Elaboration of Parameters for Evaluating Primer Coats for Inkjet Printing on Wood-based Materials

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Introduction

Currently, there are no standardised properties/features nor relevant test methods fit to characterise the print substrate for printing on wood-based materials. Likewise, there is a lack of defined parameters and relevant limit values for characterising test prints and for predicting the printing quality. Primer coats and print builds are developed today, preferably following the "trial and error" approach.

Objective

The objective of the project was to derive parameters of the print substrate having an impact on the print quality in digital printing. For that purpose, suitable procedures were to be developed and adjusted for measuring the print quality and influential parameters of the print substrate.

Material and Methods

The influence of wood-based materials was investigated on two different, uncalibrated HDF panels. One panel consisted of coniferous wood partly containing parts of bark, the other containing no bark at all.

Apart from the radiometric determination of the density profiles and thickness swelling (acc. to DIN EN 317) of both panels, the surface pH value, the colouring and the contact angle of the uncoated panels were determined. Prior to coating, the panels' top sides were sanded on a belt sander (sanding sequence: K180P, K320D; D = diagonal sanding). The surface roughness of the uncoated and coated HDF was measured optoelectronically applying the GFM 3D surface measuring device "MikroCAD".

Within the scope of Project 9, various primers were available as print substrates. The following properties were established in the primer coats:

- the colour in the L*a*b* model,
- the degree of whiteness,
- the surface topography,
- the degree of gloss,
- the contact angles after 1 s, 10 s and 60 s, surface energy and
- the pH-value.

The printing methods under review were inkjet printing in the single-pass and multi-pass procedure, using the CMYK colour model.

The single-pass printer at the IHD was extended in the course of the project by pinning units. Pinning means UV-LED units arranged behind the single printheads. This facilitates pre-curing and fixation of the ink after as early as 0.3 s after the ink droplet has hit the surface.

In order to be able to evaluate the effects of the changes in influentiual parameters, a test file was developed as a print template, containing, apart from a print image as it is usual in the industry (maple decor), another part suitable for the image-analyzing and evaluating system DOMAS of Papiertechnische Stiftung (PTS).

The print quality was evaluated visually by trained test persons following an evaluation scheme that was developed within the scope of the project and compared to the results rendered by the image-analyzing system DOMAS. The image-analyzing system preferably characterised the uniformity of the print and the contour definition of the prints. Furthermore, the colours of the full tone areas on the completed prints were measured.

Results

The investigations showed that the best print results, determined by visual evaluation (of both the single-pass and the multi-pass print), were achieved on surfaces of low roughness. Apart from the print substrate, there are also the procedural stages and ink properties that significantly influence the print quality.

Basically, the following parameters are suitable for evaluating the print substrate:

- colours in the L*a*b* model, degree of whiteness,
- surface topography,
- contact angles after 1 s, 10 s, 60 s, surface energy.

The surface energy of the print substrate must verifiably be higher than the surface tension of the print ink. In this context, the time lag between the droplet hitting the substrate and the curing unit taking effect must be taken into account. The longer the time lag, the more the ink droplet will have the chance to spread. The print substrate should prevent such spreading as best as possible, i.e., the contact angle change over time should be as little as possible. The positive effect of swift droplet fixation was also confirmed by installing the pinning units (Fig. 1).

The degree of whiteness mainly has an effect on colour reproduction. Impacts of the surface pH-value on the print quality were not verifiable.

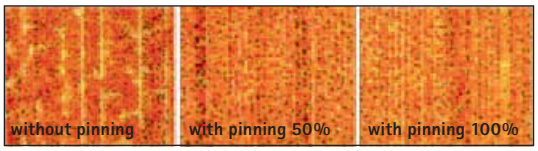

Fig. 1: Microscopic images of maple decor, with and without pinning of varying intensity (Scale: 10 : 1, left no pinning, centre 50 % performance, right: 100 % performance)

Conclusion

As a result of the investigations, it was found that the roughness of the print substrate is the main parameter influencing print quality. Moreover, the surface energy and the degree of whiteness and L*, a*, b* values of the print substrate and priming coat are of importance. The timely fixation of the ink droplets by way of LED pinning affects print quality positively.

A set of regulations in the form of IHD works standard IHD-W-476 was worked out for evaluating the print quality, consisting of requirements regarding the application of primers, the definition of primer properties, the application of a test print and its subsequent evaluation.

Literature

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