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**Studies on Moisture Management Properties of Various Textile Products**

Çeşitli Tekstil Ürünlerinin Nem İletim Özellikleri Üzerine Yapılan Çalışmalar

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**ABSTRACT**

Now-a-days expectations from textile products are increasing. As the usage of clothes such as leisure and sportswear was investigated, it can be stated that people want to buy clothes having high breathability and high thermophysiological comfort, while allowing body's heat balance to maintain. Under these conditions, liquid moisture transfer properties of clothes are also significant,

Since they affect body's ability to cool itself. There are different types of materials having different moisture management behaviors.

In this paper, studies on moisture management properties of fabrics and patents having improved moisture management properties are reviewed.

**ÖZ**

Günümüzde tekstil ürünlerinden beklentiler artmıştır. Serbest zaman ve spor giyim ürünleri gibi giysilerinin kullanımı göz önüne alındığında, insanların daha çok, vücudun ısıl dengesinin korunmasına izin veren, yüksek nefes alabilirlik ve yüksek termofizyolojik konfor içeren kıyafetler satın almak istediği görülmektedir. Bu koşullar altında, vücudun kendisini soğutma yeteneğini etkilemesi sebebiyle, giysilerin sıvı nem transfer özellikleri de oldukça büyük önem taşımaktadır. Piyasada farklı nem iletim davranışlarına sahip farklı malzeme türleri bulunmaktadır.

Bu yazıda, gelişmiş nem iletim özelliklerine sahip kumaşlar ve bu özelliğe sahip ürünlere yönelik patentlerden yola çıkılarak, tekstil ürünlerinin nem iletim özellikleri üzerine yapılmış olan çalışmalar hakkında kısa bilgi verilmektedir.

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## 1. INTRODUCTION

Currently, consumers have become much more demanding in terms of properties of clothing. Breathability is an important fabric property besides comfort and supplying body's heat balance to be maintained over a wide range of environmental conditions. Textile products should fulfil this function without inhibiting the evaporation of humidity caused by perspiration, and thus not interfering with the temperature regulation of the body (Basuk, 2018).

By the controlled movement of water vapor and liquid water (perspiration) from the surface of skin to atmosphere, perspiration is prevented remaining next to skin and enhance body's ability to cool itself (Basuk et al., 2018). Actually it is the most important point explaining the reason of chilly effect.

A fabric that is perceived as comfortable should transmit moisture vapour during the period, the body sweats actively and, when the body has stopped sweating, the fabric should release the moisture vapour held in the space to the atmosphere to reduce the humidity at the skin (Li and Zu, 2003; Karthik et al., 2018).

Moisture management is the controlled movement of liquid (perspiration) from the skin surface to the environment through the fabric (Chinta and Gujar, 2013; Motlogelwa, 2018). It is an important factor in optimizing comfort and maximizing performance (Performance Apparel Markets, 2014; Motlogelwa, 2018; Dai et al., 2008). Transport of water in fabric can take place in two different ways, one is along the plane of the fabric and the other is perpendicular to the plane of fabric. Hence, wicking can happen in two ways longitudinal wicking (along the plane of the fabric) and transverse wicking (perpendicular to the plane of the fabric) (Haghi, 2005; Karthik et al., 2018).

There are various parameters such as fabric mass and structure, fiber type, yarn count and yarn twist coefficient and finishing processes that determine moisture management capacity of the fabrics (Selli and Turhan, 2017; Li et al., 2002; Sharabaty et al., 2008; Namligoz et al., 2010; Onofrei et al., 2011; Özdil et al., 2009; Öner et al., 2013; Özgen and Altaş, 2014)

In case of fiber type, for the fibers with absorption ability, i.e. natural fibers and regenerated fibers, water is absorbed by the hygroscopic fibers to inflate the fibers and evaporate from the outer surface of the textile structure. In the fabrics made from synthetic fibers, water is removed to the outer surface by the capillary spaces between the fiber and the yarn (Tastan Ozkan and Meric Kaplangiray, 2015; Uyanık and Baykal, 2019)

Both natural (e.g. cotton) and synthetic materials, however, show some problems and limitation in managing the moisture from the body of the user. For example, cotton fabrics present a variety of problems in the managing of the moisture, due to the high absorbency of the cotton. A cotton garment, when used for example during sport activities, quickly absorbs the sweat, rapidly drenching, and thus becomes heavy and sticks to the skin. Additionally, wet cotton fabrics and garments take long time to dry. As an alternative to cotton, synthetic fibers can be used in fabrics and garments, in particular for sporting apparel. (WO 2017/013232 A, Patent, "Fabric Having Moisture Management Features")

Other fabric properties change moisture transport properties differently according to the structural parameters. For this reason, moisture management properties of fabrics were investigated by many researchers all over the world.

## 2. STUDIES ON MOISTURE MANAGEMENT PROPERTIES

Achour et al. (2015) investigated the effect of knitted fabrics characteristics on moisture management properties. Wetting and transport properties of single jersey, Rib 1&1 and English Rib fabrics made out of cotton and blended Cotton/Polyester yarns were studied. According to the results, it was determined that fabric's composition and knit's structure have a significant influence on moisture management properties of fabrics.

Troynikov and Wardiningsih (2011) studied liquid moisture management properties of knitted fabrics of different wool/polyester and wool/bamboo blends of different ratios suitable for the base layer of sportswear. It was found that blending wool with polyester or wool with bamboo has improved moisture management properties of the fabrics in comparison to 100% wool and 100% bamboo fabrics.

Özdil et al. (2009) investigated the moisture management properties of fabrics including cotton yarns, produced in different yarn counts (Ne 20, Ne 30, Ne 40) and different twist values ( $\alpha_e=3.2, 3.6, 4.0$ ). Fabrics were knitted as single jersey structure in the same production conditions. According to the overall moisture management capacity of the fabrics calculated according to measured features, it was found that all the fabrics used in this study have good moisture management capability.

Hu et al. (2005) introduced “MMT instrument” that is developed to evaluate textile moisture management properties. This new method was suggested to measure liquid moisture transfer in one step in a fabric in multidirections, where liquid moisture spreads on both surfaces of the fabric and transfers from one surface to the opposite.

Öner et al. (2013) searched the effect of raw material, weave type and tightness on liquid absorption and transmission properties. For this purpose knitted fabrics made of cotton, viscose and polyester yarns, which had single jersey,  $1 \times 1$  rib and single pique weave type, had three different tightness as tight, medium and loose, were produced. According to the results, it was determined that polyester fabrics had higher OMMC values than those of cellulosic-based fabrics and weave types examined in this study, were not found as strong as raw materials and tightness properties.

In a study conducted by McQueen et al. (2013), a protocol for handling test data which exhibits the water penetration type profile is recommended in order to manage the high variability of MMT test data and identify fabrics which are not suitable for evaluation using the MMT.

Apart from these studies, there are various blends for special applications which are patented. In addition, various textile structures were designed for sports clothes and footwear products having improved moisture management properties (JP05166431B2, JP2013066767A, CN101583294A, AU2011245379A1, CN102985604A, WO2008060928A1, US20180179701A1)

In a patented invention, a fabric was designed to provide moisture management features. In this fabric has an efficient moisture transfer from the inner side of the fabric (or garment) to its outer side and provides dry and cool feeling even at high temperatures or during or after exercise in order to avoid the feeling of wetness and the relevant discomfort (WO2017/013232 A)

In a patented method, a treatment designed for enhancing moisture management characteristics of fabric. (AU2006235897B2).

In another invention, the benefits of both a fabric comprising modified textile fibers, imparting a pleasant sensation upon contact with skin tissue and improved moisture-management performance essentially alleviating uncomfortable perspiration and heat off the skin was provided. Wicking in hydrophobic silicone-encapsulated fibers is carried out through capillaries formed between individually encapsulated fibers (WO2006/051521A1)

In another invention, the fabric is made by using a combined interlock pattern and weft knitting method. The inner layer which is touching the skin is formed applying hydrophobic fiber filament or spun yarns, while the outer layer is made of hydrophobic and hydrophilic fiber filament or spun yarns. The outer layer can also be constructed of hydrophobic higher and lower elementary thickness of fiber filament or spun yarns. According to the test results it was indicated that, humidity transferred from the body through the inner layer of the patented material (with a smaller surface area) is distributed in an outer layer with a larger surface area, effectively removing it from the environment (LT6364B)

### 3. CONCLUSION

Due to the changes in consumer preferences in recent years, apparel manufacturers pay more attention to the high-performance textiles in terms of moisture management fabrics. Since the significant increase in the demand for products having good moisture management properties, this subject was investigated by many researchers. There are many types of fibers, surfaces and structures having good capillary effect. These textile structures find application especially in sports clothes. In this study, after explaining basic principle of moisture management, the studies and various patents on products/methods providing good moisture management properties were summarized.

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