Influence of Digital Printing on the Water Absorption Properties of Weft Knitted Fabrics

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Introduction

For textile garments, water absorption is one of the most important fabric properties, because it impacts the absorption and subsequent transportation of sweat produced by the wearer's body, which impacts the comfort of the garment. Water absorption of weft knitted fabrics is not a frequently investigated topic, with the water absorption of woven fabrics being explored more often. A study investigating the static and dynamic water absorbency of woven fabrics showed that fabric water absorbency depends on the surface of the fibres used – investigated fabrics made from polyester warp yarns and wool weft yarns did not show any water absorption during the static and dynamic absorbency tests. Such results were attributed to the unique surface of wool fibre – the outer layer of the fibre is made of scales, which create a hydrophobic barrier for the water. Another study investigated the dynamic water absorption of double-layered weft knitted fabrics using the water drop method. The results showed that that dynamic water absorption for such fabrics is influenced by the fibre composition of the fabric, the course and wale density of the fabric and the fabric structure. During the study, it was observed that fabrics, which's outer layer was made from polypropylene threads, did not absorb the drop of water due to the hydrophobic nature of the polypropylene threads, while fabrics which's outer layer was made of cotton absorbed the drop gradually. Fabrics that were knitted using cotton and polypropylene threads showed the lowest absorption values, which was also attributed to their higher course and wale density. Combined pattern fabrics showed higher absorption values overall, due to the structure of the fabrics – the presence of rib floats in the fabric structure created capillaries that aided the transportation of water through the fabric. The aim of this researcher was to determine the influence of digital printing on the water absorption properties of weft knitted fabrics.

Materials and methods

- During this research, 10 variants of weft knitted fabric were investigated prior and after applying the digital printing process.
- Structural parameters, such as knitting pattern, fiber composition, linear density of the yarn, horizontal and vertical density coefficients, loop length and area density, were recorded prior to digital printing.
- Yarns made from cotton (CO), viscose (VI), modal (MO), polyester (PES) fiber and elastane (EL) and metallic (ME) threads were used.
- The specimens were knitted using the single jersey, plated (single jersey based), plated laid-in, laid-in patterns (see Figs. 1-2), using a circular weft knitting machine.
- The dynamic water apsoption was tested by the drop method.
- All tests were carried out in a standard atmosphere according to the ISO 139 standard.

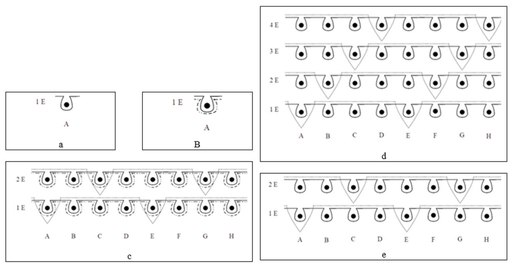

Fig 1. Patterns of the investigated fabrics: a – single jersey, b – plated (single jersey base), c – plated laid-in (single jersey base), d – laid-in 1 (single jersey base), e – laid-in 2 (single jersey base);
—— – base yarn, ·-·---·-· – plated yarn, ····· – laid-in yarn;

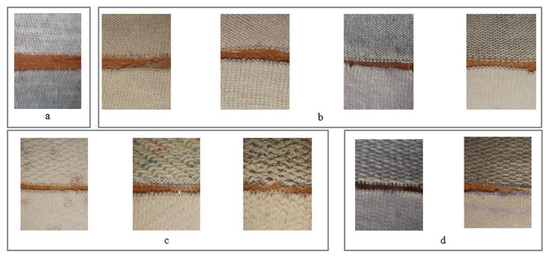

Fig 2. Images of the fabrics with the technical face (lower) and technical back (upper) sides shown: a - fabric No. 1: single jersey pattern; b – plated patterns, from left to right: No. 2, No. 3, No. 5, No. 6; c – laid-in patterns: No. 8, No. 9, No. 10; d – plated laid-in patterns: No. 4, No. 7

Conclusions

1. When comparing the water absorbency of fabrics before and after digital printing, no clear tendency has been observed. It means that digital printing does not have a negative influence on the water absorption properties.
2. The highest absorbency was observed in laid-in (No. 8 - 10) fabrics, which also had the highest fabric thickness and yarn linear density, were knitted using the same knitting pattern and had high amount of cotton fiber in their composition.
3. All investigated cotton-based fabrics (No. 1, 4, 6, 8 – 10) showed a gradual increase in liquid spot area during the time.
4. Fabric No. 4, knitted in plated pattern, demonstrated moderately low absorbency, surpassing only fabrics No. 1-3, despite having one of the highest thickness values.
5. Fabric thickness alone cannot be used to compare the absorbency of fabrics, and needs to be used considering not only the different patterns of fabrics, but also other characteristics, such as yarn linear density.

Results and discussion

- There is no clear tendency when comparing the dynamic absorption of fabrics before and after applying digital printing (see Fig. 3).

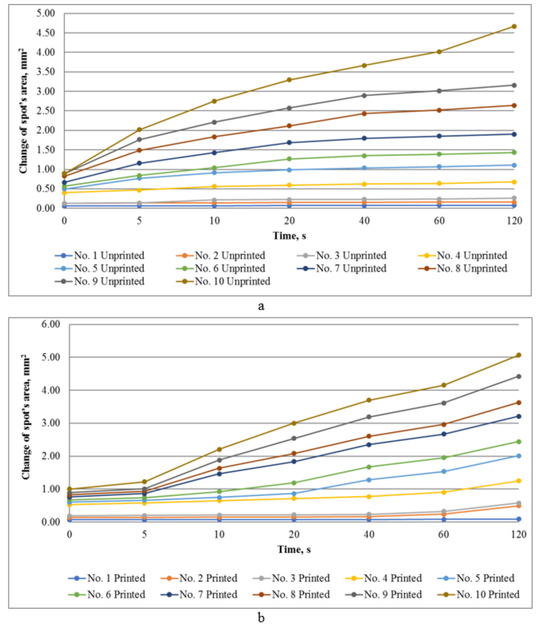

Fig 3. Chart displaying dynamic water absorption of: a – unprinted, b – printed fabrics

- All cotton-based fabrics (No. 1, 4, 6, 8, 9, 10) showed a gradual increase in liquid spot area.
- Fabric No. 10 showed the highest liquid spot area and drop area overall and formed uniquely shaped drop spread (see Fig. 4).

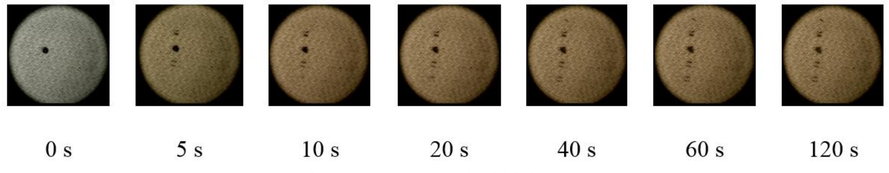

Figure 4. Drop spread of fabric No. 10

- Fabric No. 10, along with fabrics No. 9 and 8 are the thickest of all investigated fabrics, have the highest yarn linear density and show the highest liquid spot area values and are knitted in the same pattern.
- Thicker, heavier fabrics are able to absorb higher quantities of water. This trend has been observed in all investigated specimens except for fabric No. 4.