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CORRELATION OF INK PENETRATION WITHIN THE PRINTING SUBSTRATE AND PRINT-THROUGH EFFECTS IN OFFSET, GRAVURE AND SCREEN SUSTAINABLE PRINTS

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Introduction

The drying process of printing ink on absorbent substrates in conventional printing techniques essentially takes place in two steps: the penetration of the ink within the printing substrate and the oxidation or oxy-polymerization process. The process of ink penetration within the printing substrate itself begins immediately after the ink is transferred using the impression cylinder, while the oxidation or oxy-polymerization process lasts up to several hours. In this research, the correlation between the value of ink penetration within the printing substrate and the print-through effect on prints produced using three different printing techniques was observed. In this analysis prints made on sustainable printing substrates were produced with a 30% share of non-wood cellulose pulp were observed in order to reduce the consumption of wood raw materials worldwide. The results of the research prove that the degree of ink penetration

Problem Description

In this study, samples printed according to the ISO 12647 standard using three printing techniques on printing substrates obtained with a 30% share of wheat or barley or triticale were analysed (ISO 12647, 2013). The aim of this research was to observe the degree of ink penetration into the printing substrate in correlation with the print-through effect in black prints (printed with one layer of black) and in prints printed with three inks (printed with one cyan, one magenta and one yellow layer, which should achieve black coloration according to the theory of subtractive colour mixing) (Field, 1999).

Methods

The experimental part of this research was performed in the following steps: 1. production of laboratory paper substrates; 2. printing of paper substrates; 3. ink penetration depth analysis; 4. analysis of print-through effect; 5. analysis of spectrophotometric values of prints.

Table 1. Composition and marks of paper substrates

Paper substrate	Composition (%)	
K	0% straw pulp	100% recycled
R	0% straw pulp	100% recycled
30W70R	30% wheat	70% recycled
30B70R	30% barley	70% recycled
30T70R	30% triticale	70% recycled

Table 2. Printing sequence for print technique

Printing technique	Printing sequence
offset printing	cyan+magenta+yellow
gravure printing	yellow+magenta+cyan
screen printing	yellow+cyan+magenta

Results

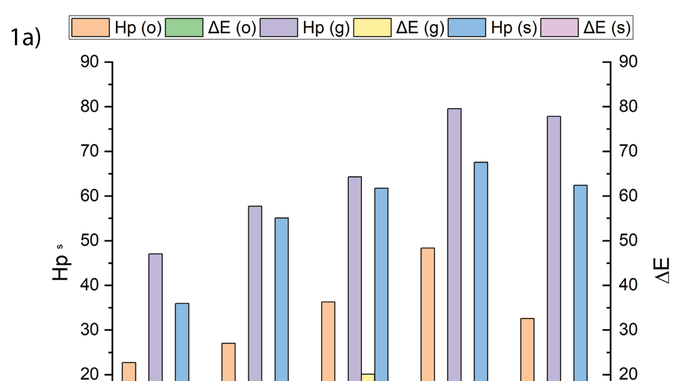


Figure 1 Correlation between the ink penetration depth within the printing substrate (Hp) and the print-through effect (ΔE^*_{00}) for prints obtained with the offset printing process (o), gravure printing process (g) and screen printing process (s) with: 1a) one layer of black ink and 1b) three layers of cyan, magenta and yellow ink

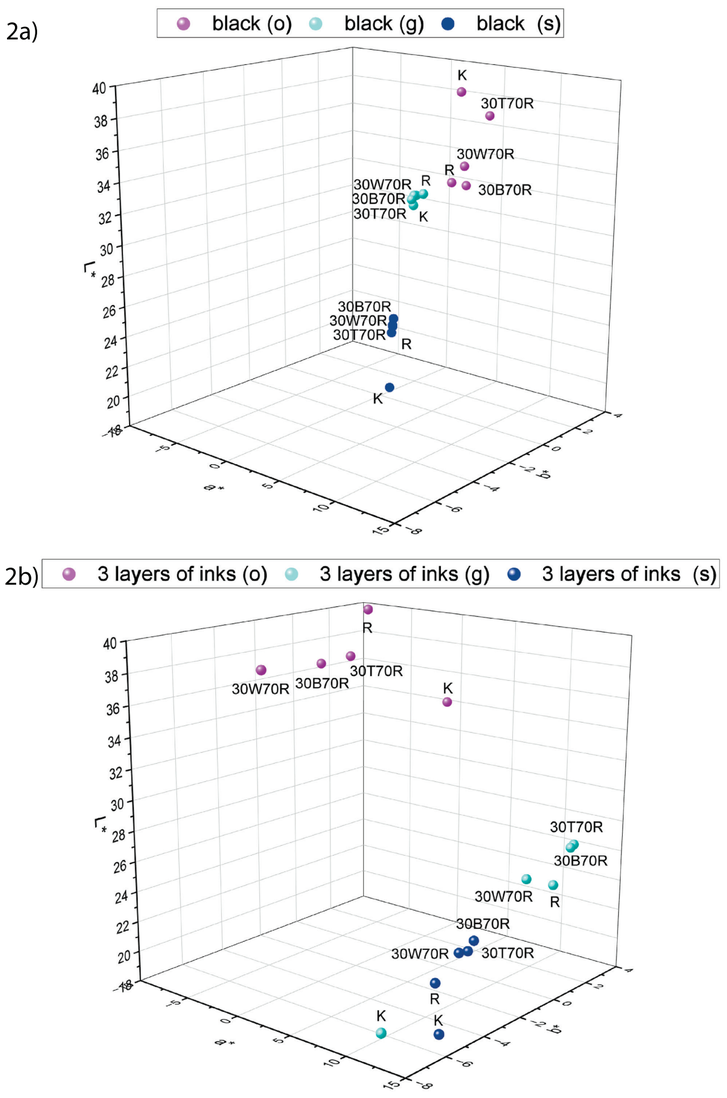
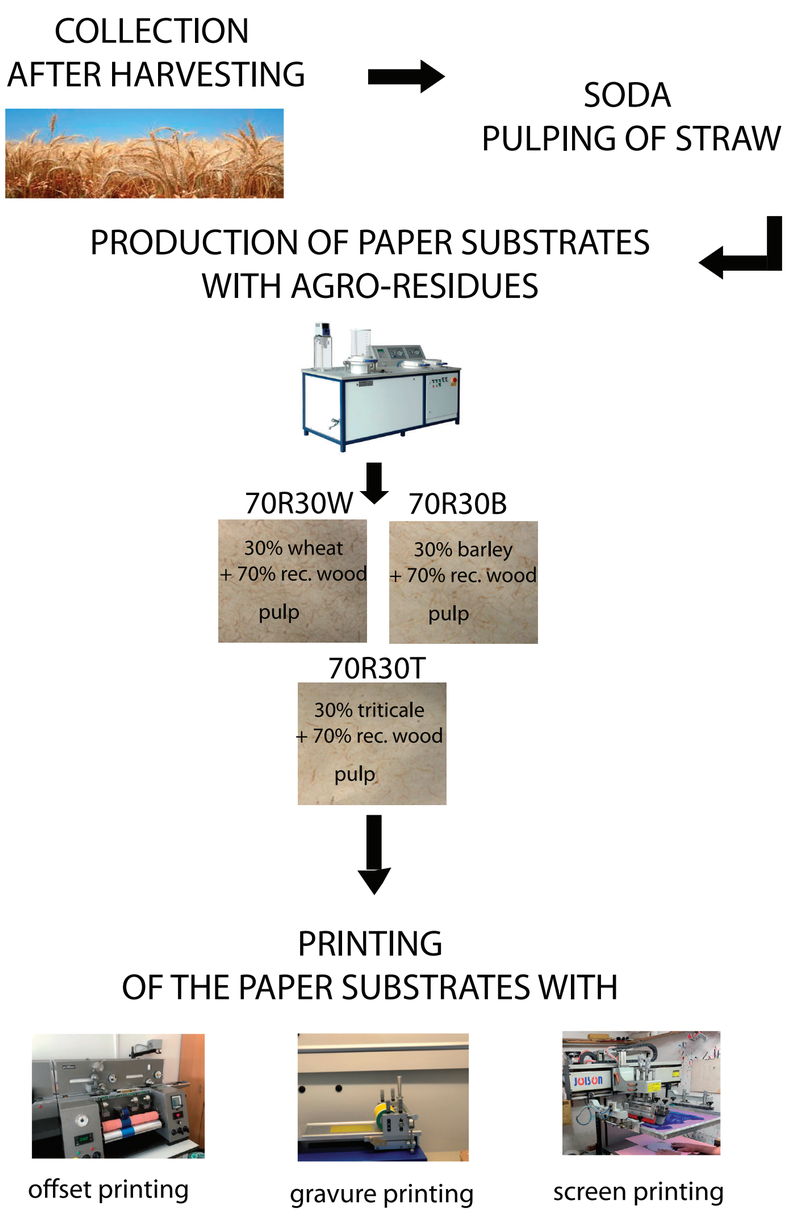


Figure 2. Colorimetric values of prints with single ink layer (black) (2a) and 3 layers of ink (brown)(2b) produced with the offset printing process (o), gravure printing process (g) and screen printing process (s)

Discussion / Conclusion

The results of the research prove that the degree of ink penetration within the printing substrate correlates with the print-through effect in all analysed black prints (printed with one ink layer), while no correlation was found in the prints that were printed with three ink layers (cyan, magenta and yellow). Meaning the print-through effect is very low compared to the values obtained for ink penetration within the printing substrate. It was also found that the lowest values for ink penetration inside the printing substrate was achieved with offset printing process, and thus the lowest values for the print-through effect.

It has been confirmed that the dynamic viscosity of the ink is directly related to the penetration depth of the ink. It was proven that the analyzed paper substrates are more suitable for multi-colour printing than for mono-colour printing with only black ink if a lower print-through effect is to be achieved. It is confirmed that the printing sequence of inks is a very important factor in achieving uniform coloration of prints produced with different printing techniques. Sustainable printing substrates with a 30% straw pulp content achieve very low deviations compared to reference substrates made only from recycled wood pulp, which confirms the possibility of using these paper substrates in all three printing processes.



ACKNOWLEDGMENTS

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