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COMPARATIVE STUDY OF PRINTING PROCESSES FOR GENERATING SECURITY FEATURES FOR SECURED DOCUMENTS

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ABSTRACT

Printing is an art of reproduction/ duplication of 'N' number of copies similar in all respect, in which printing ink is applied to paper/substrate in order to transfer the desired image (text, graphics and visuals) in a readable form for reproducing required number of identical copies with the help of printing image carrier. Printed Security feature may be generated by using all types of printing processes; it may be conventional or modern. By generating security features using various printing processes for secured documents like Legal documents, Legal & Educational Certificates, Printed documents, Identity Cards, Postage, Judiciary & RevenueStamps, tamper-evident labels, stock certificates and all kind of certificates given for authenticity, ownership or educational achievements may be easy at the same time complex. The main goal of security printing is to prevent from forgery tampering or counterfeiting of valuable documents or certificates. In modern digital era and easy excess to digital machine duplication can be done easily, so to cope-up security issues, it is necessary to aware about these newer technologies.

Keywords*: Security Printing, Printing Processes, Security Features.*

I. INTRODUCTION

Security printing is the vast field of the printing. Security printing can start with simple techniques such as printing on special paper or including watermarks or printing using special ink. The key is controlling the security of the substrate and not the content printed on it. In addition to securing substrate, specialty print-related techniques such as Intaglio Printing, Lithography, Letterpress, Micro-printing, Security inks, Security threads, Serial numbers, Anti-coping marks, Registration features and design effects. Unique document require multiple security printing techniques to ensure their security and effectiveness in society. Adding security in a document can be made easy by using printing processes, even different printing processes provides an entire new gamut of security by using different processes. That's why the most effective security printing requires a combination of various printing processes.

Major Printing Processes used for Security printing

Security features may be incorporated by printing processes which are involved during presswork on the document like passport, VISA, charge card, Identity cards etc. A combination of different printing processes may be used for incorporating security feature in document. Following are two categories of Printing Processes.

1. **Conventional Printing Process**
2. **Non- Conventional Printing Process**

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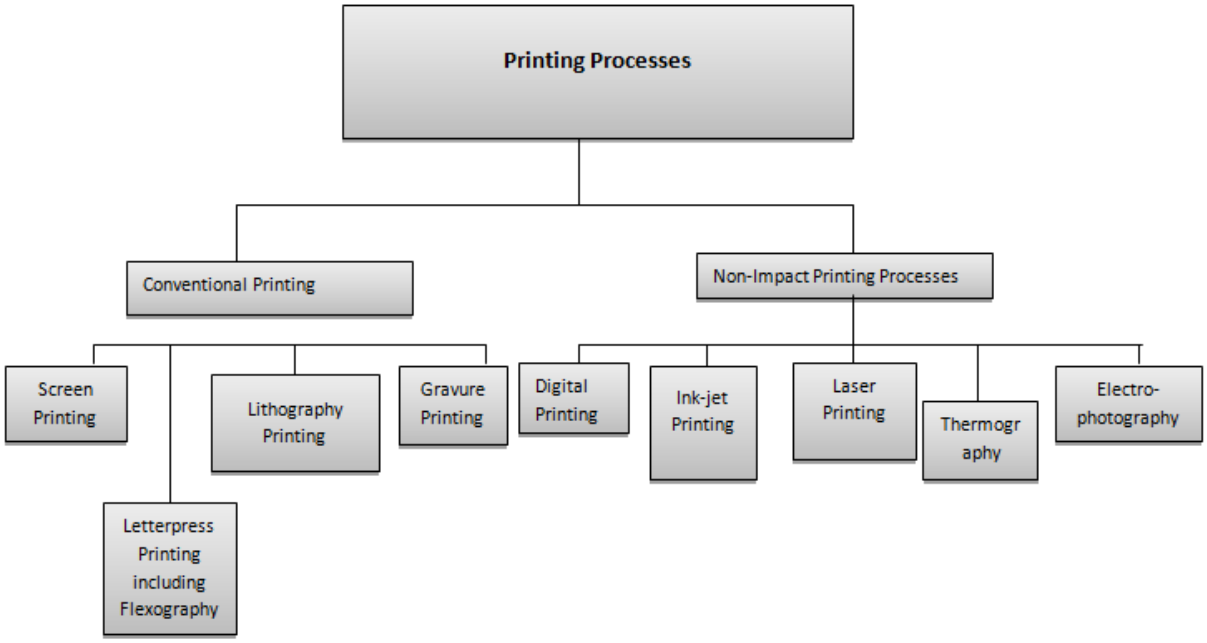

Printing Processes–Conventional & Non-Impact Printing Processes

1. Conventional Printing Process

A. Letterpress Printing

Letterpress is one of the oldest printing processes invented by Johannes Guttenberg in Germany. It is a direct method of Printing. Letterpress printing falls under relief printing process here the image and non-image areas are separated physically. The term letterpress is derived from moveable types/letter. Image area is raised while non-image area lies on surface. Thus, while ink is applied to printing image carrier on raised area i.e. image area receives inks. The gentle pressure is then applied to take the impression of the inked image on paper/ substrate.

B. Lithographic Printing

Lithography printing process was invented by AloisSenefelder in 1796. 'Greek' word 'Litho' means 'stone' and 'Grapho' means 'write'. In this process a flat limestone surface is used as an image carrier. The major principle behind this process is that grease and water do not mix and repels each other.

C. Offset Printing

Offset printing is a very commonly used printing process now a days, where the inked image is transferred/ offset from a plate to a rubber blanket and from that to on printing substrate. Offset technique is based on lithography principle. It employs a flat image carrier on which the image receives ink from ink rollers, while the non-printing area attracts water in form of thin film which keeps the non-image areas ink-free. An offset press is based on rotary principle.

D. Flexography Printing

Flexography is a rotary relief printing process based on letterpress principle which carries a flexible relief plate. This can be used for printing on almost any type of substrate including plastic, metallic films, cellophane, and paper.

E. Gravure Printing

Gravure printing processes is one of the simplest high quality printing process capable of producing printed images which have a continuous tone effect similar to a photograph. In gravure printing image and non-

image area is separated physically, here non-image area lies on surface of the metal cylinder, while image areas lies down in cavities known as cells. The image cylinder revolves in an ink fountain where it is immersed in a liquid ink. A metal blade called doctor blade made up of spring steel wipes the ink from the non-image areas which lies on the surface of the cylinder, leaving the ink in the cells of the cylinder. During the passes of substrate between image cylinder and impression roller the ink from the cells is transferred onto the substrate due to capillary action. Passing of the substrate between the gravure cylinder and an impression roller makes this process direct.

F. Screen Printing

This is a push-through process, a special type of stencil printing, which means that during the printing process the ink passes through the screen and onto the substrate. Screen printing is one of the most versatile process for transferring ink and technical coatings. Screen printing is done by spreading and forcing ink through a stencil (screen/mesh) of silk fabrics with the help of squeeze. For the screen silk, Nylon, Dacron and Steel wire screens are also being used in recent days. Cogged borders are achieved by this process. Generally, this printing process is used when printing with optical variable ink (OVI) is being done.

2. Non- Conventional Printing Processes

A. Digital Printing

It is a modern, affordable process which produces a finished product. With digital printing, no plates need to be made therefore digital artwork is sent directly to the printing press, making the process more affordable than other processes. Multiple colors can be included easily on one product without increasing the cost. The beauty of this process is that each and every print may be different from each other, that too without any change over time.

B. Laser Printing

In this process image to be printed is formed by the action of a laser on a charge- sensitive drum, then transferred to paper by means of an electrostatic charge. Laser printers are page printers and printing a complete page at a time. In this no liquid ink is used but powder or graphite-toner is used for printing purpose. Printed images or characters remain on paper surface as they do not penetrate the paper. These are made up of separate dots of various sizes, located at fix distances one form another. It is also likely to find slight traces of powder around the printed area. It is generally used when filling in with personal details as well as when inserting holder's picture.

C. Ink Jet Printing

Ink jet non-impact printing technology does not require an intermediate carrier for the image transfer therefore ink is transferred directly onto the paper without coming anything in contact with paper therefore it is called non-impact printing in real sense. The ink used for ink jet printing is usually liquid.

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S. No.	Name of Printing Process	Applications	Advantages	Disadvantages	Features Incorporated by Process
1.	**Letterpress Printing**	Educational documents, OMR Sheet Serial Number printing Bank Note / Currency, Passport, Cheque Printing and Value document Government document printing.	All types of pictures can be printed in dark and bright colors. Very thin papers can also be printed. Correction can be done at any time even at press also. Small works in less numbers can be printed economically.	Make ready time is more in comparison to other processes. The process is time taking and ink consuming. Indentation is found on the back side of the print. Maps and calendars printed by this method are comparatively expensive.	Die-stamping, cutting, creasing, embossing, perforation, and numbering work can done.
2.	**Lithography Printing**	Currency Printing, Passport, VISA,B Brand Protection and Asset Management, Tickets and event pass production, Government and Corporation document printing, Educational document printing	Halftone printing can be done by this method without making use of any screen. Works having thin lines can also be printed with same accuracy as continuous tone by this method.	This is very expensive process of printing for long run jobs. This method is not very popular because it is tedious in nature.	Guilloche pattern can be generated.
3.	**Offset Printing**	Government and Corporation document printing. Bank Note/ Currency, Cheque books, Lottery and other confidential and security works are also printed by this method. Certificates, Forms, and other Educational documents are	This is best suitable method for making copies of large works. Solid colors can be printed easily. Good printing can be achieved on rough and cheap paper. Both lines and halftone jobs are printed with quality.	Printing for very small number falls expensive. Cutting, creasing, embossing, numbering and perforation work cannot be done on this type of machines. Some time print looks like washed especially in case of	Rainbow printing can be done by this process. Uniform aspect is achieved across the border.

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Impact Factor- 5.070

		printed.	No indentation is found on the reverse side of the paper.	color printing when normal ink is used.	
4.	**Flexography Printing**	Brand Protection labels, Plastic packaging paper and Boards, Shrink& Sleeve Printing.	Printing upto 8 color is easily possible by this process. No limitation of printing visuals in four color only. The make ready process is quite simple and inexpensive in comparison to other processes. Its fast drying ink and the rotary principle facilitate high speed printing. Wherever water based inks make this process environmental friendly.	In this process there is frequent tendency of color/ shade variation, which makes printers job difficult. The limitation of inline flexography includes the inability to reproduce fine details. Evaporation of solvent from solvent based flexo-ink is known to pollute the environment.	Pearl like borders are achieved. Bar code, logo, images, serial numbering etc.
5.	**Gravure Printing**	Educational Document Printing, Cheque Printing. Currency printing. Identity Card Printing, Government document Printing, Passport Printing	Picture close to nature can be printed better than any process. Best print can be obtained by this method in any size. High speed machine makes this process extremely fast and make	Work done on a small scale is too much expensive. The edges are continuously not sharp. They are basically toothed in nature. No correction can be done after certain	Fine border can be printed. Tactile background can be achieved.

ISSN 2348 – 8034
Impact Factor- 5.070

			suitable for large run prints.	stage.	
6.	**Screen Printing**	Currency Printing, Circuit board printing, Embossed and Shining effect can be achieved, Printing on curved and irregular shapes.	All variety of size, shape and substrate can be printed. The matter can also be printed properly on rough paper. Printing set up is comparatively very cheap and all work performed manually in small scale set up.	The speed is very slow therefore long run jobs are expensive and not suitable. Because the layer of printing ink is thick and it creates drying problem. The amount of ink used is more hence it becomes expensive.	Serial numbering is done by this process
7.	**Digital Printing**	Educational document printing, FD Receipts, Insurance Policies, Packaging and Lables Personalised Bank Cheque books, Cheques with vouchers, Demand drafts.	This is a affordable process. No plate is required. Multiple colors can be included easily.	Initial cost of installation is to high.	Serial Numbering, Logo, Bar code etc.
8.	**Inkjet Printing**	Bank Note/ Currency, Event tickets, Tax documents, Educational Documents, Brand Protection, Anti-counterfeiting phone cards, Lottery tickets	There is no requirement of an intermediate carrier.		Logo, serial numbering, holders photographs , barcode QR code etc.

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9.	**Laser Printing**	Educational documents, Personalised MICR Cheque Books, Currency Printing, Cheque Printing, Electricity / Telecom bill printing.	There is no requirement of an intermediate carrier.		Text matter, images, serial numbering, fine border printing. QR code, Barcode etc.

II. CONCLUSION

In this modern world printers are more concise about security of documents printed by the combination of conventional, non-conventional and digital printing processes, by doing this they produce excellent prints/products difficult to counterfeit but due to this cost of the printed product may get increased. It is the need of the era to secure the documents by adding or enhancing developed security features as well as in printing processes on constant basis. The newer features state with replacement of conventional paper with non-tear able paper, along with drastic improvement in printing ink from Micro to Nano-particles and intricate printing design in excellent registration makes prints difficult to imitate design that makes counterfeiting more difficult.These features are not only increasing the security of the document but also enhancing the brand value of that document up to certain level. As newer printing technologies, newer types of substrates, complex design of the graphics and special inks are being used to increase the security of the secured documents. So, during this study we suggested a comprehensive list of printing processes used for secured documents, out of which in some of the products uses fewer number of printing processes and in some other products includes large number of print processes i.e. In passport and VISA we use large amount of the security features that's why more printing processes are carried out. While in other personal documents less number of security feature are used and print processes also. Printing processes are carried out according to the type of the document or according to end user requirement.

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