printing: Strategies for Reducing Substrate Consumption

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ABSTRACT

Sheet-fed litho is commonly used for printing of short-run magazines, brochures, letter headings, and general commercial (jobbing) printing. In sheet-fed offset, "the printing is carried out on single sheets of paper as they are fed to the press one at a time". Sheet-fed presses use mechanical registration to relate each sheet to one another to ensure that they are reproduced with the same imagery in the same position on every sheet running through the press. Different types of printing substrates we can use in sheet-fed offset printing for production. Coated, Un-coated & Polypropylene (PP) substrates are considered during our research work.

Aim of this study is to reduce the consumption and influence of printing substrates with the optimum utilization of printing substrates and explore the possible ways of optimum consumption of the printing substrates used in different sheet offset presses for different type of jobs. In this different type of printing substrates is study which are used in printing industries, different jobs of the "Akriti Printer" Noida" were taken into consideration. During project work jobs consuming moderate type of printing substrates were selected and the study was conducted on each selected job.

Keywords: *Sheet-fed Offset Process, Printing Substrate, Wastage Reduction*

I. INTRODUCTION

Offset Printing

It is a commonly used printing technique in which the inked image is transferred (or "offset") from a plate to a rubber blanket, then to the printing surface. When used in combination with the lithographic process, which is based on the repulsion of oil and water, the offset technique employs a flat (Plano graphic) image carrier on which the image to be printed obtains ink from ink rollers, while the non-printing area attracts a water-based film (called "fountain solution"), keeping the non-printing areas ink-free. The modern "web" process feeds a large reel of paper through a large press machine in several parts, typically for several meters, which then prints continuously as the paper is fed through.

Development of the offset press came in two versions: in 1875 by Robert Barclay of England for printing on tin and in 1904 by Ira Washington Rubel of the United States for printing on paper

Modern Offset Printing

One of the most important functions in the printing process is prepress production. This stage makes sure that all files are correctly processed in preparation for printing. This includes converting to the proper CMYK color model, finalizing the files, and creating plates for each color of the job to be run on the press. Offset lithography is one of the most common ways of creating printed materials. A few of its common applications include: newspapers, magazines, brochures, stationery, and books. Compared to other printing methods, offset printing is best suited for economically producing large volumes of high quality prints in a manner that requires little maintenance. Many modern offset presses use computer-to-plate systems as opposed to the older computer-to-film work flows, which further increases their quality.

Advantages of offset printing compared to other printing methods include

- Consistent high image quality. Offset printing produces sharp and clean images and type more easily than, for example, letterpress printing; this is because the rubber blanket conforms to the texture of the printing surface;
- Quick and easy production of printing plates; longer printing plate life than on direct litho presses because there is no direct contact between the plate and the printing surface. Properly developed plates used with optimized inks and fountain solution may achieve run lengths of more than a million impressions; cost. Offset printing is the cheapest method for producing high quality prints in commercial printing quantities;

- Ability to adjust the amount of ink on the fountain roller with screw keys. Most commonly, a metal blade controls the amount of ink transferred from the ink trough to the fountain roller. By adjusting the screws, the operator alters the gap between the blade and the fountain roller, increasing or decreasing the amount of ink applied to the roller in certain areas. This consequently modifies the density of the colour in the respective area of the image. On older machines one adjusts the screws manually, but on modern machines the screw keys are operated electronically by the printer controlling the machine, enabling a much more precise result.

Disadvantages of offset printing compared to other printing methods include

- slightly inferior image quality compared to rotogravure or photogravure printing;
- propensity for anodized aluminum printing plates to become sensitive (due to chemical oxidation) and print in non-image-background areas when developed plates are not cared for properly;
- Time and cost associated with producing plates and printing press setup. As a result, very small quantity printing jobs may now use digital offset machines.
- Every printing technology has its own identifying marks, as does offset printing. In text reproduction, the type edges are sharp and have clear outlines. The paper surrounding the ink dots is usually unprinted. The halftone dots are always hexagonal though there are different screening methods.

II. SHEET-FED OFFSET

Sheet-fed refers to individual sheets of paper or rolls being fed into a press via a suction bar that lifts and drops each sheet onto place. A lithographic ("litho" for short) press uses principles of lithography to apply ink to a printing plate, as explained previously. Sheet-fed litho is commonly used for printing of short-run magazines, brochures, letter headings, and general commercial (jobbing) printing. In sheet-fed offset, "the printing is carried out on single sheets of paper as they are fed to the press one at a time". Sheet-fed presses use mechanical registration to relate each sheet to one another to ensure that they are reproduced with the same imagery in the same position on every sheet running through the press.

III. PERFECTING PRESS

A perfecting press, also known as a duplex press, is one that can print on both sides of the paper at the same time. Web and sheet-fed offset presses are similar in that many of them can also print on both sides of the paper in one pass, making it easier and faster to print duplex.

IV. OFFSET DUPLICATORS

Small offset lithographic presses that are used for fast, good quality reproduction of one-color and two-color copies in sizes up to 12" by 18". Popular models were made by A. B. Dick Company, Multilith, and the Chief and Davidson lines made by A.T.F.-Davidson. Offset duplicators are made for fast and quick printing jobs; printing up to 12,000 impressions per hour. They are able to print business forms, letterheads, labels, bulletins, postcards, envelopes, folders, reports, and sales literature.

V. FEEDER SYSTEM

The feeder system is responsible for making sure paper runs through the press correctly. This is where the substrate is loaded and then the system is correctly set up to the certain specifications of the substrate to the press.

VI. PRINTING-INKING SYSTEM

The Printing Unit consists of many different systems. The dampening system is used to apply dampening solution to the plates with water rollers. The inking system uses rollers to deliver ink to the plate and blanket cylinders to be transferred to the substrate. The plate cylinder is where the plates containing all of the imaging are mounted. Finally the blanket and impression cylinders are used to transfer the image to the substrate running through the press.[18]

VII. DELIVERY SYSTEM

The delivery system is the final destination in the printing process while the paper runs through the press. Once the paper reaches delivery, it is stacked for the ink to cure in a proper manner. This is the step in which sheets are inspected to make sure they have proper ink density and registration.

SLUR

Production or impact of double image in printing is known as slur.

VIII. SHEET-FED VS. WEB-FED

Sheet-fed presses offer several advantages. Because individual sheets are fed through, a large number of sheet sizes and format sizes can be run through the same press. In addition, waste sheets can be used for make-ready (which is the testing process to ensure a quality print run). This allows for lower cost preparation so that good paper is not wasted while setting up the press, for plates and inks. Waste sheets do bring some disadvantages as often there are dust and offset powder particles that transfer on to the blankets and plate cylinders, creating imperfections on the printed sheet. This method produces the highest quality images.

Web-fed presses, on the other hand, are much faster than sheet-fed presses, with speeds up to 80,000 cut-offs per hour (a cut-off is the paper that has been cut off a reel or web on the press; the length of each sheet is equal to the cylinder's circumference). The speed of web-fed presses makes them ideal for large runs such as newspapers, magazines, and comic books. However, web-fed presses have a fixed cut-off, unlike rotogravure or flexographic presses, which are variable.

IX. INKS

Offset printing uses inks that, compared to other printing methods, are highly viscous. Typical inks have a dynamic viscosity of 40–100 Pa•s.

There are many types of paste inks available for utilization in offset lithographic printing and each have their own advantages and disadvantages. These include heat-set, cold-set, and energy-curable (or EC), such as ultraviolet- (or UV-) curable, and electron beam- (or EB-) curable. Heat-set inks are the most common variety and are "set" by applying heat and then rapid cooling to catalyze the curing process. They are used in magazines, catalogs, and inserts. Cold-set inks are set simply by absorption into non-coated stocks and are generally used for newspapers and books but are also found in insert printing and are the most economical option. Energy-curable inks are the highest-quality offset litho inks and are set by application of light energy. They require specialized equipment such as inter-station curing lamps, and are usually the most expensive type of offset litho ink.

Letterset inks are mainly used with offset presses that do not have dampening systems and uses imaging plates that have a raised image.

Waterless inks are heat-resistant and are used to keep silicone-based plates from showing toning in non-image areas. These inks are typically used on waterless Direct Imaging presses.

Single Fluid Inks are newer inks that use a process allowing lithographic plates on a lithographic press without using a dampening system during the process.

Ink–Water Balance

Ink and water balance is an extremely important part of offset printing. If ink and water are not properly balanced, the press operator may end up with many different problems affecting the quality of the finished product, such as emulsification (the water overpowering and mixing with the ink). This leads to scumming, catch up, trapping problems, ink density issues and in extreme cases the ink not properly drying on the paper; resulting in the job being unfit for delivery to the client. With the proper balance, the job will have the correct ink density and should need little further adjustment except for minor ones. An example would be when the press heats up during normal operation, thus evaporating water at a faster rate. In this case the machinist will gradually increase the water as the press heats up to compensate for the increased evaporation of water. Printing machinists generally try to use as little water as possible to avoid these problems.

X. FOUNTAIN SOLUTION

Fountain solution is the water-based (or "aqueous") component in the lithographic process that moistens the non-image area of the plate in order to keep ink from depositing (and thus printing). Historically, fountain solutions were acid-based and made with gum Arabic, chromates and/or phosphates, and magnesium nitrate. Alcohol is added to the water to lower the surface tension and help cool the press a bit so the ink stays stable so it can set and dry fast. While the acid fountain solution has improved in the last several decades, neutral and alkaline fountain solutions have also been developed. Both of these chemistries rely heavily on surfactants—emulsifiers and phosphates and/or silicates to provide adequate cleaning and desensitizing, respectively. Since about 2000, alkaline-based fountain solutions have become less common due to the inherent health hazards of high pH and the objectionable odor of the necessary microbiological additives.

Acid-based fountain solutions are still the most common variety and yield the best quality results by means of superior protection of the printing plate, lower dot gains, and longer plate life. Acids are also the most versatile; capable of running with all types of offset litho inks. However, because these products require more active ingredients to run well than do neutrals and alkaline, they are also the most expensive to produce. However, neutrals and, to a lesser degree, alkaline are still an industry staple and will continue to be used for most newspapers and many lower-quality inserts. In recent years alternatives have been developed which do not use fountain solutions at all (waterless printing).

XI. IN INDUSTRY

Offset lithography became the most popular form of commercial printing from the 1950s ("offset printing"). Substantial investment in the larger presses required for offset lithography was needed, and had an effect on the shape of the printing industry, leading to fewer, larger, printers. The change made a greatly increased use of colour printing possible, as this had previously been much more expensive. Subsequent improvements in plates, inks, and paper have further refined the technology of its superior production speed and plate durability. Today, lithography is the primary printing technology used in the U.S. and most often as offset lithography, which is "responsible for over half of all printing using printing plates". The consistent high quality of the prints and the volume of prints created for their respective cost make commercial offset lithography very efficient for businesses, especially when many prints must be created.

XII. RESEARCH OBJECTIVE

The objective of this study is to reduce the consumption of printing substrate along with the optimum consumption of printing substrate and explore the possible ways of optimum consumption of the printing substrate used in sheet-fed offset processes in "**Akriti Printer**" Noida"

XIII. RESEARCH METHDOLOGY

The whole study has been divided in 3 sub parts to consumptions of printing substrate improve sheet-fed offset works along with the cost, efficiency, consumption and influence of utilization of substrate used in sheet-fed offset presses

The following methodology will be adopted during the study.

1. Study of different printing substrate used in printing industries.
2. Study of the printing substrate used in different sheet-fed offset work along with the cost, efficiency, consumption.
3. Different jobs of the " Sheet-fed Offset Presses" during project work consuming moderate amount of printing substrate will be selected and the study will be conducted on each selected job.

Data collection will be done during the study.

XIV. FUTURE SCOPE

This research focuses on optimum consumption of printing substrate and explores the possible ways of optimum consumption of the printing substrate used in sheet-fed processes. In "**Akriti Printer**" Noida". In all three cases when check list get adopted number of wastage depending up on the job and machine availability. These preliminary results can be used in future. Check point suggestion incorporated in printing section on sheet-fed offset machine after consultation with various press authorities may be indicative for other presses. They may modify, increase or decrease the factors to be considered.

To implement the suggestions properly we generate a check list in form of table to check the different factors before all jobs to be handled on particular Machine on daily printing. And the check point helps to reduce the consumption of printing substrate along with optimum utilization of printing substrate. The study may be concluded in a manner that, if all suggestion were implemented in matter of practice on sheet-fed offset presses Machine, consumption of printing substrate will go done along with controlled / minimized wastage. However researcher feels that limited facilities or infrastructure was available in city like Noida. The result may vary depending upon type of Machine/Technology, and skill man power.

XV. REFERENCES

- [1] "offset printing (printing technique) - Encyclopædia Britannica". *Britannica.com*. Retrieved 2013-11-24.
- [2] Meggs, Philip B. (1998). *A History of Graphic Design (Third ed.)*. John Wiley & Sons, Inc. pp. 146–150. ISBN 978-0-471-29198-5.
- [3] Carter, Rob, Ben Day, Philip Meggs. *Typographic Design: Form and Communication, Third Edition*. (2002) John Wiley & Sons, Inc. p 11
- [4] Howard, Nicole (2005). *The book: the life story of a technology*. Greenwood Publishing Group. pp. 140–148. ISBN 0-313-33028-X.
- [5] "Rubel Offset Lithographic Press". *HistoryWired: A few of our favorite things*. Smithsonian Institution. Retrieved 30 Sep 2012.
- [6] "Short History of Offset Printing"
- [7] "Staley McBrayer, 92; Inventor of Offset Press for Newspaper Printing". *Associated Press*. April 18, 2002. Retrieved October 19, 2017 – via *Los Angeles Times*.
- [8] Kipphan, Helmut (2001). *Handbook of print media: technologies and production methods (Illustrated ed.)*. Springer. p. 354. ISBN 3-540-67326-1.
- [9] "Printing Process Explained - Lithography". *Dynodan.com*. Retrieved 2012-11-15.
- [10] Johansson, Kaj; Lundberg, Peter; Ryberg, Robert (2007). *A guide to graphic print production (second ed.)*. Wiley. p. 353. ISBN 0-471-76138-9.
- [11] Kipphan, Helmut (2001). *Handbook of print media: technologies and production methods (Illustrated ed.)*. Springer. pp. 130–144. ISBN 3-540-67326-1.
- [12] Commercial Color Offset Printing – A Compendium of Commercial Printing Terminology
- [13] Romano & Riordan^[which?] 139–141
- [14] Kipphan 209
- [15] Bruno, Romano and Riordan^[which?] 126
- [16] "What is Offset Printing"^[which?]