Analysis of the Mechanism of Interaction B/W Gravure Roller and Ink or Ink to Substrate

A Case Study of Aero Plast Pvt. Ltd., Bahadurgarh

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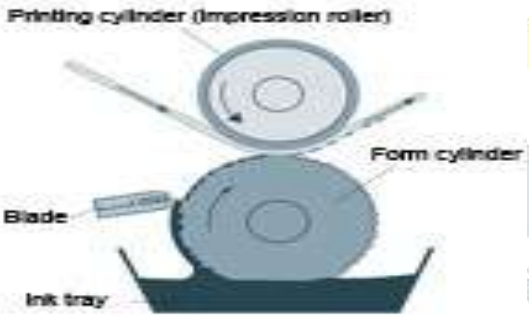
***Abstract*- In an engraving rotogravure printing machines the print cylinder (ink unit) and the impression cylinder are interaction in an ink or print substrate. The contact Surfaces comprise a metal surface and a rubber impression roller surface. it is the appears from findings based on the working in the "Aero Plast Pvt. Ltd" and experienceof people working in printing houses the issue of interactive between ink rollers and printing cylinders in an rotogravure printing machine is of great importance. It has impact on the quality of printouts, consumption of energy, time of making, The printing machine ready for operation, wear of the machine's components and related consumables like ink, flexible substrate, impression cylinder and engraving cylinder. During the theoretical studies, since the transfer takes place by a series of three phases such as inking, doctoring and printing, the ink transfer ratio. Moreover, the relationship in between the interaction b/w gravure, ink or ink roller to the substrate was subject to experimental attempts aimed at verification of the interaction mechanism presented. In order to measure the rollers compression a clock sensor was used, and for measurement of the contact area width – a device called Roller Nip Control. The results of these measurements are presented in this paper and are compared with the results obtained from the equation derived in the course of theoretical studies using the analytical method.**

***Keywords* - interaction problem, mechanism, engraving cylinder, impression cylinder, ink transfer and flexible Substrate.**

INTRODUCTION:

Rotogravure:it is a type of intaglioprinting process, which involves engraving the image onto an image carrier. In gravure printing, the image is engraved onto a cylinder because, like offset printing and flexography, it uses a rotary printing press.



The most important elements of rotogravure printing machine are impression cylinder a printing unit (fig.1), which transfers image to the print substrate, is composed of an ink unit and two cylinders, namely: engraving image cylinder transferred onto the impression cylinder provided with thePrinting technologies use differentiation between rollers.

Engraved cylinder: The first step of Gravure is to create the cylinder with the engraved images that need to be printed: the engraving process will create on the cylinder surface the cells that will contain the ink in order to transfer it to the paper. Since the amount of ink contained in the cells corresponds to different color intensities on the paper, the dimensions of the cells must be carefully set: deeper or larger cells will produce more intense colors whereas smaller cells will produce less intense ones.

Gravure cylinders are usually made of steel and plated with copper, though other materials, e.g. ceramics can also be used. The desired pattern is achieved by engraving with a laser or a diamond tool, or by chemical etching.

If the cylinder is chemically etched, a resist (in the form of a negative image) is transferred to the cylinder before etching. The resist protects the non-image areas of the cylinder from the etchant. After etching, the resist is stripped off. The operation is analogous to the manufacture of printed circuit boards. Following engraving, the cylinder is proofed and tested, reworked if necessary, and then chrome plated.

OBJECTIVE:

In this paper, main aim is following:

- To study about various mechanism interaction with gravure cylinder and ink to the substrate.
- To exist the common force surface applying during run the machine.

RESEARCH METHODOLOGY AND RESULT:

The above research work was of experimental or analysis based work in aero Plast Pvt. Ltd. Bahadurgarh Haryana.

In this paper is primary source of analysis all technical terms using that is R2R mechanism, ink spreading mechanismand ink spreading mechanism (deformation of substrate). Secondary source are analysis of the force between in gravure cylinder to ink to the impression roller.

Interaction b/w roll and ink to the substrate:

Ink transfer means delivering the ink from the greatest image engraved on the surface of a printing roll to the tensioned web .

Basically interaction mechanism involves wetting and de-wetting steps as follow:

- Wetting of the engraved cylinder
- De-wetting of the engraved cylinder
- Removal of the excess ink
- Ink transfer from the cylinder to the substrate
- Ink tear-off from the cylinder

As we know that, demand for the patterns with high resolution increase, insufficient ink transfer from the roll to the substrate becomes as one of the most critical issues of the system because it could induce poor print quality as well as non-uniform coating thickness.

Interaction mechanisms can be classified as below:

Roll to roll mechanism:

Basically ink transfer mechanisms involve wetting and de-wetting steps as follows:

The R2R gravure printing is composed of motor driven printing roller, nip roller and doctor blade.

A flexible substrate moves between the printing and nip rollers under the operating tension.

The desired patterns are engraved on the printing roller and ink feeding system wets the entire surface of the printing roller with the ink.

While the printing roller rotates, the excess ink in the non engraved areas is scraped off under a pressure using the doctor blade. At the contact areas, as the ink in the cell is transferred to the flexible under the nip force and forms the geometry of printed patterns. Due to the imperfect ink transfer in R2R gravure printing process the volumes ratio in each phase is determined as follows:

Inking ratio (ηi) is a ratio of filled volume(vf) to cell volume (vc): ηi= vf/ vc

Doctoring ratio(ηd) is a ratio remained volume(Vr) to filled volume(vf): ηd= vr/ vf

Printing ratio(ηP) is ratio of printed volume (Vp) to remained volume(Vr) : ηP = (Vp)/ (Vr)

Ink transfer ratio(ηT) is a ratio of printed pattern volume (Vp) to cell volume (Vc): ηT = Vp/ Vc

Ink spreading mechanism: ink spreading is actually tightly engagement of gravurecylinder and impression roller and between them pressurized substrate is passed.

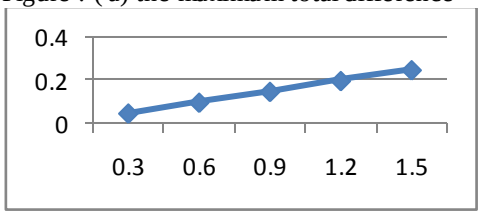
Entering and leaving the cell between the pressurized regions is most critical phase during ink transfer and it depends on;

- Wetting and de-wetting of cell
- Cell geometry
- Cylinder roughness
- Impression roller hardness
- Ink and substrate consideration

The total force such as operating tension as well as nip force applied on flexible substrate during the printing phase. Nip force is induced by two cylinders.

Under the external nip force, the rubber layer on the nip roller is deformed leading to making a contacting length on the printer roller.

Figure :-(a) the maximum total difference



During the contacting time, the engraved cell enters and leaves the pressurized region. Contacting time can be expressed a: (tc) =b/v, where v is a printing speed.

The maximum total deformation is almost linearly depends on nip force in the static case.

Ink spreading mechanism (entering and leaving of cell)

During the printing phase, motor driven printing roller rotates moving the cell and substrate along the contacting length with the engraving (v).

As Time t is from zero to tc/2 (where tc is completion time), the force distribution is increased from zero to maximum value and this force distribution results in the substrate deformation leading to reducing the ink contained volume. Finally ink was squeezed out and spread over the substrate.

Cylinder roughness:

Roughness is component of surface texturing and its plays an important role in determine how a real objects (cell of cylinder) will interact with inks, means targeted roughness value enhance the wet ability of cell with ink molecule.
Roughness average Ra is the arithmetical average value of the absolute distance of the roughness Profile from the center line.
Maximum Peak to valley height –RT is the maximum peak to valley height within the measuring length.
The targeted value of roughness for cut cylinder before chrome should be 0.2 and 0.3 Rz roughness; for polished cylinders ranges after chrome it should be between 0.4 and 0.5 Rz.
Choice of targeted roughness value depends on following factor:
Types of substrate
Dwell time (engagement time between inked cell and substrate), if m/c speed will be high dwell time will be less and vice versa.
Dwell time is engagement time between inked cell and substrate at a particular time and increase or decrease the dwell time is directly affected the holding capacity of cell with ink if surface time roughness value I not moderate. For high speed printing machine as 350 0r 400 mtr/min., Rz value should be lies between from 0.45 to 0.6.
Coated stock, transparent, or reflecting substrate are more sensitive with roughness, so required lower roughness value than uncoated stock like paper.

CONCLUSION:

In this paper analysis in interact b/w gravure cylinder and ink or ink to the substrate is main result include that is; ink transfer means delivering the ink from the target image engraved on the surface of a printing roll to the tensioned web, basically interaction mechanism involves wetting and de wetting steps include is;

- Wetting of the engraved cylinder
- De-wetting of the engraved cylinder
- Removal of the excess ink
- Ink transfer from the cylinder to the substrate
- Ink tear-off from the cylinder

The desired patterns are engraved on the printing roller and ink feeding system wets the entire surface of the printing roller with the ink.
Roughness is component of surface texturing and its plays an important role in determine how a real objects (cell of cylinder) will interact with inks, means targeted roughness value enhance the wet ability of cell with ink molecule.

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