

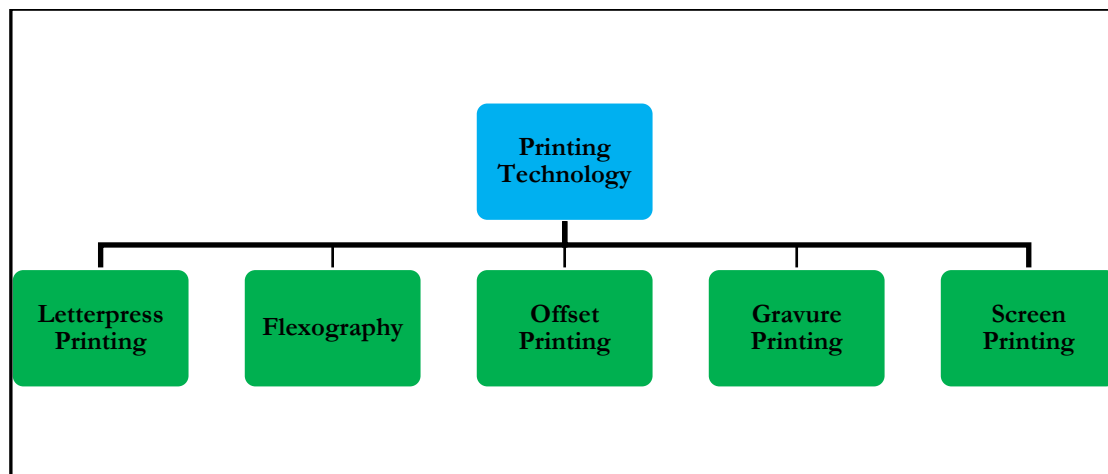
ABSTRACT

Drastic changes have been perceived in every aspect of printing segment since the inception of first printing principle by Johannes Guttenberg in 1440. Afterwards many of printing principles like flexography, offset, gravure and screen printing were emerged and are still in prevalence. Technology has also achieved so many milestones scientifically as well as innovatively especially in last couple of years. So it is being obvious to be blessed with these advancements which helped printing industry in terms of high production rate at brisk pace efficiently and effectively. This paper is aimed to explicate the numerous advancements which have taken place in printing arena especially in major conventional printing processes

Keywords: Printing process, Letterpress, Image Generation, Gravure, Flexography, Offset and Screen Printing.

I. INTRODUCTION

Printing is a way by using which numerous identical copies of any original are produced. It is an art as well as science. The journey of printing was started in 1440 when John Guttenberg invented first letter press printing principle. Major conventional printing processes are delineated as:



II. CONVENTIONAL MAJOR PRINTING PROCESSES

Each major printing process differs from each other due to its technical principle behind the printing process. Generally image carrier is often a plate which consists of image as well as non-image area, both are separated technically from each other. Image area is made to receive the ink which is to be transferred on to the substrate with the help of suitable impression pressure. Non-image area is either kept aloof from receiving ink or ink (if receives) is wiped off by making suitable arrangements.

Conventional Image Generation Methods used for Major Printing Processes

Each and every individual printing process is based on a particular unique principle which decides the way in which image carrier is prepared. The image carrier is responsible for transferring ink in the form of image on to the substrate. The image carrier is prepared in such a way that it picks up not only ink in image area, but rejects ink in non-image area also i.e. where it is not required. Image generation of different printing process is explained as below:

1. Letterpress Printing: It is a mechanical principle which requires a relative high pressure for transferring viscous ink onto the substrate. Image area is in relief format and above the non-image area. Classification of letterpress printing includes:-

- a. **Plane to Plane Surface:** Here printing surfaces as well as impression surface both are flat in nature. During printing plane surface comes in contact with each other. A controlled pressure is required in order to transfer the inked image on to the substrate.
- b. **Plane to Cylinder:** In this format matter to be printed is kept in flat format which is known as bed which moves to and fro from one end to another end of the machine. Cylinder is made to apply impression pressure for transferring the inked image on to the substrate.
- c. **Cylinder to Cylinder:** Both printing as well as impression surface both are cylindrical. The web of paper is feed in between these cylinders and the pressure between these two rollers decides the speed of printing.

Generally moveable types are used as image carriers in letterpress printing. Hot melt composition or manual method can be used for preparing image carrier.

2. Flexography: The term 'Flexography' was introduced in 1950 as previously it was known as Aniline Printing where low viscosity inks are used with resilient and soft image carrier and require 'kiss impression' to transfer inked image onto the substrate. Flexible image carriers include Rubber plate in which image area is in relief and non-image area is in recessed format. Use of natural and synthetic rubber is the conventional method of producing flexography image carrier.

3. Offset Printing: Planography plates are used for offset printing because it consists of image and non-image area in the same plane. The image and non-image area on the plate both are chemically separated. Image area is made oleophilic and non-image area is made hydrophilic so that ink-water balance can be achieved. For planography printing numerous no. of image carriers are available. These are as below: -

- a. **Pre-Sensitized Surface Plate:** - These plates are prepared by using a no. of base materials which includes paper, plastic as well as metal. Although aluminium is the most common metal preferred for the base metal because its surface can be treated in order to improve its performance. These plates are available both positive and negative working. In additive type of pre-sensitized plate, some image reinforcing materials are added during processing. Coating of non-image area is either removed or made water receptive. On another hand in case of negative working, unexposed coating is removed. Also the main difference between positive and negative working is use of imaging transparency i.e. positive or negative.
- b. **Wipe-on Plate:** - Wipe-on plates are supplied uncoated. Light sensitive diazo coating is applied on the surface. These plated bridged the gap between PS and surface plates. The coating is applied manually or with coating roller on the zinc or aluminium metal which acts as a base. Positive-type as well as negative-type aluminium wipe-on plates are available.
- c. **Deep-Etch Plate:** - It is the single metal plate made from positive film. These plates are popular since 1945 due to its slightly recessed image area which provides good print quality although it has complex processing methodology. Good image resolution and balanced ink-water are yet another advantages offer by these plates.
- d. **Metallic Plate:** - The concept of these plates is based on the fact of using separate metal for image as well as non-image area. Metallic plates can either be bi-metallic or multi-metallic. Two basic type of bimetallic are there which include either image metal above the non-image metal or image metal below the non-image metal. In addition sometimes an auxiliary metal as a base is used then it is known as multi-metal plate. These plates are known for their consistent colour reproduction without compromising any quality.

4. Gravure Printing: This is the reverse of relief plate in which image carrier are recessed below the level of non-image areas. Gravure cylinder consists of tiny cells which are used to pick up in from duct and transfer the same on to the substrate. In order to wipe off the ink from the non-image area, the doctor blade is mounted at a specific angle. Conventional methodology of gravure cylinder was engraving based which includes: -

- a. **Diffusion Etch Method:** In this method a special gravure screen is prepared by exposing through halftone positive. Then it is applied on copper gravure cylinder and developing is done. The cylinder is then placed in an acid bath where cylinder etching occurs. Then chrome plating of the cylinder is done.
- b. **Direct Transfer Method:** This method consists of a light sensitive mask made by



spraying process on the gravure cylinder which is then exposed through halftone film positive. After then same sequential steps are followed as that of diffusion etch process.

5. **Screen Printing:** A porous screen is used as image carrier in screen printing. A stencil is overlaid on the screen in order to differentiate image and non-image area. Ink is forced through the stencil openings onto the substrate. Conventional method for screen printing include: -
- a. **Tusche and glue Stencil:** - This is an artistic method in which a drawing is directly drawn on the screen with Tusche which is oil-based pigment. In order to block out the non-image area glue is used which is water-based material.
 - b. **Hand-cut Stencil:** - It is a manual method which consists of removing image areas from the base materials as screen printing is based on the fact of blocking out method of non-image area which prevents the passes of ink through itself and allowing it only in the image area. Most common steps involved for preparation of hand-cut stencil include:-
 - Cutting the Stencil
 - To apply stencil on to the screen
 - Removing the support sheet

Advanced Image Generation Methods used for Major Printing Processes

As technology has made remarkable progress in every aspect, it has also touched the printing sector significantly in different ways. Recent upgradation in various segments is articulated as below: -

1. **Letterpress Printing:** Most revolutionary advancement in letterpress printing is rotary presses which have not only increased the production speed, but added new dimensions in letterpress printing also. Stereo type plates which are casted from plaster mould from the surface of the type forme are used for rotary presses in letterpress printing.
2. **Flexography:** In order to overcome many of the disadvantages of rubber plate, photopolymer plates are the best alternatives. Rubber plate preparation was outcome of complex and tedious process. On another hand photopolymer plate preparation is easy and do not require more skills. Photopolymer plates are available in both forms sheet as well as liquid. To prepare photopolymer plate, negative transparency is used for exposing in a special UV exposing unit.
3. **Offset Printing:** Now a day offset printing are equipped with CtP and DI technology i.e. Direct Imaging technology. CtP acronym for 'Computer to Plate' in which a computer controlled imaging beam is used for preparation of printing plate from digital data. DI i.e. Direct imaging technology is technologically fascinating concept for transferring the digital data to printing press direct and eliminating all the intermediate steps. Raster image processor controls and processes the digital data for imaging purpose. Simultaneously laser imaging units creates the printing plates in all printing units. After printing the direct imaged plates are removed. Another fascinating idea of erasing the printing image is also available where plate is re-imaged for next printing job.
4. **Gravure Printing:** Most recent gravure image generation methods consists of engraving based technology for cylinder preparation. These are: -
 - **Electromechanical Method of engraving:** It consists of scanning of the original copy by a beam of light. This scanned information is stored in computer which is then translated to direct motion of diamond stylus tool. This tool cuts into the surface of the copper as it rotates. After completion of this process, the engraved cylinder is chrome plated.
 - **LASER Engraving/Cutting Method:** Entire cylinder chemically etched in acid bath. Then etched cylinder is filled with plastic material to gain smooth and uniform surface. Scanned informed is used to remove the plastic materials from the wells of the cylinder by using Laser beam. After this the cylinder is chrome plated.
5. **Screen Printing:** Use of light sensitive material in printing image generation has contributed a lot. The same is also true for screen printing also. In screen printing photographic stencils are used which are based on the use of light sensitive materials. The use of photographic stencils is one of the significant reasons behind the growth of screen printing. Photographic stencil methods offers three main process of stencil preparation includes:
 - **Transfer Image Method:** A dry emulsion is used and exposed through film positive. Then after developing stencil is adhered to clean screen. It is indirect method.
 - **Direct Image Method:** Wet emulsion is used which is coated directly on the screen. Then exposed through film positive and then developed.

- Film emulsion Image Method: It combines both direct and indirect method and hence known as Direct/Indirect method. Her liquid emulsion and sensitizer is mixed for coating and then use of film positive for exposing.

From technical perspective, each printing process has something advanced which overcome the past shortcomings. A summary is enlisted as

Sr. No.	Printing Technology/ Principle	Technological Advancement
1	Letterpress Printing	Stereotype plates casted from plaster.
2	Flexography	Photopolymer Plates are of two types which includes: - <ul style="list-style-type: none"> • Sheet Photopolymer Plate • Liquid Photopolymer Plate
3	Offset Printing	Equipped with these technology:- <ul style="list-style-type: none"> • CtP(Computer to Plate)Technology • DI (Direct Imaging) Technology: Also facilitates reimaging technology on plate cylinder.
4	Gravure Printing	Engraving based technology for cylinder preparation: - <ul style="list-style-type: none"> • Electromechanical Method of engraving • LASER Engraving/Cutting Method
5	Screen Printing	Photographic Stencil: These are: - <ul style="list-style-type: none"> • Transfer Image Method • Direct Image Method • Film emulsion Image Method

Summary: Technological Advancement for Image Generation in Major Printing Processes

Advantages offered by each printing process: Every printing process is not suitable while printing each and every job as each printing principle is made to offering unique printing characteristics which are enlisted in as below: -

Printing Principle	Job Suitability with Printing Process	Unique Characteristics
Letterpress Printing	1. Good for line and text jobs for single and multi-colour printing. 2. Small run jobs 3. Numbering and cutting	Sharp edge printing is one of the most unique characteristics for both line and halftone printing. Also offers slightly embossed effect.
Flexography Printing	1. Widely accepted for printing of packaging jobs. 2. Useful for both paper and non-paper substrates.	It offers fine halftone effect with flexible image carriers. Also used where high quality printing is not required.
Offset / Waterless/ Dry-Offset Printing	1. Suitable for short to long run jobs. But waterless offset is not suitable for shorn	It is dedicated for fine quality of line and halftone printing for smooth and even print. Waterless is committed for solid as

	run jobs. 2. Can be useful for single and multicolour printing. 3. Waterless facilitates high quality printing, especially useful for Solid printing.	well as high print quality.
Gravure Printing	1. Suitable for extremely long-run commercial and packaging jobs. 2. Useful for security printing.	It is highly committed to high print quality which is near to continuous tone. Also good highlight to shadow detail can be perceived. It also facilitates for embedding security features.
Silk Screen Printing	1. Most commonly suitable for short run jobs e.g. visiting cards, letterheads etc. 2. Almost suitable on any kind surfaces.	It offers thick ink layer while printing which have more apparent ink density.

III. CONCLUSION

This paper has presented concise overview about the advancement used for image generation purposed of conventional major printing processes due to technological advancement. No doubt that there is a remarkable contribution while plate preparation due involvement of these technological advancements. There were complex and obsolete techniques for image generation earlier. Many of the complex steps have been removed and better control on overall process of image generation by reducing chemical, film and materials consumption. In nutshell the technological advancement have widen the scope of image generation with improved quality and better proofing systems.

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