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Study of moisture absorption characteristics of cotton terry towel fabrics

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Abstract

The main objective of this work is to study the factors influencing the moisture absorption characteristics of terry towel fabrics based on 100% cotton fibres. Different moisture absorption properties studied in this research work are water absorption, absorption time, absorption rate (static absorption), dynamic, and vertical wicking. The results showed that the moisture absorption related behaviour of the terry towel fabrics were based on their fabric weight, thickness and pile yarn twist.

Keywords: Absorption, capillarity, terry fabric, cotton

1. Introduction

Terry towel is a fabric with loops on the surface either one or two sides of the fabric that can absorb huge amount of water compared to conventional structure (planar woven fabric with warp and weft yarns). Terry fabric or fabric with loop piles can be produced using both weaving and knitting technology. Generally, three different yarn components are involved in the production of pile fabrics namely weft, ground and pile warp yarns [1, 2].

Terry towel fabric is one of the main consumer goods being used by people globally. Terry towels are used in various places including bathroom, sports, swimming pool, kitchen, beach, etc. with different water absorption

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characteristics. The absorptive capacity of terry fabrics predominantly depends upon the material (fibre type, yarn type, yarn twist, etc.) and structural parameters (pile height and warp-weft density) [3, 4].

Among various natural fibres, cotton fibre is the most widespread material used for the production of terry fabrics due to its characteristics such as high absorbency, hypoallergenic properties, etc. Later, rises the use of linen, man-made cellulose (bamboo, modal, Lyocell, etc.) and other fibers [5]. New materials used in terry fabric production include zero-twist yarns, which are being produced using cotton and PVA fibres. PVA fibres are normally dissolved during the finishing process to enhance the yarn characteristics and performance. The resultant terry fabric is very soft and voluminous, which helps to increase the water absorption during its use [6].

The wetting phenomenon of textile structures involves numerous primary processes including immersion, capillary sorption, adhesion, and spreading. During immersion or capillary sorption, solid-vapor interface fades and a solid-liquid interface appears. When a liquid droplet is placed onto a fabric, it will spread under capillary action [7]. The water absorption of the terry fabric increases with increase in pile length (pile height) and areal density. The percentage of water absorbed by fabrics with a high loop density is higher than that of fabrics having lower loop density [7-9].

Wicking occurs when the fabric is partially or fully submerged in a liquid or in contact with a drop of liquid. Researchers [10, 11] reported that in the case of fibrous structures and woven fabrics, the distribution of pores with various sizes along any planar direction is anticipated. The level of wicking and liquid transportation in a fabric depends on pore sizes and their distribution. Liquid or water occupy small pores initially and moves on to larger pores [7].

Static water absorption of terry fabric defines the amount of water that can be absorbed and it is a principal requirement of any terry fabric [12]. The effect of terry fabric parameters on water absorption using various fabric constructions without any hydrophilic finish was studied by researchers [12, 13]. The water absorption characteristics were analyzed with respect to warp density, weft density, and pile height causes as improvement in static water absorption, but the pile height had the most significant effect. The percentage of water absorption is the lowest for open-end yarn, and highest for two-ply ring carded yarn. Due to higher twist and compact structure of open-end yarn, it has less water penetration capacity. The water absorption of terry fabrics decreases with increasing warp and weft densities as the fabric structure become very compact and dense. However, it can be enhanced with an increase of pile height which results to increase of pile warp surface area [13].

The main objective of this study is to understand the factors influencing the various absorption (water) related properties of terry fabrics and develop a novel terry structure with improved moisture absorption properties with respect to various applications area. Initially, five different types of cotton terry fabrics were used to study their water absorption, immersion time, absorption rate (static absorption), dynamic absorption and vertical wicking according to the standard procedures.

1.1. Materials

The yarn and fabric details of the terry fabrics studied within this work are given in Table 1 and Table 2, respectively. The images of the fabric are shown in Fig. 1.

Table 1. Properties of yarns used in terry fabrics.

Samples	Linear density [tex]			Yarn Twist [turns/m]			Pile yarn details
	Warp	Weft	Pile	Warp	Weft	Pile	
MT-1	46±(3.2)	39±(4.8)	75±(3.5)	626±(2.7)	788±(4.8)	289±(3.1)	Double yarn
MT-2	44±(6.4)	40±(3.3)	30±(1.7)	639±(1.6)	601±(2.3)	584±(2.7)	Single yarn
MT-3	46±(4.5)	35±(4.0)	35±(5.3)	625±(1.8)	564±(5.0)	654±(2.7)	Single yarn
MT-4	47±(4.6)	35±(2.5)	33±(1.0)	560±(4.4)	621±(5.0)	0±(0.0)	Zero twist yarn
MT-5	47±(3.2)	41±(4.1)	36±(3.6)	614±(4.6)	854±(4.8)	649±(4.1)	Single yarn