Dry Toner Based Electrophotographic Printing of Polymer Coated Packaging Boards: The Role of Surface Energy in Print Quality Formation

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Abstract

Packaging is an ideal application for digital printing because of the amount of variable information involved. Digital printing is suitable for short runs of highly personated packagings. The obvious benefit of digital printing is low waste amount and print-on-demand. The status of digital printing, at least in the packaging sector, is still quite moderate, but the future is bright and it has been estimated that the use of this method will increase more than the traditional printing techniques. The quality of digital printing will also approach that of offset.

The aim of this study is to evaluate the printability of various extrusion coatings used for packaging boards and to map out the role of surface energy in print quality formation.

Introduction

The extrusion coated board grades are printed in this study with Xeikon DCP/50-SP digital printing machine. The printing method in the Xeikon is based on dry toner web fed electrophotographic process. Several properties of the substrate affect the printing result, e.g. electrical properties, moisture and surface properties (surface energy, roughness).

Extrusion coatings in general have an impervious, chemically inert, non-porous surface with low surface energies that cause them to be non-receptive to bonding with toners. The most common method for obtaining good toner adhesion is to oxidise the surface. This will increase the surface energy and also provide polar molecular groups necessary for good bonds between toner and polymer molecules. The most widely used method to accomplish this is the electrical corona discharge treatment.

In this study, the surface chemistry of the polymer coatings has been modified with the corona treatment. During the corona treatment three phenomena occur: (a) chemical effect (b) physical effect (micropitting) and (c) electrostatic effect (electret effect).[1] The effects of corona have been evaluated with contact angle measurements. The influence of surface energy level on toner adhesion has been analysed with tape-peel and rub-off measurements. Print quality has been evaluated both visually and numerically. Based on these measurements, correlation between surface chemistry, toner adhesion and print quality is discussed.

Results

The corona treatment clearly increased the surface energy level of all polymer surfaces. When the surface energy was raised above that of the toner, the toner adhesion approached 100%. Some polymers had the required surface energy level already without the corona treatment and they had good toner adhesion properties.

The surface energy level of the polymers was studied as a function of time starting from the corona treatment day lasting nearly a period of one year. It was observed that the surface energy decreases most rapidly during the first few weeks after treatment. After that the decrease becomes slower or ends totally and the surface energy settles to a certain level. Even after this decrease, the surface energy level is higher than that of samples without the corona treatment.

Surface energy of the polymer coating surface seems to play a quite important part in visual quality formation. As we can see from Fig. 1, there seems to be a certain level for surface energy in order to achieve low mottling and good visual appearance. Abrasion durability of the printed samples was determined by rub-off measurement. Rub-off is one measure of toner adhesion. As Fig. 2 shows, high abrasion durability ensures low mottling values and high visual quality.

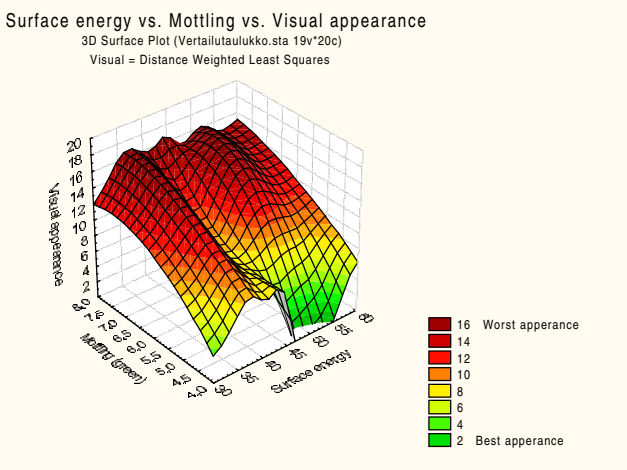

Figure 1. The effect of surface energy level on print mottle and visual quality. (The lower the mottle value, the less mottling.)

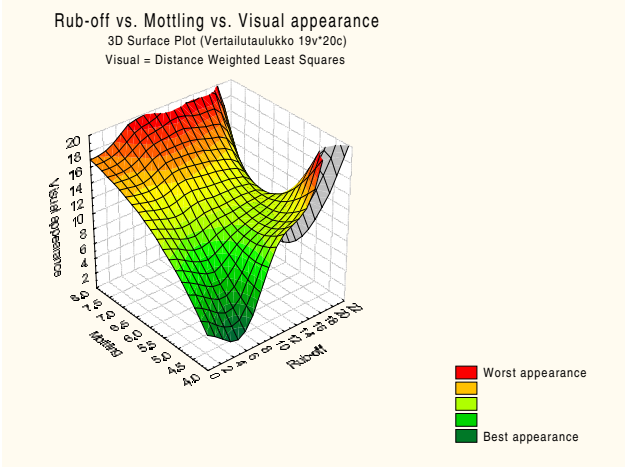

Figure 2. The effect of abrasion durability on print mottle and visual quality. (The lower the rub-off value, the better abrasion durability.)

Conclusions

In conclusion, adequate toner adhesion is essential when extrusion coated packaging applications are concerned. High enough surface energy and surface charge uniformity are necessary for uniform print quality and toner adhesion. Some polymer coatings have the required surface energy level without the corona treatment, but some coatings need surface modification in order to succeed in digital printing process.

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References

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Biographies

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