



# Effect of Porosity of Paper on printing in Different Printing Processes

Dattatrya Hanumant Shinde

B.E. (Printing), Former Lecturer (Printing Technology)  
MMP's Institute of Printing Technology & Research, Maharashtra, India

## Abstract:

This paper deals with study of appropriate printing process to be used according to the paper porosity to avoid Paper wastage for enhancing printing quality.

## Introduction

A paper surface allows the penetration of a gas or liquid, such as air or ink, through its surface down to base level is commonly known as Porosity. Structure of the paper such as fibers bonding produces various tiny air passages throughout the paper, which can either be completely submerged in the paper, extend from the surface down into the base of paper and may be penetrate completely through the whole paper.

The porosity of the paper can be controlled at various stages of paper making such as refining, Surface sizing, Coating, Calendaring and Super calendaring.

**Importance of Porosity** The porosity of the paper is no doubt has a vital role in drying process of the web fed offset especially in a newspaper. The high-speed offset machine has generally used for mass quantity production, due to nature of the machine working mechanism paper is a very important factor as it is holding maximum cost by paper itself. When paper passes in between the plate cylinder and Impression Cylinder inks get transferred on the surface of the paper and penetration of the ink starts through paper surface. The rate of penetration is depends on various factors such as fiber bonding, Coating of the paper, Surface Sizing and Calendaring of the paper.

## Porosity of a Paper for Various Printing Processes

### 1. Offset

(A) **Web Fed Offset** The Drying rate of the ink is an important factor in the web fed offset so that porous nature of the paper provides that facility to dry the ink layer on the surface of the paper as required after printing. It depends upon the porosity of the paper; Porosity allows the ink to penetrate through the surface of the paper down to the base. Decrease porosity in web offset results in failure in drying and can cause ink smudging vice versa increase in porosity than recommended can cause paper to break on press if web tension imbalance will be having serious cause to web break can be a delay in production time.

(B) **Sheet Fed Offset** As far as print quality concern as compare to Web Fed Offset, Sheet Fed results in good quality printing and drying method implemented to dry the ink layer may be vary than Web Fed presses as this process generally

used to print on high quality of the papers such as Art Paper, Glossy Paper etc., Normally the porosity of the paper used for this process is low than web fed offset as the reason is its speed is comparatively low than web fed presses. If porosity of the paper is high it leads to the strike through and show through. Show is also depends on other properties of the paper like opacity.

**2. Flexographic Printing Process** The Mechanism of this printing process is simple and machine construction is compact so recommended for short run job. As this process is known for rapid ink evaporation which helps to dry the ink quickly on press itself therefore the nature of paper/substrate used is less porous. Other important reason of low porosity of paper in flexography is the speed. As the speed of the flexography is less comparatively so has a low porosity. As the penetration of the ink through coated surface in the flexography due to low porosity influencing on printing such as density of the ink film may show the variation throughout the printed page. Due to less porosity the paper compression rate through plate and impression cylinder will leads to dot gain as well as dot variation in printed area. Anilox roller ink deposition rate to be controlled in a uniform manner as it will cause a serious problem known as mottling in this connection the porosity of the paper used for the printing is very important aspect. Higher the porosity of a paper uniform print density seen and dot gain observed on the print may be reduced with increasing the porosity in controlled manner. As the elastic property of the plate in flexography is helpful to control the nip pressure of plate and impression cylinder and it is also influence on the paper due its porosity imbalance.

### 3. Gravure Printing

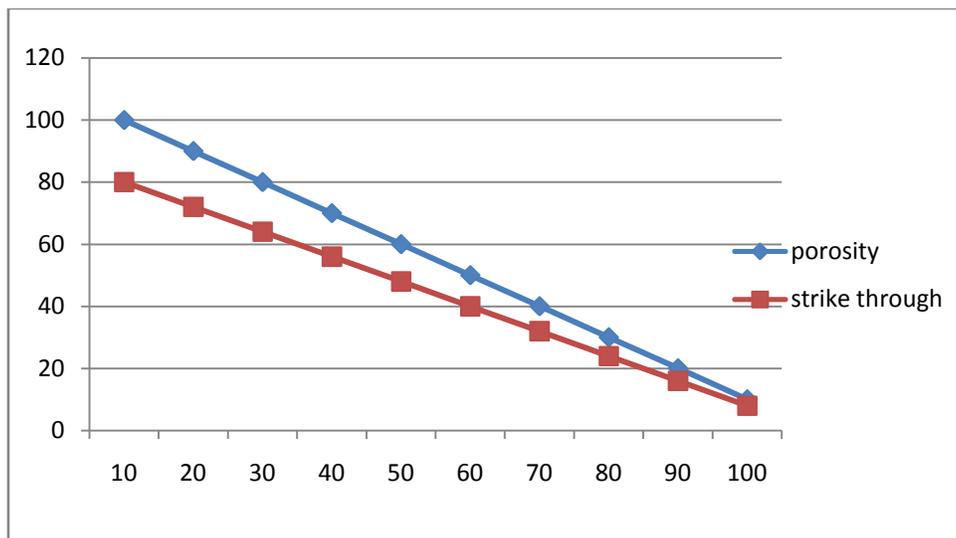
As the gravure printing is the fastest printing process and the paper used for this process is generally a coated paper of low fiber bonding which helps to maintain the speed of web on the gravure printing machine. A high grade glossy paper will be used for this work. Porous nature of the paper will cause web break on gravure printing machine. As the machine construction is compact and only the Doctor Blade is the only factor will control the flow of an ink. Porosity of a paper will definitely a influencing factor which will definitely damage paper. Gloss is one of the most important quality properties of

printed products and papermakers strive to improve the paper surface to gain higher and more even print gloss therefore the surface of the paper may be coated or high grade paper may be used for printing.

**4. Screen Printing** As the paper used for this process is of low porosity the dryer may be used to dry the ink film on the surface of the paper so the porosity of the paper in the screen printing is comparatively low. As the ink film thickness is high the porosity may be low it results in prevention of show through and strike through.

**Experimental Overview**

1. Checked Show through due to porosity of a paper on sheet fed offset machine and it is observed that show through is increased with increasing the porosity. It is also observed that that the porosity may affect on show through i.e. opacity of a paper also and theoretically it may be controlled
2. Cigarette paper and other printed products printed by the Gravure printing process have been checked for show through and strike through.
3. Sticker, pamphlet and other printed product printed by screen printing has been studied while research.



**Degree of Porosity and Strike Through relatively on Porous Paper Surface**

**Observations wrt. Porosity of a paper for a various printing processes**

- 1. Offset Printing**  
In offset printing porosity is an important criteria where if it is imbalanced web break may occur will impact press speed and downtime of the machine. Porous nature of the paper and uncontrolled rate of penetration of an ink may cause show through and strike through.
- 2. Flexographic Process**  
Porosity of a paper in a flexographic printing may on printing may cause mottling as well as dot gain in the print area will distort the image as well as text.
- 3. Gravure Printing**  
As this process require low porosity curling of a paper may cause after printing will disturb the orientation of a printed sheet.
- 4. Screen Printing**  
Screen printing produces higher ink film thickness though requires lower porosity.

**Other Factors Affecting Printing Quality w.r.t. Porosity in connection with printing processes**

**1. Opacity**  
Opacity is the light stopping ability of a paper. The low degree of opacity makes the paper more transparent as well as high

degree of opacity makes a paperless transparent. Opacity is very important property as if it is not controlled while paper making it will cause show though after printing.

- 2. Dimensional stability**  
A measure of the extent to which a paper will resist a change in size as the result of a change in moisture content or the application of a compressing force, as during printing. The cellulose fibers comprising a sheet or web of paper have an affinity for water, which means that they readily absorb water from the atmosphere. Dot gain in the printed page may be occur due misbalancing of dimensional stability of a paper. Feeding problem may be occurred due to misbalancing of dimensional stability of a paper.
- 3. Run ability of a paper**  
A term describing the interrelationships of a paper's properties which determine how a paper performs on press. Considerations of a paper's run ability include a variety of structural and surface properties, such as cleanliness of the surface , how well particles of fillers and coatings remain bonded to the paper (loose filler and coating particles can contaminate the chemistry of an offset printing press), how well a paper maintains its dimensional stability (changes in size due to changes in moisture content can affect not only the quality of the printed image, but also cause feeding problems), and other factors such as curling, wavy edges, and chemical composition that have the potential to interfere with the efficient functioning of the printing process. Runnability is usually described in concert with printability, or how well a paper's properties allow a high-quality printed image.

#### 4. Surface structure and Smoothnes of a paper

Surface structure and surface smoothness are related. However, two paperboard products with the same rating of surface smoothness can still have different surface structures. The rating for surface smoothness, is used to infer printability, ink absorption etc. but the rating does not give any information about the pattern of the surface structure or the issues this might cause during conversion of paperboard. Surface smoothness is assessed by measuring surface roughness.

#### 5. Coating of a paper

The porosity of a paper is a function of the various stages of the papermaking process. An increased level of fiber refining causes the fibers to bond together more strongly and tightly, making the paper denser, and reducing the network of air passages and thus the porosity. Surface sizing, coating, calendering and super calendering all also work to seal and/or compress surface fibers, reducing the paper's porosity.

#### 6. Calendering

The final operation on a papermaking machine, performed to impart to paper a desired finish and to increase the surface smoothness of a paper web. The calender usually consists of a stack of highly-polished steel rollers. As the paper web snakes through them, the paper is compressed and surface inconsistencies are smoothed out. The degree of calendering depends on the desired level of surface smoothness and gloss. The degree of calendering improves some paper qualities at the expense of others, however. Although increased calendering increases the apparent density, gloss, ink holdout, and smoothness of the paper, it has a deleterious effect on the brightness, compressibility, ink absorbency, opacity, porosity, stiffness, and thickness of the paper. The end-use requirements of the paper are of prime consideration when deciding the degree of calendering. Additional gloss and smoothness are often achieved using off-machine supercalendering equipment.

#### 7. Super Calendering

A paper finishing operation consisting of an additional degree of calendering performed on a special machine not connected to the main papermaking machine. The supercalender gives paper a high-gloss finish, the extent of supercalendering determining the extent of the gloss. A supercalender is a vertical alternating stack of hard polished steel and soft cotton (or other resilient material) rolls. The hard roll is pressed heavily against the soft roll, compressing the material.

#### Conclusion-

Requirement of a porosity of a paper may be changed according to the printing method adopted for printing. As porosity influence how paper surface absorb the amount of an ink which is deposited on surface of the paper while printing. Paper with high porosity increases ink absorbency and helps an ink to dry quickly but the physical structure of a paper and printing process mechanism may be the reason for show-through and strive though. Paper with low porosity increases the risk of ink hold out and may affect on folding of a paper by causing the smudging during post printing. Low porosity of a paper may cause curl in the paper and found misbalancing of a

dimensional stability while printing may disturb the production down time.

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