The Stability of Ink-Jet Prints

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Abstract

The stability of the printed area can be observed from two different and independent points of view: physical and optical; each of them is relevant for the final use of the print. In our study we observed the influence of substrate surface on the stability of ink-jet printing. For this purpose, we chose different samples of paper (varying in quality, grammage, composition, surface treatment). The analysis of paper surface (smoothness, roughness, porosity) was first done on unprinted paper with conventional PPS method and with modern CLSM method. Also the dynamics of water penetration was measured. All the paper samples were subjected to ink-jet priniting. The samples were exposed to heat resistance test according to the ISO-11798 standard. The mechanical stability of the prints, expressed as rub-off resistance, was measured before and after the heat resistance test. Two different methods were used: Quadrant and Pira Wallace. The obtained results represent a part of a larger study on the behavior of various types of masterless printing.

Introduction

Different characteristics of substrate, printing ink and the mechanism of drying influence the stability of the prints. Regarding the printing substrate, the most important factors are the surface properties, like roughness or porosity, coating layer properties, etc. Also relevant for the paper structure is its bulk or density. Their influence to the print stability is even greater when using water-based printing inks that penetrate into the substrate, as is the case with IJ inks. The composition of the printing ink is another important parameter in the study of abrasive damages of the prints. If colorants in the ink are dyes, the stability of the print may differ from that printed by pigment containing inks. The aim of this study was to examine the influence of substrate surface on the mechanical and thermal stability of IJ prints.

Experimental

Different types of paper were used: **Z** - Zweckform Photo Paper recomanded for IJ prints, one side coated, high glossy, (130 g/m^2, 170 µm), **K** – Carton board one side coated multilayered white board, (300 g/m^2, 430 µm), **I** - ICP Permanent Paper made at the Pulp & Paper Institute in Ljubljana, which corresponds to standard – ISO 9706, no surface treatment, (70 g/m^2, 110 µm), **T** – Three-ply Tissue Paper with a low percentage of secondary fibres, (60 g/m^2, 185 µm). The paper samples we subjected to the penetration test, which was made by Penetration-Dynamics Analyzer (PDA). The analytical technique employed is based on recording the change of intensity of ultrasonic signals transmitted through a solid sample while one its faces is in contact with a liquid. Paper surface roughness was measured by two different conventional methods - PPS and Bendtsen and also by observing the surface of the samples with confocal laser microscopy – CLSM: Scan area 460 µm × 460 µm, air objective with numerical aperture 0,6, Laser beam wavelength 458 nm and resolution in z-direction 2,7 µm. Prints were done by Canon BJC-8500 IJ printer with magenta cartridge BCI-8M and black cartridge BCI-8BK (resolution: 600 dpi; colour intensity 100%). For resistance to heat, the ISO-11798 method was used. Printed paper samples were exposed to elevated temperature (90°C) for 12 days. The mechanical stability of prints, expressed as rub-off resistance, was measured with two different methods: Quadrant and Pira Wallace.

Results

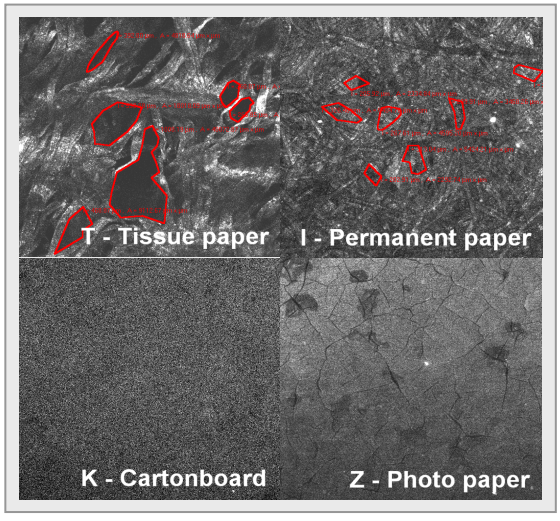

Figure 1. Surface topography, CLSM method

Both the PPS and Bendtsen methods are based on airflow measuring principle, but the obtained results are

not comparable. The smoothest surface according to PPS is sample K – Carton board and according to Bendtsen it is sample Z – Photo paper. The results of topography evaluation observed by CLSM method show that the surface of sample K is more homogenous than the surface of sample Z (Figure 1).

The dynamic penetration method (PDA) was meant to determine the absorption capacity of the substrate. The highest degree of penetration was observed with sample Z – Photo paper (Figure 2).

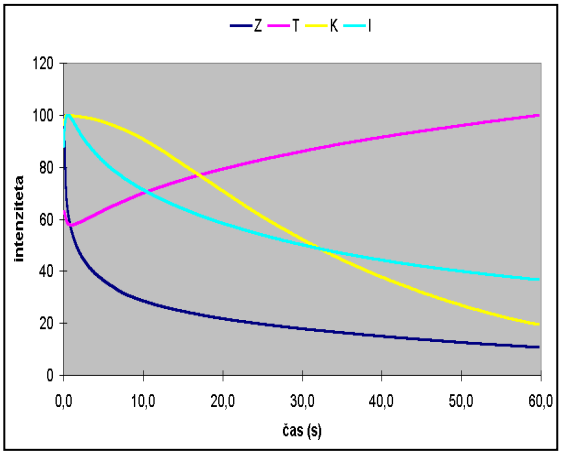

Figure 2. The results of PDA penetration test

The obtained results of rub-off resistance test measured separately by Pira Wallace and Quadrant differ (Figure 3). The sample T – tissue paper, cannot be measured with Quadrant. The results show that magenta printed area has a higher mechanical stability than carbon. The least stabile is the black printed sample I – Permanent paper.

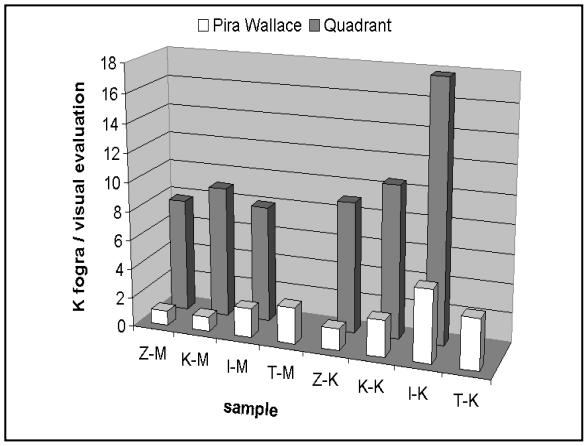

Figure 3. The results of rub-off resistance test measured by both methods; Pira Wallace and Quadrant.

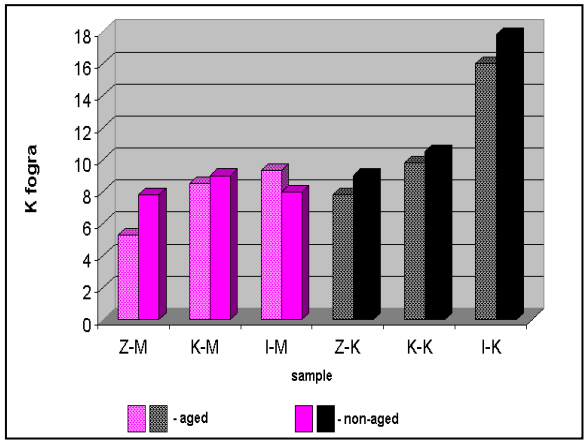

Figure 4. Rub-off resistance, Quadrant method, before and after heat resistance test.

Conclusion

When the colorants in the IJ ink are dyes, as is the case with C, M and Y, the ink is attached to the paper surface in the same way as to the interior fibres reached by penetration. The black ink is a pigment based ink. Therefore it is possible that at the very surface of the dried ink layer some pigments are not attached strongly enough. This can lead to a lower physical stability of such IJ prints. After the heat resistance test, the improvement in mechanical stability is evident. It can be due to the heating of colour whereby the binding becomes stronger.

References

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Biographies

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