INVESTIGATION OF THE QUALITY PARAMETERS OF SPECIAL EFFECT INKS

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Abstract
The aim of the study was to determine the influence of the kind of paper and the ink film thickness on the observed optical effect of the ink. The study involved different types of printing substrates, i.e.: gloss coated, matt coated, uncoated and cardboard and different ink film thicknesses. The tests were carried out in offset technology with the use of IGT AIC 2-5 laboratory device. The MA98 X-Rite multi-angle spectrophotometer was used to evaluate the laboratory prints. It was proved that all the parameters tested in the research have a great influence on the achieved optical effect. It is assumed that the obtained test results may find application in practice.
Keywords: *special effect inks, multi-angle spectrophotometric measurements, gloss measurements, colour coordinates, paper bases*

1. Introduction

Special effect inks play very important role in the print quality. With their use it is possible to obtain many interesting visual effects, which significantly increase attractiveness of the final product.

They are generally divided into two groups:

- platelets of homogenous materials without substrate (e.g. aluminium, copper-zinc platelets),
- platelets of a layered structure of at least two optically different layers in the layer-substrate structures and multilayer structures without the substrate.

The optical effect depends on many factors for example:

- layers' transparency,
- layers' refractive indices,
- layer's thickness,
- kind of a pigment,
- thickness of pigments,
- orientation of the platelets,
- kind of a metal coating etc. [1, 2].

Research related to special effects inks are within the scope of the authors' interest. Some more works were presented on this topic [3, 4]. Many other researchers also deal with this interesting subject [5, 6, 7].

Metallic inks are one of the effect inks which are very popular to achieve luxury prints. The different optical effects of this inks can be measured under the different viewing conditions. The multi-angle spectrophotometer is one of the best methods to measure and evaluate this effect. In this article the research results achieved with the use of this device were presented.

2. Materials and laboratory setup

For the purpose of the study different laboratory devices were used:

- IGT AIC2-5 printability tester with the grinding IGT AE unit,
- IGT micropipette,
- multi-angle MA98 X-Rite spectrophotometer,
- X-Rite eXact spcetrophotometer,
- analytical Radwag AS/X balance meter,
- Erichsen Picogloss 503 glossmeter,
- X-Color QC software.

Paper strips were printed in offset technology using a printability tester IGT AIC-2. Offset sheet-fed inks were applied onto the IGT device by means of a pipette with a precision of up to 0.01 cm^3. The ink was rubbed on the grinding set for 4 minutes, then the forming roll was put for 1 minute against to the printing set. Different colours of inks were tested in the studies. The prints were made with four different ink film thicknesses. To achieve different ink film thicknesses on the paper base different amounts of inks were applied onto the grinding set: 0.05 cm^3, 0.15 cm^3, 0.3 cm^3, 0.6 cm^3. The IGT device was washed after each printing operation, then the ink was applied again on the grinding set. The colour coordinates parameters of the prints were measured under different viewing conditions with the use of multi-angle spectrophotometer. Such angles were used in the studies: –15°, 15°, 25°, 45°, 75°, 110°.

Tests were performed under the standard climatic conditions such as temperature of 23°C and 50% of relative humidity.

Four different papers of a grammage 200 g/m^2 of different gloss, CIE whiteness and ISO brightness parameters were tested in the studies.

3. Results and discussion

Exemplary results of one of the effect ink tested in the studies were presented in the Fig. 2. The spectrophotometric measurements were made with reference to the sample printed with the highest ink film thickness (0.6 cm^3

amount of ink applied on the grinding set) which means that samples printed with three other thicknesses were compared with the sample printed with the thickest ink film. The X-Colour QC software compatible with X-Rite MA98 spectrophotometer was used in the evaluation. The colour changes of blue metallic ink printed on the gloss coated paper due to the different viewing conditions such as: –15°, 15°, 25°, 45°, 75°, 110° were demonstrated in Fig. 1.

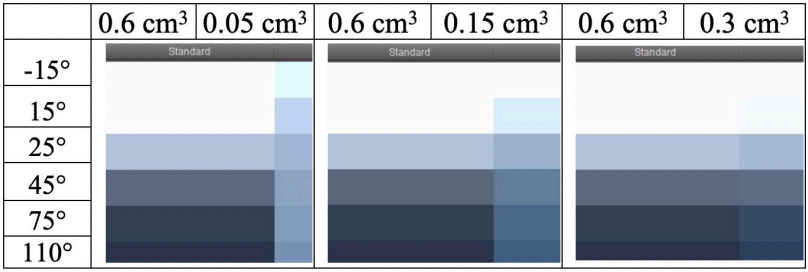

Fig. 1. Changes in colour of blue metallic ink on gloss coated paper due to different viewing conditions (-15°, 15°, 25°, 45°, 75°, 110°) and different ink film thicknesses.

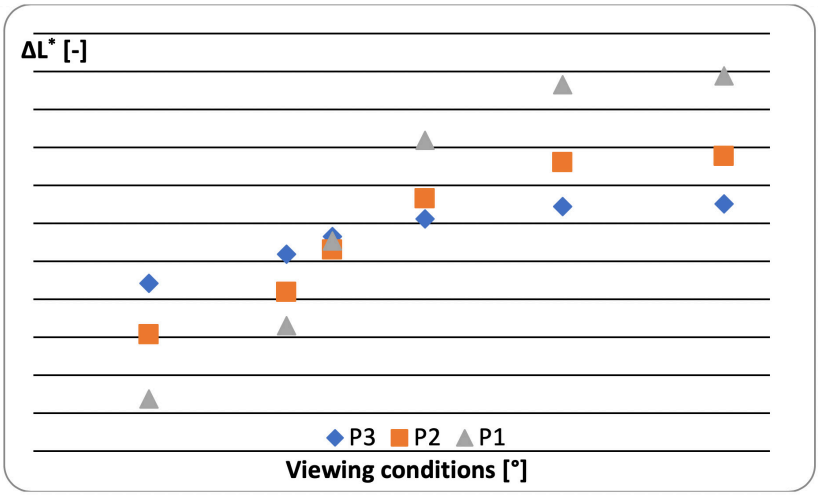

Fig. 2. ΔL parameter changes of blue metallic ink observed under different angle viewing conditions in reference to the thickest ink film amount applied on the gloss coated paper, P1 – 0.05 cm³, P2 – 0.15 cm³, P3 – 0.3 cm³*

Exemplary results of ΔL^* parameter changes of blue metallic ink observed under different angle viewing conditions in reference to the thickest ink film amount applied on the gloss coated paper (P4 – 0.6 cm^3) were presented in Fig. 2. The other three thinner ink film thicknesses were named as P1 – 0.05 cm^3, P2 – 0.15 cm^3, P3 – 0.3 cm^3.

4. Conclusions

It was proved that the biggest metallic effect is achieved only on gloss coated papers. On uncoated paper bases the metallic effect is observed only for the thickest ink film thickness. For thinner ink film thicknesses the metallic effect is hardly noticeable.

It was observed that the prints achieved on gloss coated substrate with the thickest layer of ink are also characterized by the biggest gloss value and the best print quality.

The L^* parameter was the most important one of CIELAB and CIELCh parameters affecting the ΔE^*_{ab} values.

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