ABSORBENCY AND WICKING OF WATER ON TERRY WOVEN FABRICS

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Abstract: *This paper reports the concept of absorbency and wicking of water as well as water transfer management for terry woven fabrics. Evaluated terry woven fabrics with the different material composition and structural parameters were used for the manufacturing of towels. The terry woven fabric is designed to take moisture away from the skin and it should be performed in the shortest time. Therefore, the sorption and suction properties were evaluated by measuring the absorbency and wicking. It has been proved that the material composition and basic parameters influence these properties and the high initial absorbency capacity is accompanied by a low starting suction height of the terry woven fabrics.*

Keywords: *absorbency, wicking, terry woven fabrics, permeability, water transfer management*

1 INTRODUCTION

Transferred from the skin to the textile material and further into the surrounding environment, water determines the level of comfort for one woven fabric component. The transfer of water from the skin through the porous woven fabric to the environment is performed in the following ways: convection, conduction (diffusion through a system of pores and capillary), sorption (absorption, diffusion and desorption) and migration (adsorption by surface fibers) [1]. There are various factors determining the permeability of the water by the woven fabric [2].

In order to analyze these properties in terry woven fabrics, it is necessary to evaluate the transfer and sorption properties of this assortment [3]. The transfer properties are determined by capillary wicking. It is influenced by capillary action, pore distribution and surface tension. Absorbency process is a continuation for evaluation and specification of properties which were determined by measuring of the absorption of water by the woven fabric. The measurements were repeated after every washing (max. number of washing procedures = 5 times).

The aim of this experiment was to evaluate the dependence between absorbency and wicking on a selected range of terry woven fabrics which are intended for the production of towels. Changes in these properties can be influenced by the material composition and woven fabric structure. Based on the mentioned fact, the effect of these parameters on the sorption properties was also evaluated in the paper.

2 EXPERIMENTAL PART

2.1 Materials

A terry towels are textile products which have a loop piles on one or both sides. Research process was based on the selection of 9 terry fabrics with the different material composition (Figure 2). Before the measurement process of mentioned properties, it was necessary to make an analysis of the structure of terry fabrics. The area density, mass per unit area, thickness of fabrics and linear density of all sort thread was evaluated [5-7].

The characteristics and parameters of selected investigated terry fabrics are shown in the Table 1.

Measurements of thickness were performed before washing and after the final fifth washing.

Besides one type of weft threads, two systems of warp threads are required for production of terry woven - basic warp and loop warp [4]. Therefore, Figure 1 shows a different fineness of warp, weft and loop weft threads in the terry woven fabrics [7].

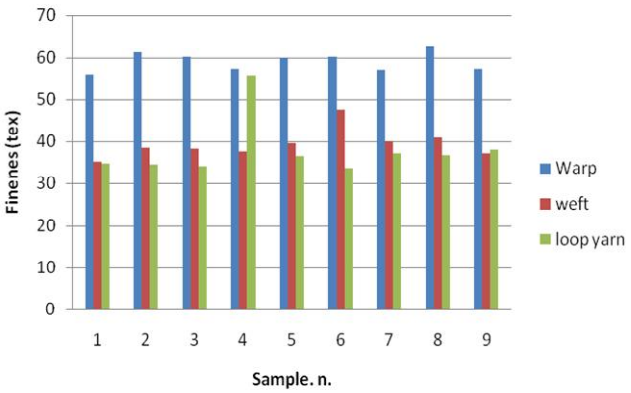

Figure 1 Fineness of thread in the terry woven fabrics

Figure 2 Terry woven fabrics

Table 1 Parameters of terry woven fabrics

Sample No.	Material composition of terry woven fabrics	Mass per unit area ρ_s [g.m^{-2}]	Area density ρ_v [kg.m^{-3}]	Thickness *h* [mm]		Thickness difference *h* [%]
				before washing	after 5 washing	
1	100% cotton	400	180	2.22	2.39	7.65
2	100% cotton	450	202	2.23	2.64	18.39
3	100% cotton	500	209	2.39	2.84	18.33
4	100% cotton	600	187	3.21	3.43	6.85
5	100% microcotton	400	152	2.63	2.86	8.75
6	70% cotton 30% tencel	450	219	2.05	2.57	25.37
7	60% cotton 40% regenerated cellulose	450	219	2.05	2.53	23.41
8	55% cotton 45% regenerated cellulose	450	208	2.16	2.68	24.07
9	50% cotton 50% regenerated celulose	450	175	2.56	3.09	20.70

2.2 Methods

The research process involved the measurements of absorbency and wicking in relation the terry woven fabrics. These properties were measured before washing and after the 1st, 2nd, 3rd, 4th, 5th terry washing of fabrics.

2.2.1 Measurement of absorbency

Standard method is based on the weighing of sample before and after water absorbency.

The testing procedure was used for a determination of water absorbency under the specified conditions. Air conditioned samples (number 10) with dimensions of 100×100 mm were weighed with an accuracy of 0.1 g.

The samples are fixed on the cradle holder and placed into a container with distilled water at 20±1°C and the water level in container was 50 mm above the top part of the sample (Figure 3). After 60±1 minutes, holder with samples was removed from the water and it was left in a vertical position for 120±3 seconds to drip the excess water [8, 9]. Then, samples were weighed in an accuracy of 0.1%. The result of weight loss for tested samples was calculated with the following formula:

$$N = \frac{m_1 - m_0}{m_0}.100 \quad (1)$$

where N [%] is an absorbency of water, m_1 [g] is weight samples after a water absorbency and m_0 [g] is weight of before samples a water absorbency.

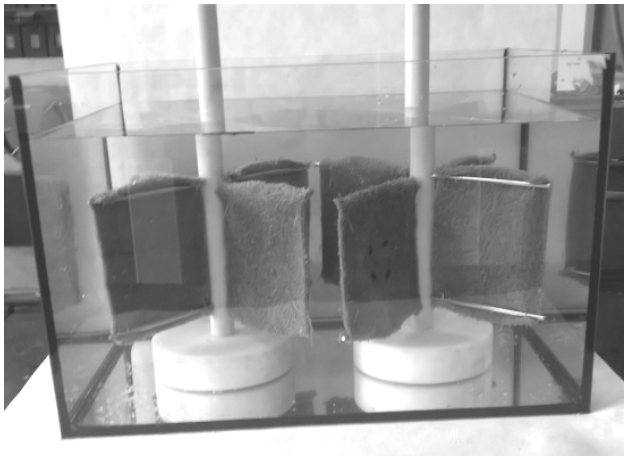

Figure 3 Measurement of absorbency of terry woven fabrics

2.2.2 Measurement of wicking

Wicking is caused by capillary forces inside the terry woven fabrics. The capillary action was measured in such a way that the terry woven fabric strip (6 samples) with predefined dimensions was immersed into the water (Figure 4). The depth of the immersed end of the sample was 2 mm. A suction height was measured by vertical meter at predetermined time intervals. The total testing time was 30 minutes because after that time, there was the occurrence of the steady state. The testing was performed in the direction of the warp and weft [10].

Figure 4 Measurement of wicking of terry woven fabrics

3 RESULTS AND DISCUSSION

3.1 Absorbency of terry woven fabrics

The absorbency of all terry woven fabrics was considerably high. She was calculated from the weight of the samples before and after the test according to formula (1). Figure 5 shows a comparison of the results of measurement of absorbency of the tested materials. The results of measurements were based on the following facts:

- the highest absorbency capacity was observed for samples before washing,
- the absorbency capacity of the samples was stabilized due to repeated washing,
- the highest water absorbency was measured for the sample 5 because of the higher fineness of used fibres (designated as micro cotton) and the lower mass per unit area,
- made of 100% cotton, terry fabrics had better absorbency properties than those which contained any other component together with cotton.

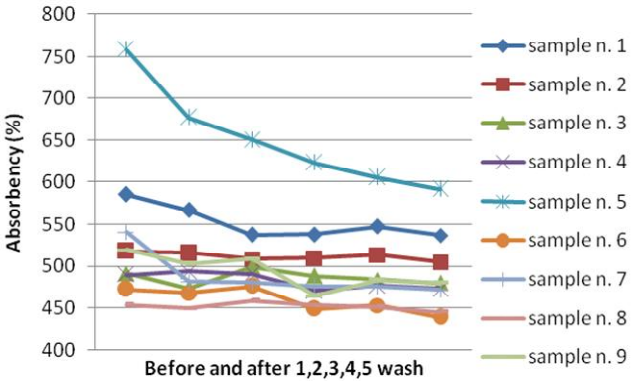

Figure 5 Measurement of terry woven fabrics absorbency

3.2 Wicking of terry woven fabrics

Figures 6 and 7 show a comparison of the results for wicking measurement in the direction of warp and weft [10]. The results of measurements were:

- the similar wicking in the warp direction than in the weft direction was measured,
- the wicking value has been stabilized after a repeated washing,
- the highest wicking was measured for samples designated as 1 and 2, which were manufactured of 100% cotton.
- a different behaviour during wicking was observed only sample designated as 3.

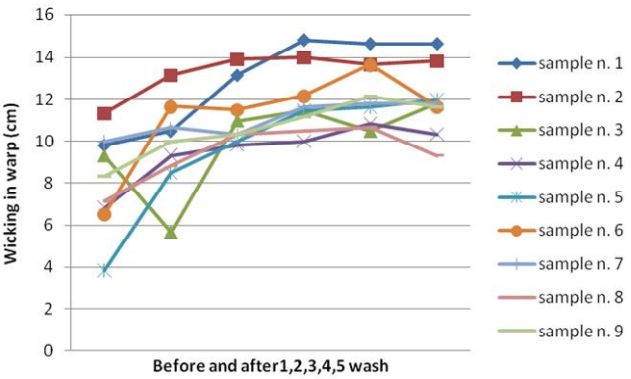

Figure 6 Wicking of terry woven fabrics in direction of warp

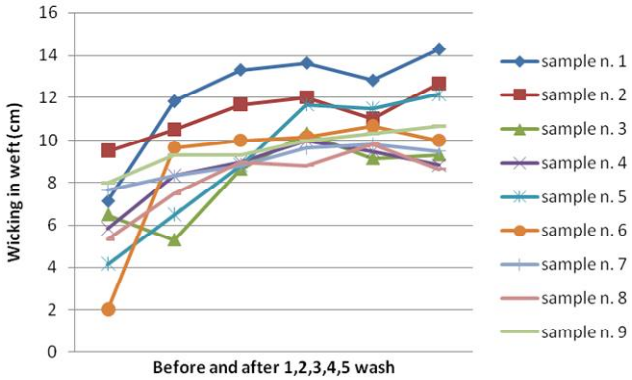

Figure 7 Wicking of terry woven fabrics in direction of weft

The results of wicking and absorbency after the last washing procedure were compared by correlation analysis. In relation to the monitoring of the properties, the rate of correlation dependence is negligible. However, in Figures 5-7 it can be seen that by repeated washing the absorption decreases and the wicking increased (up to the level equalized after the fifth wash).

4 CONCLUSION

The paper presents the results of comparative tests which were performed for terry woven fabrics (terry towels). The reason for performance of these measurements was to specify the most suitable terry towel in relation to the sorption of water in the shortest possible time. Mentioned measurements were made before and after five individual washing procedures. On the basis of the analysis and obtained results for terry fabrics assortments, it can be concluded that:

- the absorbency capacity of terry fabrics was the highest before washing. It subsequent decreased after repeated washing;
- it was confirmed that the best absorbency capacity was exhibited by woven fabric which was made of 100% cotton (sample designated as 1 and 5);
- it was also proven that the fineness of cotton fibres increases the absorbency capacity (sample designated as 5);
- the absorbency of the towel was decreasing and increasing wicking due to repeated washing;
- as the water absorbency is the highest and wicking is lower during all washing processes, it is possible to conclude that:
    - due to absorbency, physical as well as chemical processes occurred in the fibres, causing a change absorbency
    - wicking was increased due to changes in shape (narrowing) of the capillaries during repeated washing.

Generally, it can be assessed that the high initial absorbency capacity of the terry fabric is accompanied by a low starting suction height of the fabric. During a repeated washing, both properties were stabilized. There is a negligible ratio of correlation dependence between absorbency and wicking. Thickness of the terry fabrics was increased due to a repeated washing. In comparison to the terry fabrics containing cotton, this increase in thickness was higher for terry fabrics which contained any other component together with cotton (Table 1). Measurements of selected properties proved that the material composition can affect the evaluated properties. Based on the performed measurement procedures, it can be stated that cotton can be considered as the best material for the production of this assortment. It was repeatedly proven that the assessed properties of textile woven fabrics are influential parameters for moisture [11].

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