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Moisture Management Property-An outlook

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Abstract

Clothing is supposed to protect humans – in accordance with their environment - from cold, heat, wind, and weather. If possible, it should fulfill this function without inhibiting the evaporation of humidity caused by perspiration (good moisture management), and thus not interfering with the temperature regulation of the body. When we start to sweat, our body humidity is absorbed by the textile we are wearing. If the humidity remains in the fabric and is not transported to the surface for evaporation, cooling cannot occur. The body warms up and even more sweat is produced.

ISSN: 2578-0271

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Submission: June 23, 2021

Published: September 07, 2021

Volume 6 - Issue 3

How to cite this article: Thambidurai A*, Arunraj A, Prabu K. Moisture Management Property-An outlook. Trends Textile Eng Fashion Technol. 6(3). TTEFT. 000638. 2021. DOI: 10.31031/TTEFT.2021.06.000638

Introduction

Moisture management often refers to the transport of both moisture vapor and liquid away from the body. It can be defined as controlled movement of water vapor and liquid water (perspiration) from the surface of the skin to the atmosphere through the fabric. When a synthetic material is subjected to this moisture management treatment, it develops improved hydrophilicity followed by very fast drying behavior. In hot conditions, trapped moisture may heat up and lead to fatigue or diminished performance. In cold conditions, trapped moisture will drop in temperature and cause chilling and hypothermia. Excess moisture may also cause the garment to become heavy, as well as cause damage to the skin from chafing. Because of the various parameters (type of fibre, material construction, technology available, etc.) and different requirements depending on the application purpose of the textile, the finishing must be adapted to each individual case. Moisture management property is the important aspect of any fabric for apparel, which decides the clothing comfort. The process of moisture transport through clothing under transient humidity conditions is an important factor which influences the dynamic comfort of the wearer in practical use.

Processes involved in moisture transmission through textiles

Water vapour can pass through textile layers by the following mechanisms.

A. Diffusion

B. Sorption

C. Wicking

D. Evaporation

Liquid water can pass through textile layers by the following mechanisms by means of wetting & wicking.

Mechanism involved in moisture transmission through textiles

There are four mechanisms that allow the body to lose heat to the environment to maintain its thermal balance. The way the heat loss is divided between the mechanisms depends on the external environment.

A. Conduction

B. Convention

C. Radiation

D. Evaporation

However, ideas differ among textile manufacturers as to how to achieve an optimized moisture management. To bring about the different effects, a suitable fiber material is used, and subsequent finishing is applied. It is possible to combine specialized fibers and finishing.

Hydrophobic textiles: Synthetic fibers absorb only a very small amount of humidity. This can lead to insufficient transmis¬sion of humidity away from the skin and to an unpleasant damp feeling. Furthermore, the water which is not transported to the outer surface is no longer available for the cooling of the body.

Hydrophilic textiles: Natural Fibers are known for their greater capacity to absorb humidity. Emerging liquid is absorbed efficiently and transported to the skin surface for evaporation. How-ever, after exercise, a larger amount of liquid must evaporate, which can cause stronger cooling and freezing.

Combinations of inner hydrophobic and outer hydrophilic layers: It is designed to transport humidity rapidly from the skin and evaporate it on the outside. The special construction of the material enables trans¬portation of humidity from the inside to the outside of the textile to take place. The two-sidedness of the fabric is either attained by processing different materials during manufacturing or by varied coatings of the fabric surfaces. Textiles which are in part hydrophobic are manufactured by the application - for example with a puncture technique - of a hydrophobic coating on the inner side of a hydrophilic fabric. The idea is that humi¬dity can be transmitted through the hydrophilic "windows", while the hydrophobic areas do not absorb water and stay dry, leaving the skin with a dry feeling. Microfibers, by virtue of their extreme fineness, form especially small gaps and have a big surface area. This leads to high capillary effect for the transportation of humidity, and rapid evaporation. Special fibers are designed to increase the capillary force and the humidity transportation, by means of special profiles (for example Trilobal & hollow fibers). The larger surface areas of these fibers also serve to promote evaporation.

Moisture management fabric requirements:

For a fabric to be a good moisture management fabric it needs to fulfil the following attributes according to

A. Optimum heat and moisture regulation

B. Good air and water vapour permeability

C. Rapid moisture absorption and conveyance capacity

D. Absence of dampness

E. Rapid drying to prevent catching cold

F. Low water absorption of the layer of clothing just positioned to the skin

G. Dimensionally stable even when wet

H. Durable

I. Breathability and comfort

J. Easy care performance

K. Lightweight

Moisture management transmission process

Regarded as a second skin, the textile material should work synchronously and be compatible with the human body's heat regulation mechanism. Transmission of the moisture in both liquid and vapor form is equally important to make the wearer feel comfortable. In this regard, wetting, wicking and moisture vapor transmission are of critical importance. This transmission occurs by three mechanisms.

Simple diffusion through inter yarn spaces: Controlled by the water vapor pressure gradient across the inner and outer faces of the fabric, this is the main mechanism for transferring the vapor in low moisture content conditions. The size and concentration of inter yarn pores and the fabric thickness governs the resistance to diffusion.

Capillary transfer through fibre bundles: Wicking of the liquid water through the yarns takes place which is then evaporated at the outer surface. The efficiency of yarn working depends on the surface tension, i.e., wet ability of the fibre surfaces, and the size, volume and number of capillary spaces is determined by the choice of yarn and fabric construction.

Diffusion through individual fibres: Depending on the hydrophobic or hydrophilic nature of the fibres, the water vapour is absorbed into the fibres at the inner surface of the fabric, diffused through the fibre structure and desorbed at the outer surface.

Applications of moisture management:

Following are the areas where the moisture management techniques are popularly applied:

A. Inner wears

B. Athletic wear (active sportswear)

C. Performance wear (climbing, walking, skiing)

D. Comfort wear (nightwear)

E. Military (multi-climate clothing)

F. Health (hospital bed linens, wound dressings)

G. Agricultural technology (Geo-textiles, greenhouse screening panels, soil moisture control)

H. Technical solutions (protective clothing, firefighting, industrial clothing)

I. Industrial (filter & valve technology, building, packaging)

J. Upholstery (transport)

Moisture management properties of a fabric are hence characterized by 10 moisture management indices namely,

A. Wetting time top

B. Wetting time bottom

C. Top absorption rate

D. Bottom absorption rate

E. Top maximum wetted radius

F. Bottom maximum wetted radius

G. Top spreading speed

H. Bottom spreading speed.

I. Accumulative one-way transport index

J. Overall Moisture Management Capability (OMMC)

The performance of the fabric is assessed through the American Association of Textile Chemists and Colorists (AATCC)using a grading scale of 1-5 based on the above indices, where Grade 1 is poor, and Grade 5 is excellent [1-8].

Conclusion

Moisture management performance is an important characteristic affecting their comfort and maintenance and thus defining, to a large extent, their acceptance by end-users. Although they depend on inherent properties of the textile, such as its composition and structure, they can be significantly enhanced by surface modification and application of suitable finishing agents. In the case of moisture management, the type and application method of the selected finishes is such as to enhance the wicking properties and thus to facilitate the transport of moisture from the skin to the outer surface of the fabric, where it can evaporate. The material deposited on the fibre surface that would intervene with these functional finishes, inhibiting their action, should be avoided. Softeners, lubricants and other products that modify surface properties should be carefully investigated before being used along with moisture management finish.

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