

# Paper Requirements for Offset Lithographic Printing

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## INTRODUCTION

Paper made of cellulose fibres is the backbone of any printed product and hence the printing industry. Paper is the printers most important and expensive raw material. The quality of printed product depends largely on the quality of paper being used. Papers are manufactured in a wide variety of types, thicknesses, colours and qualities. Papers are also manufactured specifically to meet the special requirements of the various printing processes. Offset lithographic printing is the widely used printing process in the world to-day. Because of its unique nature, the requirement of paper used with this process are somewhat different from that of other processes. This article explains the basic principle involved, complexity of the process and the requirements of paper for trouble free and better quality printing.

## THE PROCESS

Lithography is distinguished from other printing processes by the particular arrangement of image and non-image areas of the printing plate. Both image and non-image areas are on the same surface. They are separated chemically from one another. Thin aluminium plate is coated with light sensitive and oleophilic coating. When the plate is exposed through the image carrying film, the solubility of the coating changes. On development with suitable solvents the coating from the non-image area gets removed leaving the coating in the image areas hard enough to withstand the rubbing action between the plate and other parts coming into contact with it. The image areas are oleophilic and hydrophobic. That is, it readily accepts oil based inks and repels water. Whereas the non-image areas are hydrophilic or it readily accepts water. After wetting the entire surface of the plate, if an inked roller is passed over

the plate, the ink will stick only to the image areas. When the inked plate comes in contact with a rubber blanket, the image gets transferred on to the blanket which in-turn transfers it onto the paper. On the offset printing machine the aluminium plate carrying the image and non-image areas is kept round the plate cylinder and the two ends are firmly clamped to it. The blanket made of resilient material is fixed on to the blanket cylinder. The impression cylinder clamps take the lead edge of the paper and the paper is taken in between the blanket cylinder and the impression cylinder. Necessary pressure is exerted between the plate-blanket nip and blanket-impression cylinder nip. Figure-1 illustrates basic parts of an offset printing machine.

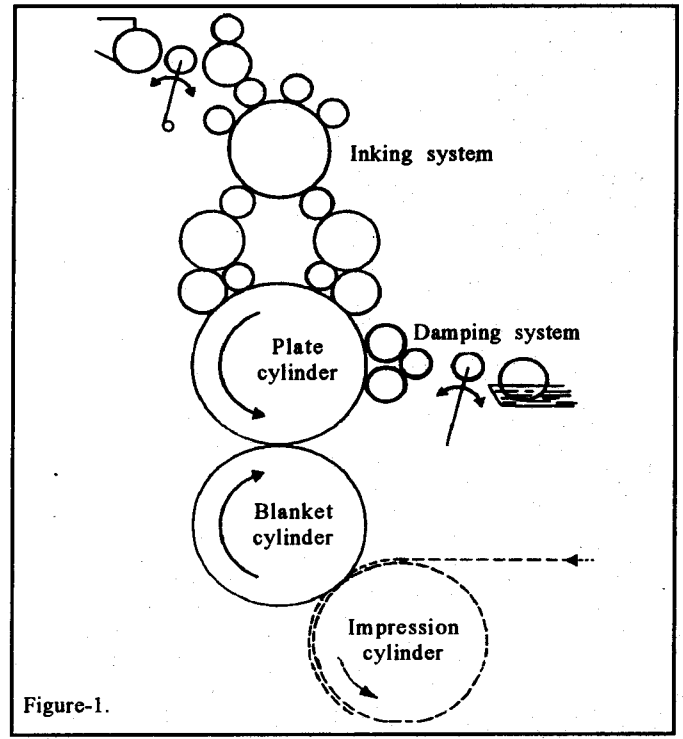


Figure-1.

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In offset lithographic printing, the ink films have to split twice—from plate to blanket, then from blanket to paper. The ink film thickness transferred to paper will be roughly one fourth of the film applied on to the plate as the ink splits equally on the contacting surfaces. Hence the ink film thickness on paper will be thin. To produce, a high intensity of colour in these thin films, offset inks are to be made rather more tacky. The ink dries partly by absorption and partly by oxidation. If non absorbant paper is used then the ink has to entirely dry by oxidation.

Litho plates have to be damped before being inked. Little of this water transfers to the paper through the blanket. Paper being a hygroscopic material, this water gets absorbed by the paper and its dimensions change.

### **PAPER PROPERTIES REQUIRED**

Properties of paper are many. A paper property crucial for one process may not be crucial for another. The degree of importance of a particular paper property may differ from one process to another. Here some of the properties important for offset process as listed below are described.

1. Smoothness
2. Surface Strength
3. Absorbency
4. Acidity or Alkalinity
5. Water soluble materials
6. Hygro-instability
7. Moisture content.

The paper properties required differ according to the nature of the printing surface, type of ink used and the way in which it dries, the machine characteristics and the atmospheric conditions. In offset process printing surface is flat and made of resilient rubber. The type of ink used is very tacky. In order to desensitise the non-image area the plate is wetted with water before being applied with ink. A part of this water gets transferred to paper through the blanket. The atmospheric temperature and relative humidity of printing press will greatly affect

the printing quality. We will discuss how do these factors determine the paper properties required for offset printing.

### **SMOOTHNESS**

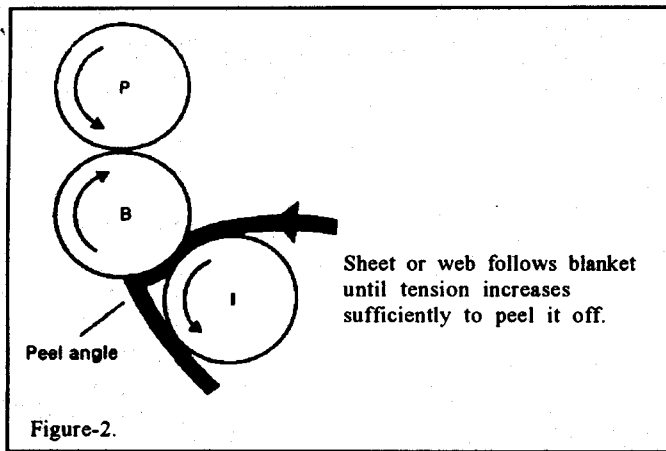
In offset process, the ink is printed on to paper from a resilient rubber blanket. This blanket is able to conform to the surface roughness of the paper thereby ink can reach the depressions on the paper surface. Good quality offset prints can be made on relatively rough paper such as offset cartridge. The deformation of the blanket to meet the surface irregularities will tend to increase the dot size. In very fine half tones involving process colours, the quality of printing on rough paper will suffer. In such cases papers with smooth surface, such as coated papers will be preferred.

### **SURFACE STRENGTH**

The ink from the blanket has to be transferred on to the paper. This transfer does not occur completely. The ink will split with part of it remaining in the blanket and part getting transferred to the paper. The ink being tacky some force is needed to make the ink film to split. When a blanket-ink-paper sandwich is separated, splitting occurs always in the weakest zone. If the surface strength of the paper is stronger than the tack of the ink, the splitting will take place in the ink. If the surface strength is lower than the ink tack, then the splitting takes place in the paper. In coated paper pieces of coating or even the entire coated layer may be split away and left on the blanket surface. This is called "picking".

The presence of water may add to this problem. When paper passes through the first printing unit, the paper coating absorbs moisture. If the coating binder is soluble, the surface may be weakened sufficiently to pick on the second print unit, even though it was strong enough when dry. This is called "wet-pick".

Due to the tackiness of the ink, the paper will try to stick to the blanket. The paper is to be peeled off from the blanket surface. The paper does not come straight out of the nip. It follows the blanket for some way before peeling off. The more tacky the ink, the more the paper will follow the blanket



and the more it will be bent when it separates as shown in figure-2.

This bending of paper can be severe enough to crack the coating, weakening the surface so much that the ink can detach small particles of the coating resulting in picking.

Fluffing is a more serious problem in offset litho graphic printing. The blanket deforms under pressure in the nip, creating a rubbing action on the paper surface. The rubbing action and the tackiness of the ink helps to dislodge loosely bound fibres. These fibres adhere firmly to the blanket surface. When these fibres come in contact with water the water is absorbed by the fibres and hence repel ink. As the fluff builds up on the blanket, it will interfere with the ink transfer, causing the colour to lighten. Very often the press has to be stopped to clean the blanket and hence press down time is increased. The increased deposition of fluff increase pressure between plate and blanket. This accumulation of fluff may be abradative and may wear away image coatings on the plate surface resulting in "blinding".

From the above discussion, it is clear that the surface strength is an important requirement of offset litho papers. It should also need to be unaffected by water to avoid "wet-pick".

The Offset paper need to be more rigid so that it will spring away from the blanket earlier and hence will have less tendency to pick.

### ABSORBENCY

Ink made of pigments and vehicle, when

applied to paper under pressure, greater part of the vehicle penetrates into the pores of the paper. This makes the viscosity of the ink layer to rise until the layer becomes so thick that it gels and becomes set. This process is to be completed before the next printed sheet comes in contact to avoid 'set off'. The vehicle then taking oxygen from the air gradually changes from a gel to a hard dry film.

If the paper used is more absorbent the oil will penetrate more deeply into the paper. This will increase the risk of the print on one side of a sheet being visible on the other side and hence spoils the appearance of the print. This defect is called 'strike through'.

If the paper is not absorbent enough, due to insufficient oil penetration, a thicker ink film will be left on the surface resulting in longer setting time. This increases the risk of 'set off'.

The above discussion clearly indicates that paper used in offset printing should have a medium value of absorbency. For low absorbency paper set off is more likely. High absorbency increases the effect of strike through.

### ACIDITY OR ALKALINITY

Lithographic inks dry by oxidation. Oxidation drying is a complex reaction the rate of which is affected by several factors. The paper pH and the atmospheric relative humidity are the two important factors among them. At low RH values the variation in pH will not have any effect on the ink drying time. But at higher relative humidity conditions ink drying is delayed resulting in set off problem. If moist room conditions are encountered, it is recommended that paper pH should not be less than 5.

If the paper pH is high, the alkalinity of the paper may react with the plate coating and may result in 'image blinding'.

### WATER SOLUBLE MATERIALS

Casein coated papers can be printed without difficulty provided the casein has been hardened so that it is insoluble in water and does not transfer to the plate. Uncoated papers often contain loading materials such as china clay to improve opacity

These materials are harmless in the paper, but if these materials are water soluble they get transferred on to the blanket. If these materials are hard and abrasive they can wear the coating and plate surface.

Papers for offset litho must not contain water-soluble materials that can harm the plate if they transfer to it. Paper coatings should be water resistant.

## **MOISTURE CONTENT AND DIMENSIONAL STABILITY**

An average paper will contain about 5-10% moisture when supplied by the manufacturer. As paper is made of hygroscopic fibres, the paper will readily adjust its moisture content to that which is compatible with the prevailing room humidity. When the paper does this, it is said to reach equilibrium with room humidity. When paper is exposed to a different humidity condition, it will either absorb moisture from the atmosphere or release it to the atmosphere. This absorption or release will be followed by changes in dimension. The change in dimension will be more across the grain direction. The change in dimension will be negligible along the grain.

In the case of multicolour printing, close register could be achieved between colours if the change in dimension is negligible in both directions. To achieve this the paper needs to be dimensionally stable, or the variation in dimension is very small.

Printing machine has got facility to adjust for the dimensional variation. When the paper is fed through the machine for printing the first colour, the paper changes dimensions after the image has been printed. The image will stretch or contract on both grain and cross-grain directions. When the second colour is printed on this deformed image it will not fit and hence misregistration occurs. If this misregistration is within the allowable value the printing will be alright. If it exceeds due to dimensional instability of the paper then the printed sheet will have to be rejected. If the paper is made long grain, i.e. the grain direction is parallel to the long side of the paper, the second image will be adjusted on the press to suit the deformed first image. This could be

achieved by varying packings used in the plate and blanket cylinders. This adjustment is possible only around the cylinder. No adjustment could be done along the cylinder axis.

Another major problem with papers is the wavy edges and tight edges. When a stack of papers is unwrapped in a humid atmosphere the paper edges are exposed and hence absorb atmospheric moisture. The papers expand leaving the centre intact and this results in wavy edges. Where as if the stack of papers is opened in dry atmosphere, the paper edges release moisture and hence shrink. This creates tight edges. If the papers with wavy edges or tight edges are fed into the machine creases are formed spoiling the image. Such type of problems are to be tackled by the printer. He has to make sure that the paper inside the packet is in equilibrium with the atmosphere and then open the packet. If there is any difference, then he has to make arrangements to bring the paper to the equilibrium condition before it is being fed into machine.

If the paper is supplied to the printer with wavy edges or tight edges, he can not do anything but to reject the same. This will happen if the paper is not packed with damp proof wrappers. The paper manufacturer should see that the papers are supplied in bitumen coated craft paper which will safeguard the paper from atmospheric conditions.

## **SUMMARY**

The important properties required for offset papers are summed up below:

1. **Dimensional Stability-** The offset paper should have very high dimensional stability particularly for multi-colour printing using single colour and two colour printing machines.
2. **pH-** The pH of the paper should be in the range of 5-7. Paper having pH less than 5 will retard ink drying particularly in moist atmosphere and more than 7 will affect the plate.
3. **Smoothness-** Smoothness is not a critical property for offset printing for general work. Smoother the paper the quality of print will increase especially in fine half tone process colour work.

4. **Surface strength-** The paper should have high fluff resistance, particularly in the case of uncoated ones. Pick resistance is another important surface strength required for paper for offset process.
5. **Absorbency-** Paper for offset process should have adequate absorbency property.
6. **Non-soluble materials-** Paper for offset process should not contain any filling or coating material soluble in water.
7. **Moisture content-** Moisture content of the offset paper should be in equilibrium with the atmospheric condition of the printing process.