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SORPTION PROPERTIES OF HALF-MILANO RIB KNIT FABRICS

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ABSTRACT

In this research, the effect of the technical side of the fabric and the composition of the yarn on the sorption properties of half-Milano rib knit fabrics was studied. Four types of yarns, 90% cotton 10% antistatic PET, 80% cotton 20% antistatic PET, 70% cotton 30% antistatic PET, and 65% cotton 35% antistatic PET were used to develop half-Milano rib knit fabrics. The developed samples were dyed and treated with softener. The physical properties of the developed samples such as area density, course and wale density and thickness were determined according to ISO 3801, EN 14971 and ISO 5084, respectively. The water absorption capacity (%) and the water absorption time (s) of the samples were measured according to the standard test method ISO 20158: 2018. It was concluded that the sorption properties of the samples depend on the technical side of the fabric and the composition of the yarn. Water absorption capacity was found to be more dependent on yarn composition than on fabric technical side, and water absorption time was found to be more dependent on the fabric technical side.

KEYWORDS

Sorption properties, half-Milano rib, antistatic, water absorption time, water absorption capacity.

INTRODUCTION

Moisture management in textile apparel is a critical factor in persuading customers to buy the product. Many researchers have worked on garment moisture management using various functional materials, such as fibers, coatings, and finishes, to meet the need. S. Kumar et al. [1,2] has investigated the thermo-physiological properties of knitted garments made of wool, eri silk, and bamboo yarn. Due to the hydrophilic character of bamboo fibers and the hydrophobic nature of wool, the moisture management of silk was found between of both bamboo and wool. It was lower than bamboo but found higher than wool. The type of raw material has a significant impact on the performance of the material in its final use. The water absorption capacity and the tendency to water retention were influenced by the chemical structure of the fiber materials [3]. Because of their great wickability, man-made synthetic fibers, including polyesters and micro-polyester, are often found to be highly effective for obtaining a better moisture transfer rate. Cotton, viscose, modal, bamboo, Tencel, and other natural fabrics absorb moisture well because of their chemical structure of cellulose, which contains the hydroxyl group. Moisture absorption is caused by the hydroxyl group [4–7]. The effect of a single pique and honeycomb structure on the moisture management of eri silk knitted fabrics was studied by Kumar et al. [8]. Low-weighted materials require less time to absorb than thick fabrics. The water vapor of fabrics is also influenced by the thickness and mass per unit area of the textile materials. The amount of water vapor in textile fabrics decreases as the fabric thickness increases. The volume density of textile materials, in addition to thickness, has been shown to be efficient in water absorption capacity [9]. The aim of this study was to investigate the effect of the technical side of the fabric and the composition of the yarn on the water absorption capacity (%) and the water absorption time (s) of the developed knitted fabrics.

MATERIALS AND METHODS

In this study four types of yarn compositions 90% cotton 10% antistatic polyester (PET), 80% cotton 20% antistatic PET, 70% cotton 30% antistatic PET and 65% cotton 35% antistatic PET developed by Haining TAIERXIN New Materials Co., LTD China were used to develop half-Milano rib knit fabrics. The full automatic flat knitting machine M-100 (MATSUYA, Japan, 2016, 14E gauge) was used to develop the samples. After development, the samples were dyed and treated with hydrophilic AQUASOFT®SI softener. The physical properties of the samples were determined according to the ISO 3801 standard test method area density EN 14971 fabric density, and ISO 5084 thickness. Physical properties of the samples are given in Table 1. Water absorption capacity (%) and water absorption time were determined according to ISO 20158:2018. For measuring the water absorption capacity and water absorption time of the half-Milano knitted fabric, a sample size of 10 cm x 10 cm was used. The water absorption time was measured using a stopwatch. For calculation of the water absorption capacity, the samples were dry weight (m_1) and then after absorbing the water, the wet weight (m_2) was measured. Water absorption capacity (%) was calculated according to the equation [1]:

$$\text{WAC}\,\% = \frac{m_2 - m_1}{m_1} \times 100, \qquad [1]$$

where, m_1 - mass of dry sample mass (g), m_2 - mass of wet sample (g).

Table 1. Physical properties of half-Milano rib knitted antistatic fabrics.

Fabric codes	Yarn composition	Fabric area density (g/m^{-2})	Course density (cm^{-1})	Wale density (cm^{-1})	Thickness (mm)
MM1S	90 % cotton, 10 % antistatic polyester	640.5 ± 0.09	18 ± 0.0	16 ± 0.0	1.80 ± 0.04
MM2S	80 % cotton, 20 % antistatic polyester	661.7 ± 0.09	18 ± 0.0	16 ± 0.0	1.77 ± 0.01
MM3S	70 % cotton, 30 % antistatic polyester	574.9 ±0.06	18 ± 0.0	16 ± 0.0	1.86 ± 0.01
MM4S	65 % cotton, 35 % antistatic polyester	541.8 ± 0.05	16 ± 0.0	16 ± 0.0	1.83 ± 0.01

RESULTS AND DISCUSSION

In Figure 1 results of the water absorption capacity of half-Milano fabrics are given. The tendency to water absorption of the fabrics was found to be similar on both the technical face and the technical back of the fabric in Figures 1 (a) and (b).

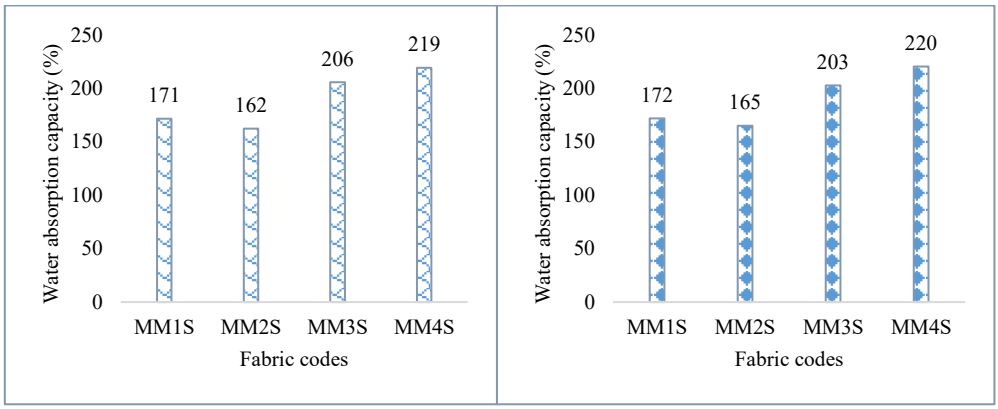

Figure 1. Water absorption capacity (%) of half-Milano rib knit fabrics (a) technical face side (b) technical back side.

An increasing trend was found in the water absorption capacity of half-Milano rib fabrics from MM1S toward MM4S, supposedly it was found because of the decreasing area density towards MM4S fabrics. The area density of the fabrics decreased due to the presence of an increasing percentage of antistatic polyester fibers in the yarn composition and the low density of polyester fibers in comparison to cotton causing a lower area density. In Figure 2 it is evident that the water absorption capacity was found to be dependent on the density of the fabric area with strong R^2 values ($R^2 > 0.997$ and $R^2 > 0.996$) for both face and back technical sides of the fabrics, respectively.

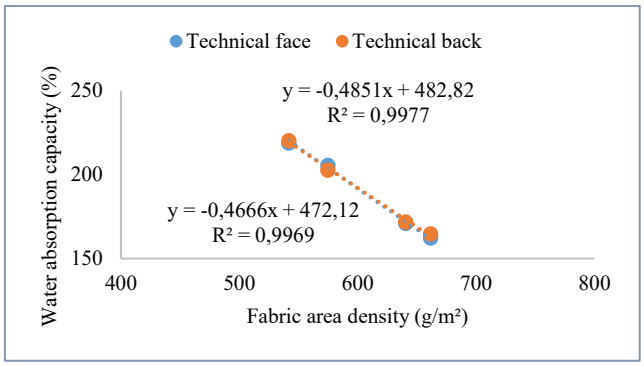

Figure 2. Dependency between Water Absorption Capacity and Fabric Area Density.

In Figure 2 water absorption time of the half-Milano rib knit fabrics is given. The water absorption time of the half-Milano rib knit fabrics was different for the technical face (Figure 3 (a)) and technical back side (Figure 3 (b)) of the fabrics. It was found due to a difference of fabric structure on both sides of the fabrics because of combination of knit and miss stitches that causes a difference in the appearance of fabric on both the technical face and the back side.

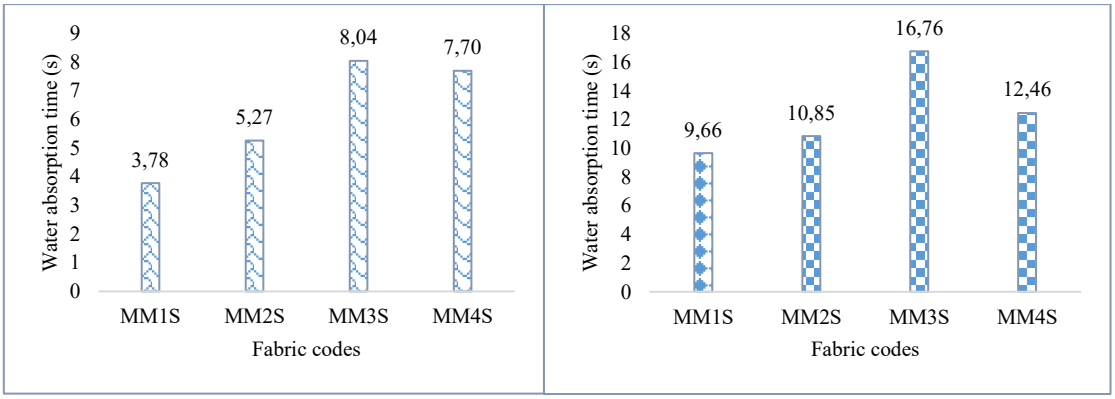

Figure 3. Water absorption time of half-Milano rib knit fabrics (a) technical face side (b) technical back side.

An increase in the water absorption time of the samples found as MM1S < MM2S < MM3S for the technical face and back side of the fabric, while only MM4S showed abnormal behavior that supposedly occurred due to the equilibrium of the crossing of cotton and the polyester fibers and response changed towards water absorption time. The increase in water absorption time occurred due to the increase in the percentage of antistatic polyester fibers in the yarn composition due to its hydrophobic nature.

CONCLUSION

From this study, it was concluded that the technical side of the fabric and the composition of the yarn had an effect on the sorption properties of half-Milano rib knit fabrics.

The water absorption capacity (%) was found to be affected by the composition of the yarn. With an increase of the percentage of antistatic polyester in the yarn composition, water absorption capacity increased.

Water absorption time (s) was found to be affected by the technical side of the fabric and yarn composition as well. The half-Milano rib knit fabric showed a high water absorption time on the technical back side of the fabrics. The percentage of antistatic polyester fiber in the yarn composition also changes the absorption time of the fabrics.

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