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# The effects of fragranced microcapsules application o the physical and print quality characteristics of the prints

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## Introduction

The printing industry faces immense challenges and a demand for new, innovative and value-added print products that can deliver both customer benefits and higher profits for printers. In order to decorate, protect or give a new functionality to the printed product, different types of coatings are used today, which may contain different materials that enable certain properties, e.g. fragrant microcapsules (Milošević, 2019; Ghosh, 2006). Microcapsules are tiny particles that have a very regular, spherical shape and usually consist of two main parts: the core – encapsulated active material, and the shell – an outer part that protects the core (Ghosh, 2006). The fragrant microcapsules encapsulating scents, are mechanically activated by a frictional movement (ie. rubbing motion, application of pressure and shear force) under which the shell of the microcapsules bursts and releases the encapsulated fragrance. Numerous types of microcapsules encapsulate different active ingredients (ie. agents) and have different functionalities and can be incorporated into printing substrates or applied to their surface by various printing or non-printing techniques (Milošević, 2019; Rodrigues et al, 2009; Goetzendorf-Grabowska et al 2004; Goetzendorf-Grabowska et al, 2008; Urbas et al, 2017). Coated prints with fragrant microcapsules have a new functionality, but as a negative effect, the applied coating layer changes its important physical and optical properties, resulting in higher surface roughness and thickness of the prints and a change in print quality characteristics. For this reason, it is important to analyze the physical and optical properties of the coated prints with different fragranced microcapsules mass concentrations, and to determine the extent to which they differ from the original prints (uncoated samples) (Milošević, 2019, Urbas et al, 2017).

## Methods

The characterization of the fragrance microcapsules (size/volume distribution calculations) was based on a SEM analysis (scanning electron microscopy; JSM 6060 LV, Jeol, Japan) and subsequent image analysis (500 measurements; ImageJ software) (ImageJ, n.d.). The characterization of the surface properties of the coated prints was performed by atomic force microscopy (AFM, VeeCO di CP II, Digital Instruments, USA) and scanning probe microscopy software (SPIP, Denmark). For the analysis of the surface roughness properties of the coated samples the standard surface roughness parameter was used (Root-Mean-Square roughness - Sq). The optical properties, i.e. the print gloss of the coated prints was measured using the Elcometer 407 Statistical Glossmeter (X-Rite, USA) in accordance with ASTM D523-89 standard (ASTM D523-89, 1999).

For substrate material that was to be printed and coated in the experiment, a matt coated paper (GardaMatt Art, Lecta, Spain) with the following basic properties was used: base weight 130 g/m², specific volume 0.85 cm3/g, thickness 111 µm and CIE whiteness 121.3.

## Results

Table 1 shows the results of the surface roughness characteristics of the samples (Root-Mean-Square roughness – Sq) for a solid tone patch (only printed, uncoated), a coated sample with the only varnish without microcapsules (0 %), a coated sample with varnish and fragrant microcapsules in the mass concentration of 1 %, and a coated sample with the varnish and microcapsules in the mass concentration of 7 %. Figure 1 shows 3D renderings of the AFM data for the same four sample groups.From the data presented, it can be seen that only the printed sample (solid tone patch) has the highest surface roughness (Sq) compared to other samples (Figure 1a). The coating process without fragranced microcapsules drastically reduced the value of the surface roughness (to 19.40 nm) and enabled a very uniform and flat surface structure (Figure 1b). The subsequent addition and increase of the mass concentrations of the fragrant microcapsules in the varnish coating layer (1 % and 7 %) resulted in a significant increase in the surface roughness values (Sq), Table 1. Higher concentrations of the fragrant microcapsules in the coating layer caused more pronounced changes in the surfaces of the coated samples, which resulted in the generation of the numerous new peaks (Figures 1c and 1d).

Table 1

Root-Mean-Square surface roughness values

| Sample | Sq [nm] |
|---|---|
| Solid tone | 56.21 ± 3.49 |
| 0% | 19.40 ± 5.20 |
| 1% | 22.70 ± 6.23 |
| 7% | 53.06 ± 7.15 |

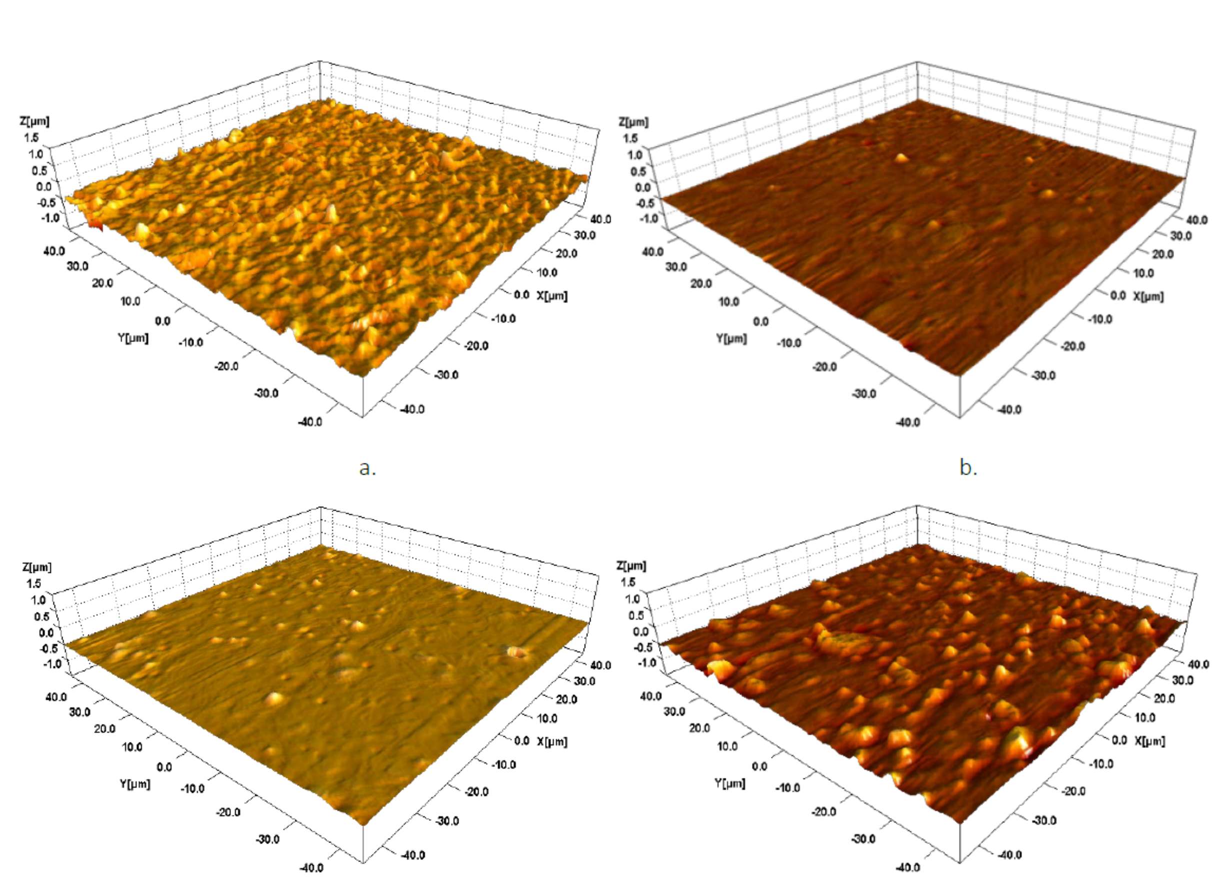


Figure 1

3D renderings of the acquired AFM data: (a) only printed sample, (b) 0 % sample, (c) 1 % sample, (d) 7 % sample (AFM; 90×90 µm)

The use of the fragrant microcapsules not only increases the value of the final printed product, but also changes the basic print quality properties. Figure 2 shows the measured print gloss values of the tested samples. It can be seen that the sample printed without varnish (cyan solid tone patch) has the lowest print gloss value. The coating applied only with the varnish enabled the highest print gloss value. The addition of fragrant microcapsules, however, led to the generation of many surface irregularities, which affected the reflective properties of the samples, i.e. reduced the print gloss values. With increasing mass concentration of the fragrant microcapsules (from 1 % to 7 %), the print gloss decreased, which is consistent with the previously analyzed surface roughness data.

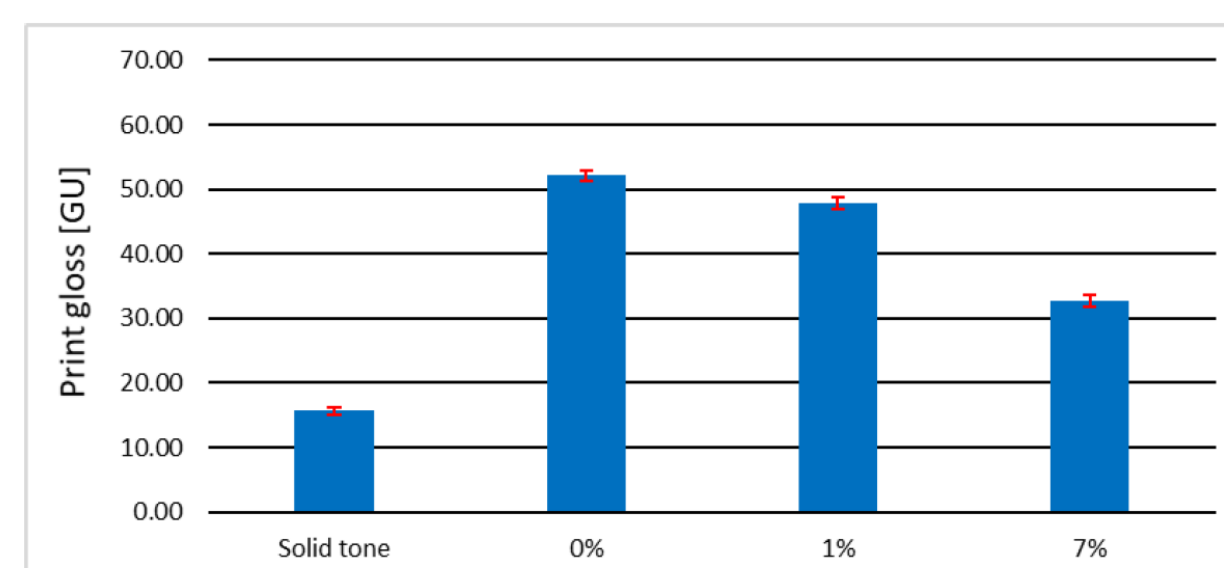


Figure 2

Print gloss data of the analyzed samples (60° angle)

## Discussion / Conclusion

From the AFM and print gloss analyses presented, it can be concluded that the coating process performed with only varnish, without the fragrant microcapsules, resulted in a uniform, non-porous surface structure with only a few isolated peaks. The resulting surface was much smoother (lower surface roughness value) than the reference sample (only printed solid cyan tone), which in turn enabled the highest print gloss. The use of fragrant microcapsules in the coating process resulted in rougher surfaces with more irregularities, changing the original flat surface of the only coated sample without fragrant microcapsules. The higher concentration of the fragrant microcapsules in the coating layer (7 %) resulted in a higher surface irregularity of the surface, resulting in a significant increase in the surface roughness value (Sq) and a decrease in print gloss.

## REFERENCES

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