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MOISTURE MANAGEMENT PROPERTIES OF DOUBLE FACE DENIM FABRICS

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ABSTRACT

Moisture management is one of the key performance criteria in today's apparel industry, which decides the comfort level of fabrics. Denim has become the most popular fabric to be widely used to produce various items. In this study, moisture management characteristics of three different Denim fabrics were determined. A comparison between simple and double face Denim fabrics was carried out in terms of moisture management properties. The results indicate that double face Denim fabric have good moisture management properties compared with simple Denim fabric.

KEYWORDS

Denim fabric, Double face weave, Comfort properties, Moisture management.

1. INTRODUCTION

Thermo-physiological comfort is directly influenced by the moisture transport properties of textiles. To maintain its comfort, human body perspires in both liquid and vapour form. Clothes to be worn should allow the transfer of this perspiration in order to maintain the thermal balance and the comfort of the wearer (Das et al, 2007; Song, 2011).

Comfortable clothing should transmit moisture vapour during active sweating and, when the body has stopped sweating, the fabric should release the moisture held in the microclimate to the atmosphere to eliminate humidity from the skin as quickly as possible. Thus, the faster a fabric permeates, the better its comfort (Ramkumar, 2007).

Wicking is another process to maintain the comfort feeling in sweating conditions (in liquid form). It is the ability of a textile fabric to transport moisture away from the skin to fabric's outer surface in multi-dimensions (Azeem, 2017). Fabrics that rapidly transport liquid away from the surface of the skin make wearers feel more comfortable by keeping the skin dry. In extreme conditions where the body sweats a lot (high level activity or/and high atmospheric temperature), it is not only desirable for the fabric next to the skin to absorb liquid rapidly but also to transport it through the fabric promptly to avoid the discomfort of the fabric sticking to the skin (benltoufa et al, 2008). In fact, when the liquid wets the fabric, it reaches the spaces between the fibers and produces a capillary pressure (Das et al, 2007).

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Nowadays Denim is widely used to produce various clothing items. Denim is a heavy woven fabric made, mainly from 100% cotton coarse indigo dyed warp yarn. It is predominately used with the twill (3/1) and (2/1) weave structure. Denim is available in different weights ranging. Denim's durability lies in the combination of the yarn and the weave. The wearer's today need durability and comfort in their fashion items including Denim (Morris, 1981; Nayak, 2009) which is perceived as the comfortable, fashionable, affordable and durable clothing item for all age groups.

The aim of this study is to compare moisture management properties of double face Denim fabric with simple Denim in order to perceive clothing comfort of these structures.

2. MATERIAL AND METHOD

Three Denim fabrics were considered in this study. Sample 1 presents the reference sample which is a classic Denim fabric. Sample 2 and 3 were a double face Denim where all their physical and structural properties are shown in table 1.

All the measurements were conducted after conditioning of the fabrics for 24 hours under the standard atmosphere conditions 20ºC±2 temperature and 65±2 % relative humidity. The moisture management tester (MMT) is used to measure dynamic liquid transport properties of fabrics in three dimensions according to AATCC 195-2009. The Moisture Management Tester (MMT) was developed by Yi Li, Qing Wen Song and Jun Yan Hu to measure the flow of water when drops of water touch the surface of fabric (Hu et al, 2005). The instrument gives different indices, which quantify the movement of water in different directions in a textile material. The fabric side that was used as 'top' during testing in this study refers to that side of the Denim fabric, which would come into contact with skin when the Denim garment is worn. The relative water vapour permeability values of the fabrics were tested using the Permetest instrument. This instrument enables the determination of relative water vapour permeability [%] and evaporation resistance Ret [m^2Pa/W] of dry and wet fabrics.
Measuring head of this small Skin Model is covered by a resistant semi permeable foil, which avoids the liquid water transport from the measuring system into the sample. Cooling heat flow caused by water evaporation from the thin porous layer is quickly recorded by a special computer evaluated sensing system. In terms of heat transfer this instrument presents the model of real human skin. Given by a new concept of measurement, which enables to distinguish small changes of water amount absorbed in the fabric during unsteady state of diffusion (Hes, 2002). The instrument provides all kinds of measurements similar to the ISO Standard 11092, and the results are evaluated by identical procedure as required in this standard. The correlation coefficient of measurements related to the ISO Standard SKIN MODEL exceeds 0.9. The results are treated statistically, displayed and recorded for next use (Hes, 2003). Also, Air permeability measurements are made using SDL Atlas Air permeability instrument according to EN ISO 9237 standard with 100 Pa air pressure.

Table 1: Properties of tested Denim fabrics

Fabric sample	weave	Warp yarn	Weft yarn	Weight (g/m^2)	Thickness (mm)
1	Simple face (reference)	Cotton	Cotton	350	1.05
2	Double face	Cotton	PES	347	1.28
3	Simple face	Cotton	PES	322	1.20

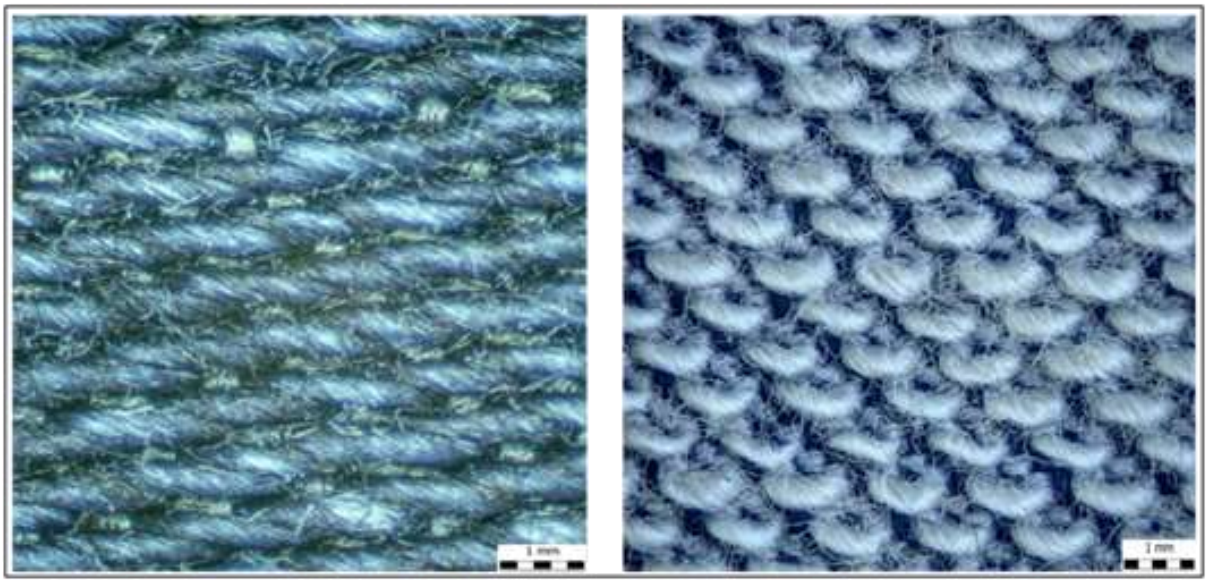

Figure 1: Face and back side of double face Denim fabric

3. RESULTS AND DISCUSSION

Air permeability, relative water vapour permeability and moisture management properties of Denim fabrics are presented below.

3.1. Air permeability and Water vapour permeability

The air permeability of a fabric is the ability of the fabric to allow the atmospheric air to flow thorough the fabric and reach the skin. It is related to the porosity of the fabric. The higher the porosity, the higher will be the air permeability. According to figure2, double face Denim fabrics have the highest air permeability. This is because of the loose structure (especially back side) as well as the higher porosity. Reference Denim fabric has the lowest air permeability value because of the compact structure.

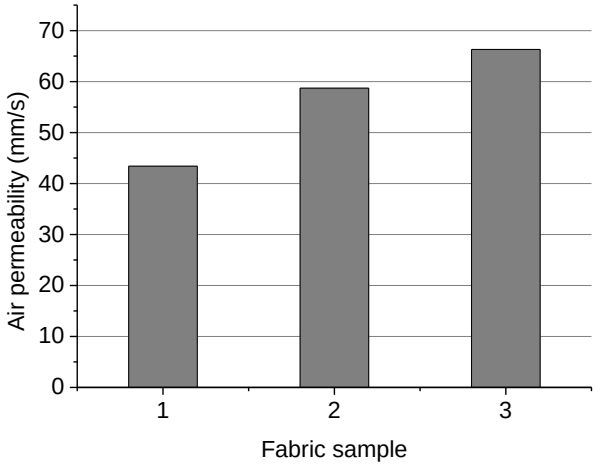

Figure 2: Air permeability of different fabrics

Water vapour permeability is the fabric ability to transport the moisture (vapour form) away from the skin. Fabrics have to evacuate this vapour before it become liquid, avoiding the fabric to get wet and reducing the uncomfortable sensation of the wearer.

In terms of water vapour permeability, all tested Denim fabrics demonstrated a good level of relative water vapour permeability. According to figure 3, we observed the effect of the weight of the Denim fabrics on this property. Relative water vapour permeability increased when the weight of the samples was decreased.

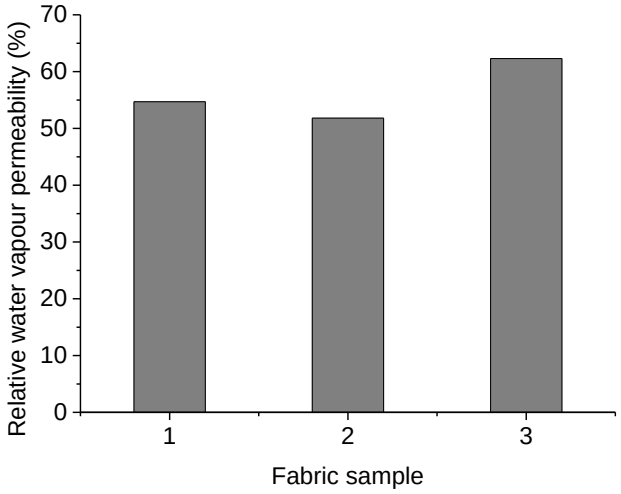

Figure 3: Relative water vapour permeability of different fabrics

The density of the fabric doesn't allow the transport of moisture vapour through the fabric, case of sample 1 and 2 compared to sample 3 which has the highest relative vapour permeability. Thus, sample 3 transport is more breathable than sample 1 and 2.

3.2. Moisture management capacity and drying rate performance

Multi-directional liquid moisture transport capabilities of Denim fabrics were measured by MMT instrument. The moisture management results of different fabrics are given in table 2.

Table 2: MMT results of different fabrics

Fabric sample	Wetting time (s)		Absorption rate (%/s)		Max wetted radius (mm)		Spreading speed (mm/s)		OMMC	AOTI (%)
	Top surface	Bottom surface	Top surface	Bottom surface	Top surface	Bottom surface	Top surface	Bottom surface		
1	4.36	4.51	33.82	47.75	15	15	2.57	2.58	0.322	206.89
2	4.55	4.60	26.21	28.37	13.33	16.66	2.18	2.70	0.332	135.01
3	6.22	6.77	31.86	29.00	13.66	13.33	2.61	2.29	0.341	256.1

Wetting time

The wetting time of top surface (WTT) and bottom surface (WTB) are the time periods in which the top and bottom surfaces of the fabric just start to get wetted, respectively, after the test begins. Sample 1 and 2 have almost the same wetting time on top and bottom surface which is lower than the wetting time of sample 3. It is unexpected because sample 3 has higher porosity and low weight. Thus, the passage of liquid through yarns and inter-yarns of sample 3 should take less time than sample 1 and 2.

Absorption rates

Absorption rates on the top and bottom surfaces
(%/sec) are the average moisture absorption ability of the fabric, in the pump time.

Maximum wetted radius

MWR_{top} and MWR_{bottom} (mm) are defined as the maximum wetted radius (MWR) at the top and bottom surfaces, respectively. The lower MWR_{top} means lower wet touch (with the skin) and higher skin comfort. Sample 3, has the lowest MWR_{top} which indicates its good moisture transport property.

Spreading speed

Spreading speed (SS; mm/sec) is defined as the accumulative SS from the center to the MWR. Due to the same yarn composition, the SS of samples doesn't change a lot.

Overall moisture management capacity

The overall moisture management capacity (OMMC) is an index to indicate the overall capability of the fabric to manage the transport of liquid moisture. The higher the OMMC is the higher the overall management capability of the fabric. All Denim samples have almost the same OMMC which indicates a good overall management capacity. Sample 3 has the highest OMMC value.

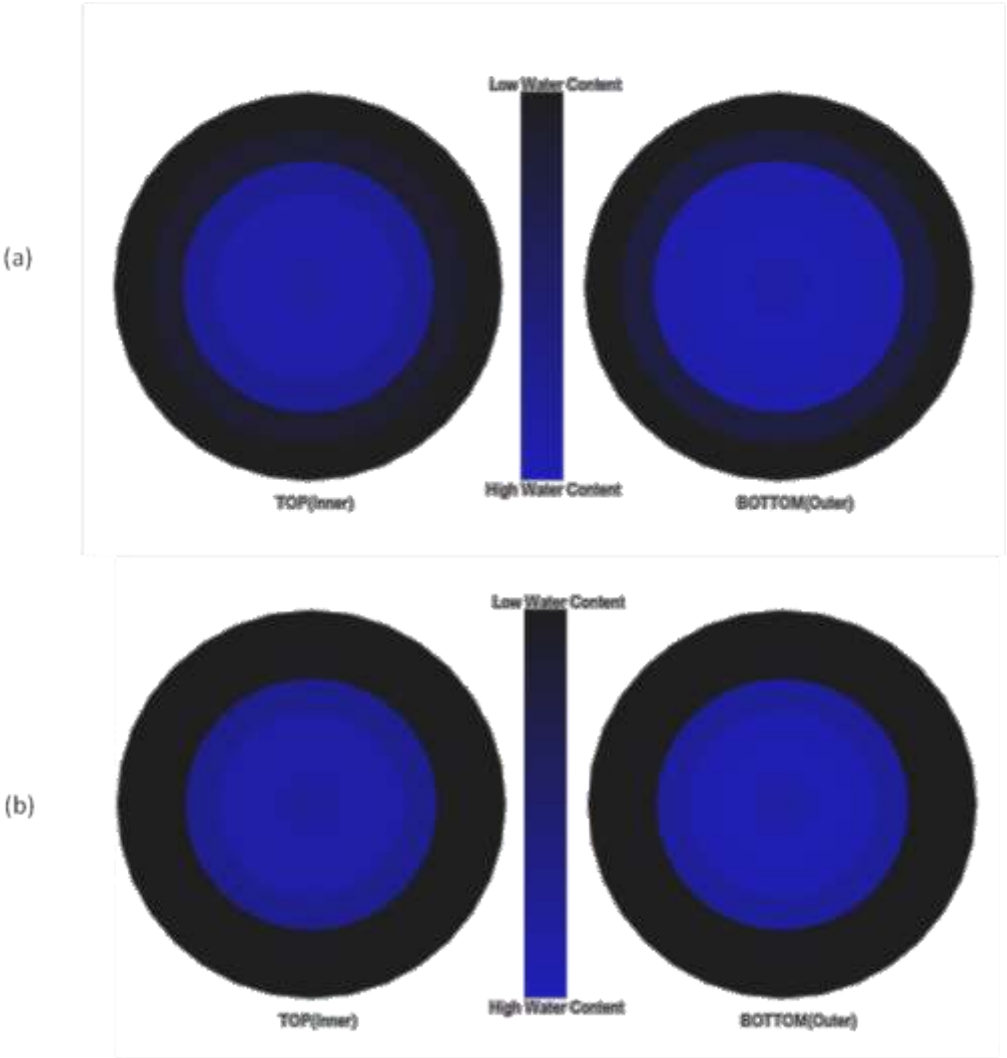

Figure 4: Water content (a) double face Denim, (b) Denim reference

4. CONCLUSIONS

It is evident from the presented study that the weight and composition of tested fabrics affected moisture management properties, as well as water vapour and air permeability. All Denim fabric tested have close moisture management properties. However, the double face Denim fabric (sample 3) has the best

properties in terms of air and water vapour permeability and moisture management because of its low weight and its higher porosity compared to the other samples, it can be considered as the most breathable and comfortable compared to the other sample.

REFERENCES

Azeem, M.(2017): Mechanism of liquid water transport in fabrics; a review. *Fibres and Textiles (4) 2017 Vlákna a textil (4) 2017*, 58.

Benltoufa, S. (2008): Capillary Rise in Macro and Micro Pores of Jersey Knitting Structure. *Journal of Engineered Fabrics & Fibers (JEFF)*, *3*(3).

Das, B (2007): Moisture transmission through textiles. Part I: Processes involved in moisture transmission and the factors at play. *AUTEX Research Journal*, *7*(2), 100-110.

Hes, L. (2002): The Effect of Planar Conduction of Moisture on Measured Water Vapour Permeability of thin woven fabrics, *Proceeding, Fall Fiber Society Conference, Lake Tahoe.*

Hes, L., Dolezal, I. (2003). A new computer-controlled skin model for fast determination of water vapour and thermal resistance of fabrics, *Proceeding*, *7th Asian Textile Conference, New Delhi*.

Hu, L et al (2005): Moisture management tester: a method to characterize fabric liquid moisture management properties. *Textile Research Journal*, 75(1), 57-62.

Morris, M, Prato, H (1981): Consumer perception of comfort, fit and tactile characteristics of Denim jeans. *Textile Chemist and Colorist* 13: 24-30.

Nayak, R (2009): Comfort properties of suiting fabrics. *Indian Journal of Fibre and Textile Research* 34: 122-128.

Ramkumar, S (2007):. Relationship Between Cotton Varieties and Moisture Vapor Transport of Knitted Fabrics. *Journal of Engineered Fabrics & Fibers (JEFF)*, *2*(4).

Song, G. (2011): *Improving comfort in clothing*. Elsevier.