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ANALYSING THE REPRODUCTION QUALITY OF BRAILLE DOTS ON SELF-ADHESIVE LABELS PRODUCED WITH UV INKJET PRINTING

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Introduction

Although modern digital technologies have largely replaced many traditional communication methods, including braille for the blind and visually impaired, braille remains a vital component of literacy for this community. To accurately recognise the braille dots that make up the standardised characters, it is important that they have the correct dimensions, both in size and height. In this study, the reproduction quality of braille dots on two types of self-adhesive labels was analysed. The elements were printed using the UV inkjet printing technique with different number of passes (layers) to define and analyse the changes that occur with an increasing number of UV varnish layers. The samples were printed with 2, 4, 6, 8, 10 and 12 UV varnish layers. The image analysis with the scanning electron microscope (SEM) focussed on the change in diameter of the dots. The braille dots show deviations from the digitally defined diameter in the graphic prepress (1.60 mm), especially in the horizontal direction, which is due to the spreading of the varnish and the movement of the print head. The first layers of UV varnish behave differently depending on the substrate, while the application of further layers reduces deformation and improves dot formation. Lifting the print head led to a stronger spreading and deformation of the dots in both samples.

Problem Description

The aim of this study was to determine the feasibility of reproducing braille dots of a suitable shape and diameter (1.60 mm) and to evaluate how the appearance and diameter of the dots are affected by increasing the number of varnish layers.

Methods

In this study, the quality of braille reproduction was analysed in terms of the diameter dimensions of braille dots printed with UV varnish on a Roland VersaUV LEC-540 device using two types of self-adhesive labels.

Table 1
Characteristics of the self-adhesive labels used (Muflon, n.d.; JAC, 2021)

	Type of self-adhesive label	Weight (g/m²) ISO 536	Thickness (µm) ISO 534
Sample 1	MP CHROM 90V EP KR80 – paper	90	74
Sample 2	JAC SERILUX 70100 – PVC film	114	90

The braille cell was produced with a dot diameter of 1.60 mm in accordance with the Marburg Medium standard. The braille dots were printed with an ECO-UV varnish that was applied directly to the substrate and cured with UV light. Full braille cells were printed with 2, 4, 6, 8, 10 and 12 layers.

Results

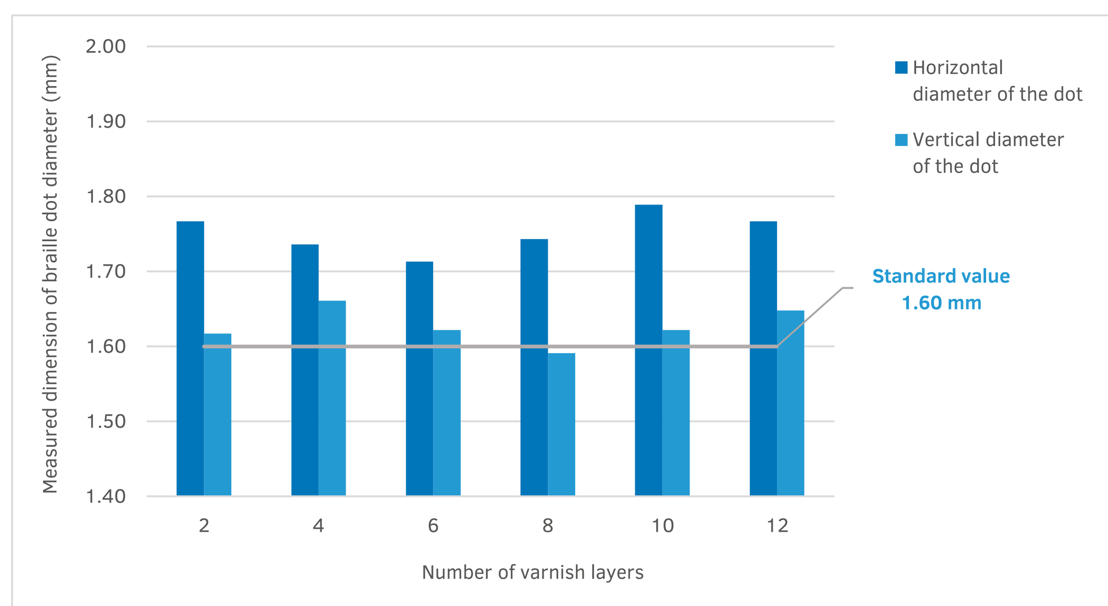

Figure 1

Measured dimensions of the diameter of the braille dots in horizontal and vertical direction printed with 2–12 layers of UV varnish on sample 1

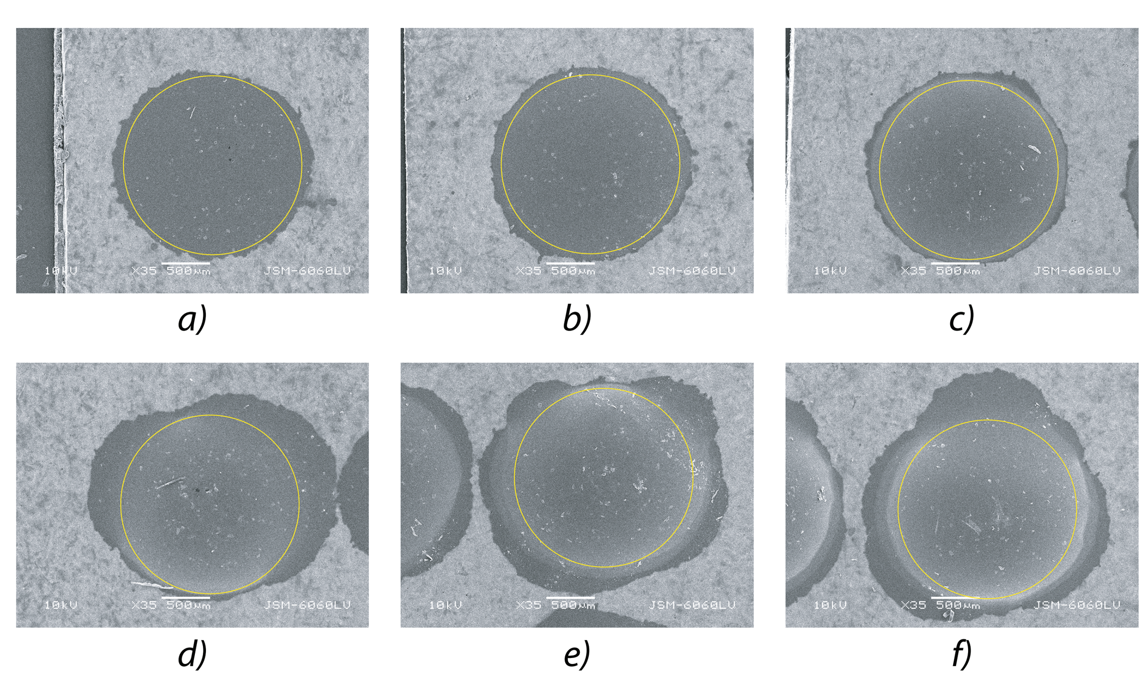

Figure 2

Braille dot surface printed with 2 (a), 4 (b), 6 (c), 8 (d), 10 (e) and with 12 layers of UV varnish (f) on sample 1 (SEM; 35× magn.)

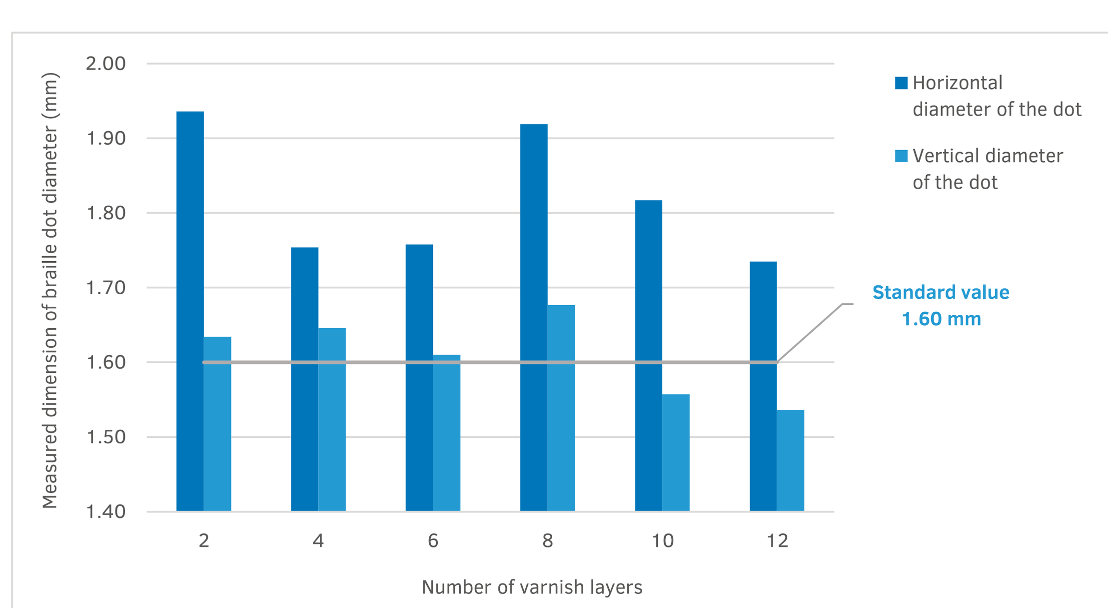

Figure 3

Measured dimensions of the diameter of the braille dots in horizontal and vertical direction printed with 2–12 layers of UV varnish on sample 2

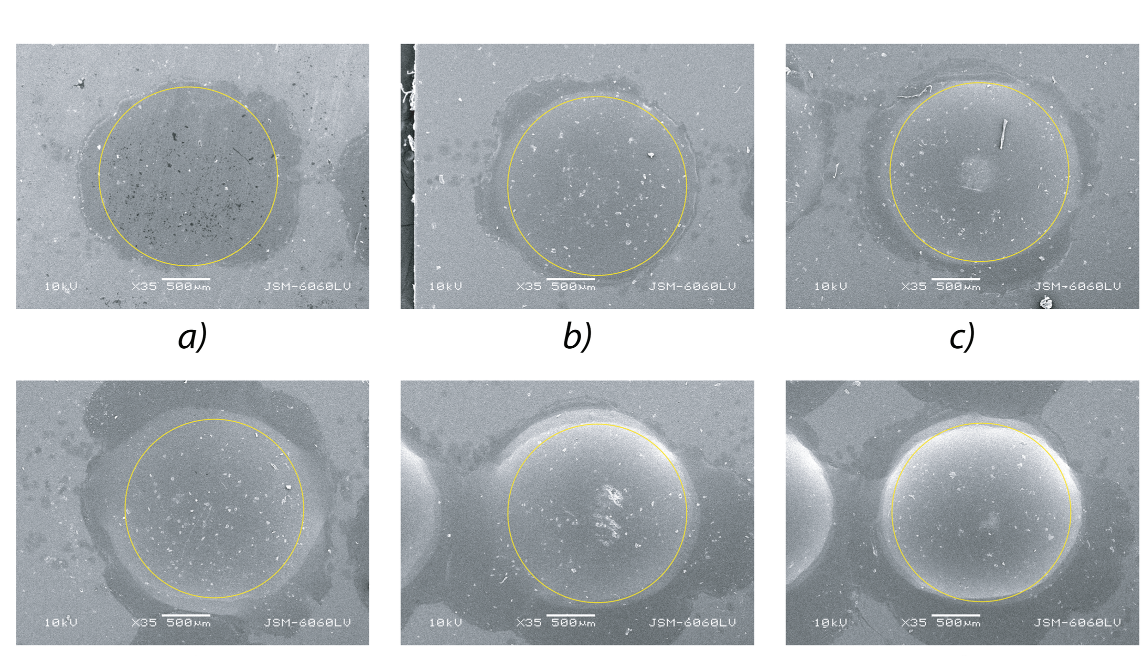

Figure 4

Braille dot surface printed with 2 (a), 4 (b), 6 (c), 8 (d), 10 (e) and with 12 layers of UV varnish (f) on sample 2 (SEM; 35× magn.)

Discussion / Conclusion

Measurements and analyses of the diameters of braille dots printed with UV inkjet technology and UV varnish show a discrepancy between the digitally specified dimensions and the actual measured values. The diameter of the dots measured horizontally is consistently larger than the diameter measured vertically, with the vertical measurements being closer to the maximum standard value of 1.60 mm.

The application of the initial layers of UV varnish causes an interaction with the substrate, where the substrate in sample 1 absorbs the varnish, while the non-absorbent surface of sample 2 results in more pronounced varnish bleeding until polymerization occurs. The application of the initial varnish layers changes the surface structure of the samples, including their roughness, surface tension and similar properties. This has also been shown in previous studies (Urbas et al., 2016; Rotar et al., 2020). Additionally, when more layers are applied, the varnish interacts with the previously polymerised UV varnish layers, resulting in smaller dot deformations and improved vertical braille dot formation. Similar results and conclusions were observed in the study by Miloš, Vujčić, and Majnarić (2021). This trend was observed in samples printed with 4 and 6 layers of varnish, where the braille dots increasingly approached a round shape and standard values. With the further application of varnish layers, especially after 8 layers, there is increased varnish bleeding. This is attributed to the lifting of the print head and the gravity flow of the varnish from the height of the dome-shaped dots that have already formed. Although this deformation may affect the aesthetic appearance of braille dots, it is not expected to significantly affect the legibility of the braille, as the dots remain dome-shaped and are presumably tactilely recognisable.

This research demonstrated the importance of analysing the production of braille on different substrates. It was found that the braille dots on sample 1 (paper) were more clearly and precisely formed than on sample 2 (PVC film). This research enabled certain conclusions and assumptions to be made why there was a difference in the formation of braille dots, i.e., the behaviour of UV varnish on the given materials, but it would be necessary to investigate the absorptivity of the materials, their roughness, contact angle, and similar parameters to confirm the given conclusions.

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