

Analysis of Moisture Management Parameters in the Woven Cotton Fabrics After Chemical Treatment with Moisture Management Finishes

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Abstract: *Comfort is the most demanding aspect of textile materials. Nowadays, when it comes to garments, sportswear, leisure wear the customers seems to be much demanding and much concerned of the comfort of the garment. Breathability of the fabric is one of the textile properties that has gained importance among the awared customers. To be comfortable, the fabric must have arrangements for the body's heat balance under wide range of environmental conditions. Moisture management is the key criteria for checking the performance of fabric comfort. Garments which transfer body moisture and evaporate quickly increases the ability of fabric to cool the body. Various processes like diffusion, absorption are employed in the transfer of moisture from body to the surrounding whereas the perspiration makes the fabric wet and is wicked away from the fabric thereby ensuring a temperature balance. This report gives a brief idea of moisture management fabrics, the processes involved, the technology involved and the factors affecting moisture management. At the end of this report, the current project done by us is highlighted.*

Keywords: Moisture Management, Cotton

1. Introduction

Moisture Management refers to the controlled transport of moisture vapours and water away from the body. Controlled in the definition means that no compromise on the comfort level of the textile should be made. To maintain the state of comfort of the fabric, it should maintain the heat balance of the body under wide range of environmental conditions.

It is defined as the ability of a garment to transport moisture away from the skin to the garment's outer surface. This action prevents perspiration from remaining next to the skin. Moisture is transported in textiles through capillary action or wicking. In textiles, the spaces between the fibres effectively form tubes, which act as capillaries, and transport the liquid away from the surface.

India is a humid country so moisture management of fabric is needed in order to ensure that the person wearing these fabrics feel comfortable and very near to nature. Natural fibres such as cotton are hydrophilic meaning that their surface has bonding sites for water molecules. Therefore, water tends to be retained in the hydrophilic fibres which have poor moisture transportation and release.

Synthetic fibres such as polyester are hydrophobic meaning that their surface has few bonding sites for the water molecule. Therefore, they tend to remain dry and have a good transportation and release. Moisture absorption and release properties do not coexist in common fibres.

Maintaining body heat under different environmental conditions is very essential for a fabric which determines its comfort level. The human body releases around 60 ml of water vapour at ambient conditions even when it is at rest. When we do some activity like walking or play any

sports, the body warms up and sweats more which is more or less absorbed by the textile material. This humidity needs to be transferred to the surface of the fabric for evaporation and thus producing a cooling effect. Therefore, to make a wearer feel comfortable, not only should the fabric evaporate the perspiration from the skin surface to the fabric surface but, the moisture should also get evaporated. Moisture adds weight to the garment and makes the skin cold. It can also cause irritation and skin diseases. Hence, it is very essential to have a moisture management fabric so as to make the wearer feel comfortable.

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

- Optimum heat and moisture regulation
- Good air and water vapour permeability
- Rapid moisture absorption and conveyance capacity
- Absence of dampness
- Rapid drying to prevent catching cold
- Low water absorption of the layer of clothing just positioned to the skin
- Dimensionally stable even when wet
- Durable
- Breathability and comfort
- Easy care performance
- Lightweight
- To transport the humidity to the atmosphere 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. That means that the finer the fibres, the smaller the gaps are, and the better the humidity transport.
- To evaporate the humidity as early as possible-The evaporation of humidity absorbed does not depend on the type of fibre, but on the surface area of the textile used. The larger

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- The surface, the finer the fibres and the more fibres there are at the surface – the faster the humidity evaporation.
- 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 absorb more humidity compared to thinner fabrics, and their surface does not significantly expand in the process. That's why drying thick fabrics take considerably longer

2. The Current Project

Cotton fibres absorb a good amount of water and have a very good moisture regain property and are therefore considered a good material to be used in garments for common use. Although the cotton fibres absorb large amount of moisture but the tendency of transferring this moisture to environment is poor (it is a slow process). So the sweat/perspiration generated during sports or any other activity does not easily get evaporated through cotton fabrics and thus these do not provide comfort to the person. So, in order to target this problem with cotton fabric and making it comfortable for apparel use we are aiming to decrease the evaporation time required for the absorbed moisture on the fabric to evaporate.

In this project we are aiming to decrease the evaporation time by applying two different types of moisture management finishes so as to make the fabric more absorbent and quick dry and thereby more comfortable.

3. Aim of the Project

The aim of this project is to analyse 25 untreated cotton samples for their moisture absorbency by testing them for drop absorbency and vertical wicking. These samples thereafter are chemically treated with two different moisture management finishes. After this the durability of finish and the change in moisture management parameters is analysed. These changes will then be related to fabric cover, fabric weave type, GSM and the construction of the fabric.

In this Project we are mostly concerned with the 100% cotton fabrics and blends such as 97% Cotton+3% Lycra with weave types: Plain, Dobby, Twill and Oxford.

In this project, 25 different fabrics are analyzed. Mostly all the fabrics are 100% cotton except three. The remaining three are 97% cotton + 3% Lycra. This is more preferred because of its stretch ability and shape retention properties. It shows high resiliency properties than 100% Cotton due to its soft and rubbery segments. They also exhibit highest water vapour permeability as this fabric is made up of finer yarns with low fabric cover that gives high porosity.

4. Plan of Action

Considering our aim discussed above we adopted following plan of action-

After collecting 25 different cotton samples, the untreated samples were tested. The three tests done on these samples were;

a. Vertical Wicking (Method - INC S1045) - In this method, two specimens were cut from each fabric sample, one along the warp and other along the weft direction. The dimensions of the specimen were 17 cm * 2.5 cm. For example - every weft specimen had 17 cm length in weft direction and 2.5 cm length in warp direction.

0.5 cm mark was thereafter made in the longest length direction. The specimens were then immersed in doubly ionized water (which is kept in a beaker of 100ml up to the height of 4.5 cm) such that 0.5 cm is only immersed in water and the stopwatch was made on. After 5 minutes and 30 minutes, the amount of length traversed by water along the longest length was noted.

b. Absorbency Test (Method - AATCC-79) - In this method, each sample fabric was mounted on an embroidery hoop with all creases out of it. A burette dispensed a drop of water onto the surface of the fabric from a distance of 9.5mm below the burette. Time is thereafter recorded until the water drop absorbs completely.

c. Core pH - For this, 10 g of a fabric sample was weighed and then cut into small pieces of approximate dimensions of 1.5 cm * 1.5 cm. In the meantime, 250 ml of doubly ionized water was boiled in a beaker on a hot plate. After this the cutted specimen was put in this water and was boiled for 10 minutes. After this the water was cooled down for 3 hours and then the pH of this water was tested on a pH meter.

After testing the untreated samples, each fabric was chemically finished with two different types of moisture management finishes -the specifications of which are given below-

a. Moisture Management Finish 1:

i. Non ionic silicone softener with extremely good soft release and antistatic property and wash durable wicking property

ii. Silicone softener imparting excellent softness and very good surface smoothness imparting antistatic properties and has very high shear stability.

iii. Wetting Agent

iv. Pad-Dry Conditions: pH - 5.5, Temperature - 140°C, Time - 1minute

b. Moisture Management Finish 2:

- i. Thermo reactive polyurethane for permanent soft handle effects on all natural and regenerated cellulose fibres as well as polyamide
- ii. Highly effective hydrophilic silicone emulsion suitable for cellulosic rich blends
- iii. Hydrophilic Softener which gives very nice soft & natural handle without any effect of whiteness of cellulosic, synthetic or wool fibres and their blends
- iv. **Pad-Dry Conditions:** pH - 5.4, Temperature - 155°C, Time - 1minute

- After the finish was done, the rigid samples of both finishes were tested for vertical wicking and absorbency test as listed in second point of plan of action.
- After testing the rigid samples, we did heavy laundries (HL) of these two differently finished samples separately. Firstly the samples which were chemically treated with finish recipe 1 were given for 3 heavy laundries and the remaining half section for 20 heavy laundries. After obtaining these samples from laundry they were dried and condition for one day after which these samples were tested for vertical wicking and absorbency.
- Similar procedure was adopted for samples which were chemically treated with finish recipe 2.
- In the meantime, the GSM and cover factor of all the untreated samples was also calculated.

Success Criteria - The increase in wicking rate and moisture absorption of the finished fabrics which meets the budget, quality, requirements of the user is considered as a success.

After listing out all the data we shall analyze the change in moisture absorption and durability and compare the 2 Moisture Management finishes accordingly.

5. Results and Discussion

A. Weave structure and moisture management parameters

The test results of the fabrics are shown in the excel sheet.

From the results it can be seen that vertical wicking and Moisture Absorption Properties of Twill 4/4 weave is higher than twill 2/2 and Matt 2/2 weave which is further higher than plain weave. Therefore the final order is : Twill 4/4 > Twill 2/2 = Matt 2/2 > Plain.

Matt Weave- In matt weave, multiple ends and picks interlace with each other in a group. The number of interlacement in the fabric is much lower than that of

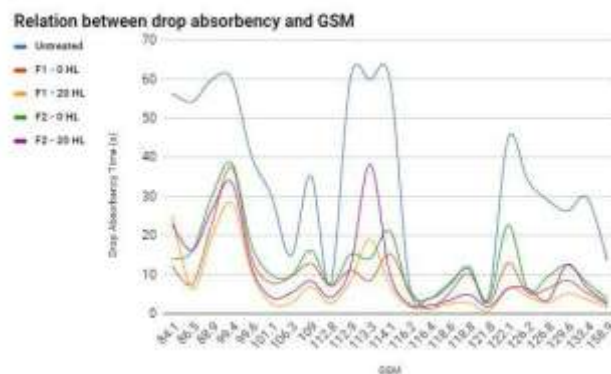
plain weave. In 2x2 matt weave, two ends and two picks form pairs and interlace in the form of plain weave.

Twill Weave- Twill weave has lesser interlacements than the plain weave. Thus the crimp in yarns for twill weave will be lower than that of plain weave. Twill lines are formed on both sides of the cloth and twill weaves enables greater weight, closer setting and better draping quality than plain weave in the cloth.

As mentioned above, because of lesser interlacements and closer setting of twill 4/4 weave, the capillaries present in the weave are straight and are closer to each other enabling good wicking properties than Twill 2/2, Matt 2/2 and Plain weave which have more interlacements in comparison to the Twill 4/4 weave.

The closer setting of Twill 4/4 weave enables more surface area of finished fabric to contribute in the drop absorption activity and thus Twill 4/4 weave exhibits good moisture absorption in comparison to Twill 2/2, Matt 2/2 and Plain weave.

B. GSM of fabric and moisture management parameters

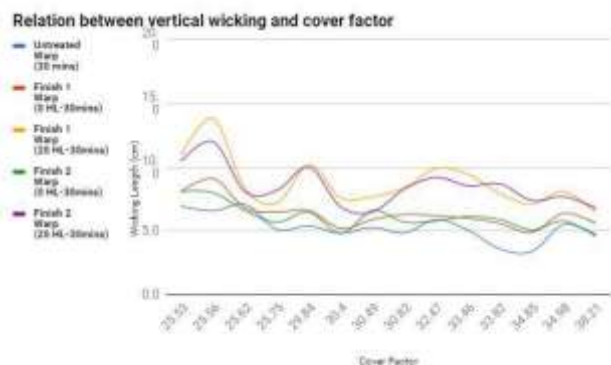


We can conclude from our project that the drop absorbency time of fabric decreases with increase in the GSM. The reason for this behavior is that with increase in GSM the density and surface area of fabric increases leading to more availability of finished surface area for absorbency. Now when a drop is put on high GSM fabric, it will take less time to sink into the fabric due to the availability of more finished surface area.

The fluctuations in the above graph are due to the other factors like fabric weave, finished construction of fabric. Overall it is clear from the above graph that the drop absorbency time of fabric is reduces with time.

C. Cover Factor and moisture management parameters

cover factor of the fabric also decreases the vertical wicking length.



Vertical Wicking length decreased with increase in the cover factor of the fabric. With increase in the cover factor, the hinderance to the movement of water along the capillaries comes in play. This hinderance exerts an opposition to the water movement and thereby the distance moved by the water along the length of the fabric is less.

D. The two finishes and their durability.

From the compiled data in excel sheet, it can be seen that the moisture management properties of finish 1 are better in comparison to the finish 2.

The two finishes were obtained from two different suppliers.

From the sheet it is also clear that rigid samples (0 HL) of finished fabrics have better moisture management properties in comparison to the untreated fabrics. Compared with the 3HL and 20HL samples, the order of moisture management parameters is as follows: 20HL > Rigid > 3HL > Untreated (for both the finishes)

Reason:

Rigid samples of finished fabric has better wicking and moisture management properties than untreated because of the softness, wet ability and surface smoothness imparted by the finishes. Surprisingly rigid samples of finished fabrics exhibited better properties in comparison to the 3HL. It was because of the hard water used in the lab due to which the fabric handle was destroyed.

6. Conclusion

Concluding from this project, the moisture management parameters and thereby the comfort level of the cotton fabrics can be improved by using a weaving structure which has less number of interlacements (like twill, matt). The density of the fabric also considerably determines its moisture management parameters. As observed in the experiments, the fabrics with higher GSM showed good moisture absorbency. Increasing the