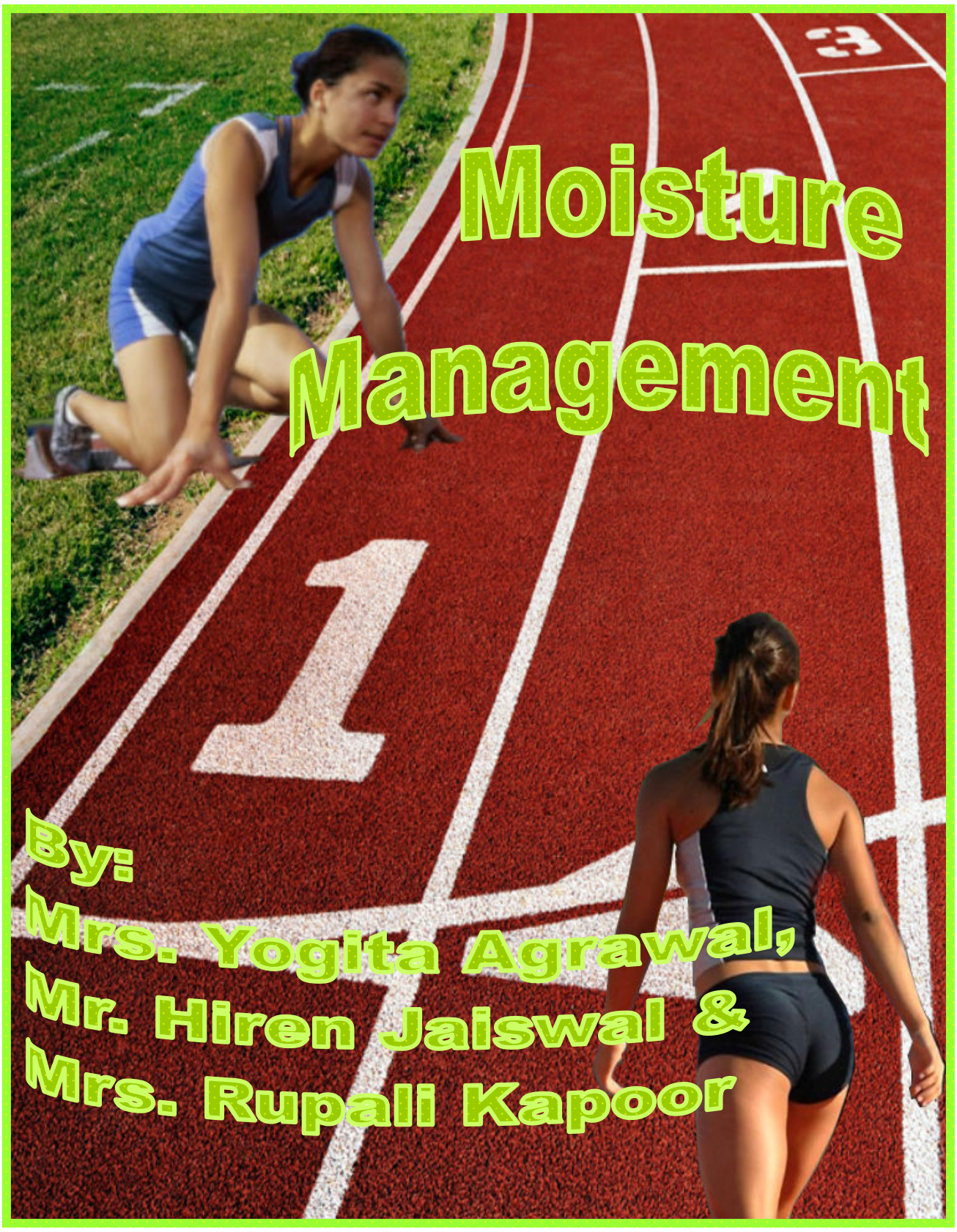

Moisture Management
By:
Mrs. Yogita Agrawal,
Mr. Hiren Jaiswal &
Mrs. Rupali Kapoor

Moisture Management

By: Mrs. Yogita Agrawal, Mr. Hiren Jaiswal & Mrs. Rupali Kapoor

Introduction

Moisture management is understood as “the ability of a textile to absorb gaseous or liquid humidity from the skin, to transport it from the inside of a textile to the outer surface and to release it into the surrounding air”.

The Moisture Management fabric drew the attention of the high-end performance users and is for the high-performance end of the market. It is a kind of fabric which absorbs the moisture from the wearer and moves it away from the garment. The action of this fabric helps in preventing the moisture next to the skin. This kind of action helps to make skin moisture free. It proves its worth in the sportswear. This is the fabric of new age technology and its usage in new technology is expanding day by day.

Importance of Moisture Management

To understand the importance of moisture management we have to understand the function of clothing and the problem related to those clothing we met in our day to day life for that we took a simple example of exercise.

- **Function and Problem of Normal Clothing:**
  - 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 more or less absorbed by the textile we are wearing. If the humidity is not transported to the surface for evaporation and remains in the fabric, cooling cannot occur. The body warms up and even more sweat is produced.
  - After its exercise, the body cools down and sweating ceases. However, any humidity retained in the clothing evaporates after a while, even if the body does not need to be cooled down any more. There after, we start to freeze.

During hard physical activity body sweats and in conventional clothing like cotton, the moisture traps out. The moisture locks out between clothing and body and then it increases body temperature and perspiration even more. The result of excessive perspiration can be one to diminished performance and fatigue. Due to trapped moisture, this is the usual condition which happens in very hot temperature. Chilling and Hypothermia is the common condition happen in the cold temperature due to the trapped moisture. Excessive moisture can add weight to the garment and even it irritates the skin of the wearer and increases the chances of the skin diseases. The moisture near to the skin makes skin cold when wind blows in the cold days.

This Moisture Management fabric is very useful if worn next to the skin at the time of exercising. It keeps skin dry.

Concept of Moisture Management

To analyze the "concept of moisture management" of a textile one has to know about both the basic temperature regulation of the human body, and about the properties of the textile required by this regulation.

Temperature Regulation of Human Body:
The human body has different ways of trying to maintain its temperature. For example, in a cold environment, in order to minimize heat exchange with the surrounding atmosphere, blood circulation in the arms and legs is reduced. If the body warms up, the blood circulation increases in an attempt to release surplus heat, hence forth we start to sweat.

During perspiration water (containing salt and other substances) is transmitted through the pores of the skin, from which it then evaporates. Through the cold which is generated during evaporation, the warmth surplus is consumed – in this way the body cools down again, and its temperature is re-adjusted.

Moisture management fabrics are high tech synthetic fabrics which are normally made of polyester microfibres or polyamide. These light weight fabrics dry quickly compared to the other fabrics and are easy to handle. By doing various processes, one can enhance the affectivity of this fabric. Blends are also possible in this fabric by using other fibre types.

Non-absorbent fabrics are used inside and moisture materials are used on the outside in making of fabric and it is worth effective. The Non-Absorbent material keeps the skin dry and the absorbent material keeps moisture away.

Moisture travels by capillary action in these fabrics. Moisture travels through the spaces between the fibres that act as tubes. The fabric which has narrower spaces gives up moisture more quickly. Hence these fabrics are the best for moisture transport.

Factors Affecting Moisture Management

The main factor which affects moisture management is absorbency.

- It increases the ability for moisture to be drawn into the fabric.
- It affects comfort levels. The higher absorbency leads to the more comfort levels.
- Garment becomes saturated.
- Less absorbency leads to regulate body temperature, improve muscle performance and delay exhaustion.

Thus moisture absorbent capacity of fabric also affects the moisture management.

Goals of Optimized Moisture Management Fabric

In consequence of the described problems in temperature regulation, main goal in the development of optimized sportswear is

- To transport humidity to the outer surface as fast as possible: The humidity has to reach the surface of the clothing first in order to evaporate. This occurs by capillary force, also known as wicking. The capillary force increases as the gaps between the individual fibres become thinner. It means that the finer the fibres are, the smaller the gaps are, and the better the humidity transport.
- To evaporate the humidity as quickly as possible: Contrary to what is frequently assumed, the evaporation of humidity absorbed does not depend on the type of fibre, but on the surface area of the textile used. In other words, the larger the surface, the finer the fibres and the more fibres there are at the surface – the faster the humidity evaporation. Therefore, humidity evaporates from a hydrophobic polyester fibre just as fast as it does from a hydrophilic cotton fibre of the same fineness.
- To make the skin feel dry: Clothes which have a humid feel about them are unpleasant to wear. However, there are differences between materials as to the level from which water content makes the textile feel humid. Whereas cotton can absorb a certain volume of water without feeling humid, polyester feels wet and clammy even with small amounts of humidity stored in it. Moreover, thick textiles – on the basis of their mass alone - absorb more humidity compared to thinner fabrics, and their surface does not significantly expand in the process. That‘s why drying thick fabrics takes considerably longer.

Transmission of Moisture

Transmission of moisture in the atmosphere is done by fibre in different ways:

The sorption-desorption process: During transient conditions, sorption-desorption is an important process to maintain the microclimate. A hygroscopic fabric absorbs water vapour from the humid air close to the sweating skin and releases it in dry air. The flow of water vapour from skin to the environment is enhanced by this comparatively to a fabric which does not absorb and reduces the moisture built up in the microclimate. In the absorption-desorption process an absorbing fabric works as a moisture source to the atmosphere.

It also works as a buffer by maintaining a constant vapour concentration in the air immediately surrounding it, i.e. though temperature changes due to the heat of sorption, a constant humidity is maintained in the adjoining air.

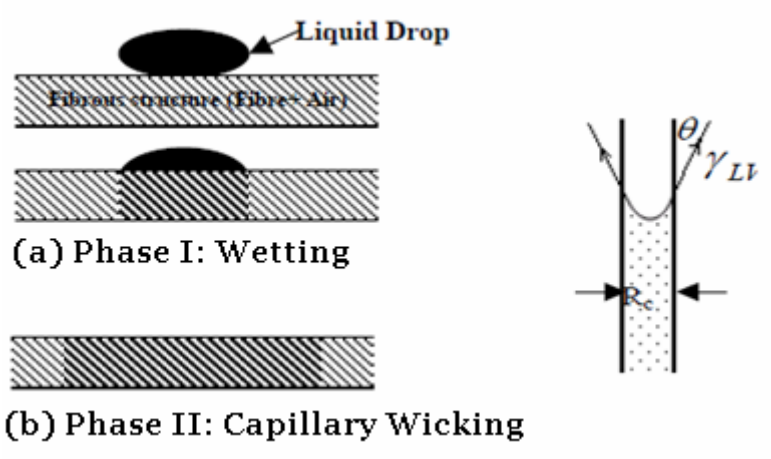
Diffusion of water molecules through the fibres: The vapour pressure gradient acts as a driving force in the transmission of moisture from one side of a textile layer to the other in the diffusion process. Water vapour can diffuse through a textile structure in two ways, simple diffusion along the fibre itself and through the air spaces between the fibres and yarns.

In the case of diffusion along the fibre, water vapour diffuses from the inner surface of the fabric to the fibre surface and then travels along the interior of the fibres and its surface, reaching the outer fabric surface. At a specific concentration gradient the diffusion rate along the textile material depends on the porosity of the material and also on the water vapour diffusivity of the fibre.

Convection Process: Convection is a mode of moisture transfer that takes place while air is flowing over a moisture layer. The mass transfer in this process is controlled by the difference in moisture concentration between the surrounding atmosphere and the moisture source. This is known as the forced convection method.

Liquid water transmission: The flow of liquid moisture through textiles is caused by fibre-liquid molecular attraction at the surface of the fibre materials, which is mainly determined by the surface tension and the effective capillary pore distribution and pathways. Liquid transfer through a porous structure involves two sequential processes – wetting and wicking.

- Wetting is the initial process involved in fluid spreading. The fibre-air interface is replaced with a fibre-liquid in this process.
- In the case of clothing with high wicking properties, moisture coming from the skin is spread throughout the fabric offering a dry feeling and the spreading of the liquid enables moisture to evaporate easily.



When the liquid wets the fibres, it reaches the areas between the fibres and produces a capillary pressure. By this pressure, the liquid is forced and is dragged along the capillary due to the curvature of the meniscus in the narrow confines of the pores.

Diffusion is the main mechanism for transferring moisture in low moisture content conditions. The porosity of the fabrics is the main factor of water vapour diffusion. The convection method is important in transferring perspiration from the skin to the atmosphere in windy conditions. When the moisture content of clothing is very high and the body is producing large quantities of liquid perspiration, wicking plays an important role in moisture transmission. With an increase in air velocity, the moisture transfer by convection increases. High wicking properties should be possessed mainly by fabrics to be worn as work wear in tropical climates or as sports wear. Therefore a fabric should be

designed according to the area of application to give best comfort for the level of perspiration generated.

Different Concept for Achieving Moisture Management

However, ideas differ among textile manufacturers as to how to achieve an optimized moisture management. A suitable fibre material is used or a subsequent finishing is applied in order to bring about the different effects. It is also possible to combine specialized fibres and finishings.

- Hydrophobic textiles (for example those made of polyester) absorb only a very small amount of humidity. It can also lead to insufficient transmission of humidity away from the skin and to an unpleasant damp feeling. The water which is not transported to the outer surface is no longer available for the cooling of the body.
- Hydrophilic textiles (for example those made of cotton) are known for their greater capacity to absorb humidity. Liquid is absorbed with efficiency and transported to the skin surface for evaporation. However, a larger amount of liquid has to evaporate, after exercise, which can cause stronger cooling and freezing.

Combinations of inner hydrophobic and outer hydrophilic layers are designed to transport humidity rapidly from the skin and evaporate it on the outside. The two-sidedness of the fabric is either attained by processing different materials during manufacturing or by varied coatings of the fabric surfaces. The special construction of the material enables transportation of humidity from the inside to the outside of the textile to take place.

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 humidity 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.

- Micro fibres, 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 fibres are designed to increase the capillary force and the humidity transportation, by means of special profiles (for example trilobal). The larger surface areas of these fibres also serve to promote evaporation.

Depending on the amount of physical effort made by the athlete, and the degree of humidity released, it could make sense to combine different concepts in order to reach an optimized moisture management.

As far as endurance sports are concerned, which produce continuous, slight sweating, it is not as important to evaporate humidity immediately as it is in the case of intermittent effort, after which cooling is immediately needed. Thus, a runner would choose a thicker

cotton t-shirt for doing sports, whereas for a football player, thinner polyester qualities are more suitable.

Testing Method

As there is no official definition of the term “moisture management”, no standard is as yet available for testing of moisture management. How-ever, different testing methods have already been developed:

1. ASTM moisture vapor test (open cup test): Cotton Incorporated
   In this test, the textiles are bent over cups containing water. The temperature of the water, the air above the water and the surrounding air is the same. The weight of water evaporated through the textile is measured after a certain time.
2. GATS (gravimetric absorbency test system): Cotton Incorporated
   The fabrics are put on a porous plate through which water is transmitted to the backside of the sample. The water is more or less soaked up there by the fabric. The fastness and value of the water absorption is measured, as well as the speed of drying.
3. Cotton Incorporated Gross Absorbency Test: Cotton Incorporated
   In this test, the sample is placed on another textile which is evenly saturated with water. The lower textile is kept saturated by a sponge placed under it, while the sample soaks up the water and evaporates it.
4. Moisture Management Tester (MMT): The sample is placed flat between two plates of different diameters with circular sensors. The sensors measure the changes in resistance between each upper and lower pair of sensors, after application of special liquid. In that way the duration of moisture absorption, the radius of spreading, the speed of spreading, the amount of moisture transported, and by this, the overall moisture management can be measured.

Despite the lack of a standard for objective testing of “moisture management”, there are interesting possibilities for the variation of moisture transportation and skin feeling - also and especially - with the help of a subsequent finishing of fabric.

Because of the various parameters (type of fibre, technology available, material construction etc.) and different requirements depending on the application purpose of the textile, the finishing must be adapted to each individual case.

Developments in Moisture Regain Fabrics

Invista is a leading company which manufactures moisture management fabric. CoolMax and Thermolite are brands of this company and these fabrics are being used in the sportswear and also used in the garments used for outdoor activities. Other companies are competing these brands for last ten years and new companies are also growing in this field of moisture management. Few other known names are American Fibers and yarn, Intera, Hind, Lenzing, Nano-Tex, Miliken, Patagonia, Rhovyl, Polartec, Tomen, Comfort Technologies, Wellman, Honeywell, Marmot, Intex, Mitsui, PearlIzumi, Nike, Schoeller and Usa-Pro. Growth has been seen in the moisture management fabric in the last few years.

The manufacturers are doing researches for new developments to improve the quality and add more functions to the moisture management fabrics. New innovations in the field of smart textiles and smart fabrics are adding their values. The future is very bright. There is a good prospect of new developments like adjustable pore sizes and thicknesses in the very near future.

Conclusion

The moisture management is an essential property for any textiles or apparels especially for sports wears. The general sports apparels can have low moisture transfer but the active sports wear must have high moisture transfer.

Reference

- *www.fabric2fashion.com*
- *http://www.autexrj.com*
- *http://www.seminarprojects.com/Thread-moisture-management-in-textiles*
- *www.wikipedia.com*