Ink Wetting/Dewetting in Flexographic Printing

Kam Chuen Ng

Corning Incorporate

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Flexographic printing is an ink transfer process. It involves a conformal contact between a hard surface and a deformable flexographic plate. Understanding the ink wetting and transfer in flexographic printing will help to improve print quality. Flexography is a two-step printing process. Ink is transferred from an anilox roller to the flexographic plate and is then transferred from the plate to the substrate. The amount of ink transferred in each step depends on the capillary number and possibly the surface energies of the contact surfaces. In the actual flexographic printing, we only see the final results of the image on the substrate. When we examine the printing defects, it is not easy to determine during which step the defect originated and was propagated. In fact, the wetting/dewetting process starts on the plate until the ink is transferred to the substrate. The wetting/dewetting starts again on the substrate until a UV curing or drying step is applied.

Most inks have significant propensity for dewetting during the printing step. Dewetting is often observed in larger patch uniform solids area, leaving a print that contains areas with no ink, and lower optical density due to poor coverage. A pattern of micro-size regular features can be superposed onto the solid area of a flexographic plate to mitigate the ink flow and produce higher print densities. This is referred to as a DigiCap pattern.

The goal of this paper is to understand the effect of ink initial laydown, DigiCap pattern size and its depth on how ink breaks on the flexographic plate. We will model the wetting/dewetting process on the solid area on the flexographic plate with or without DigiCap pattern. We extend Schwartz's thin film precursor model [1-3] with disjoining pressure on the flat surface to a surface having a structure with holes. Equilibrium contact angles which could be spatial dependent are specified in the model. Basically, we modify the height of liquid to account for the structure of the features and modify the contact angle near the sharp edges in the disjoining pressure of the model. The modification of contact angle near the sharp edges depends on the equilibrium contact angle and the slope of the feature [4-5].

The model has been used to simulate the wetting/dewetting process on the plate with a solid patch with or without DigiCap patterns. A good correlation between the modeling simulations and printing experiments was found.

- When printing a large solid patch, the ink tends to retract into big drops quicker without a surface patterned with DigiCap like features.
- With dense DigiCap patterns, the ink will break into smaller drops which are pinned to the pattern.
- With a less dense DigiCap pattern, bigger drops are formed.
- When the initial thickness of the ink is large, the effect of the pinning from the DigiCap pattern is less effective.
- From the simulation results, it is demonstrated that for ink to spread evenly on the plate, (a) the transfer of ink from the anilox roller cannot be too much (b) the spacing between the holes cannot be too wide, and (c) the DigiCap depth cannot be too shallow.

References

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