NC STATE
Wilson College of Textiles

JTATM
Journal of Textile and Apparel, Technology and Management

Volume 12, Issue 4, 2022

Influence of Functional Finishes and Polyester type on Comfort Properties of Active Sportswear

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ABSTRACT

Sweat generation and loss of metabolic energy are more in active sports compare to other activity of human being. There is a need to design a fabric, which gives comfort in these conditions. The moisture vapor transmission, air permeability, wicking of moisture and drying behavior by fabric influences the comfort of clothing. The comfort behavior of fabric is improved by various technologies like change in fabric structure; change in fiber composition or by chemical treatment. In the present study, the comfort characteristics of weft knitted fabrics were investigated after chemical treatments using different levels of concentration of four different finishes. The weft-knitted jersey fabric is produced using three different types of polyester fibers. Moisture management properties of the fabric and supporting factors like thickness, porosity, contact angle, drying behavior, water vapor permeability and vertical wicking is studied to evaluate the overall comfort behavior of fabric after finishing. It is found that all the parameters specified in moisture management test are significantly improved by moisture management finish, while soil release and antimicrobial finish have a lesser impact. The ultraviolet finish significantly influences to the moisture management properties of micro-polyester fabric only. The micro polyester fabric is exhibit better moisture management than texturized polyester and polyester spandex blended fabric. This is due to more capillary channels available to transport the liquid quickly from a top surface to bottom surface. The water vapor permeability, vertical wicking, drying behavior and air permeability are significantly improved with the application of moisture management finish and higher in micro-polyester fabric compare to other types of polyester fabric. The effect of the laundering cycle is also studied and found that after ten laundering cycle, there is an increase in all studied comfort properties. Thus, fabrics made of micro polyester and treated with moisture management finish may be used to have excellent comfort during rigorous physical activities.

Keywords: Sportswear fabrics, Moisture properties, Functional finishes, Laundering cycles

1. INTRODUCTION

Moisture transport in textile has been an important area of research for many decades [1-4]. In active sports, high level of metabolic energy and sweat generation takes place [5]. In these conditions, moisture vapor transmission and moisture accumulation under clothing determine the comfort of sportswear [6]. Globalization has added competition at the highest level in making an apparel product more sustainable, fashionable and customer focused. By increasing its both aesthetics and functional properties is the way to make the apparel products more demandable in the market [7]. This has been possible with textile chemical finishing applications. Hence, finishing is the heart of textile processing and it imparts functional and protective features like anti-microbial, moisture management and many more. Functional finishing such as ultraviolet-resistance and antibiosis is often applied to textiles in order to improve their performance in use [8]. It accomplishes the result of making the fiber more absorbent (hydrophilic).

Anti-microbial finished textile lowers down the psychological discomfort associated with foul odor arising out of microbial growth and by fungi causing skin infections. This is avital aspect as human body sweats during various sports activities and the temperature of human body also increases, favoring microbial growth. This growth of microbes can be stopped by reducing cross-interaction in the textile material by applying antimicrobial finish. This phenomenon not only prevents infections but also helps in improving performance of sports person by eliminating discomfort [9-11]. The ultraviolet rays which are a part of sunlight, have few adverse effects on human body such as skin burns, suntan, skin aging, suppressing effect on immune system and more severe disease. Because of the ever-increasing incidence of skin cancer, clothing is an important means of reducing exposure to ultraviolet radiation [12]. Since light colors reflect most of the light, so they have better UV protection factor as compared to dark colors. UV finish incorporates chemical compounds that absorb energy in the ultraviolet region of the electromagnetic spectrum [13].

Synthetic fibers have low moisture regain; therefore, they accumulate static charge during manufacture and during wear. Charged fibers attract soil from the atmosphere, positively charged fabric attracting more soil than the negatively charged one. The fiber cross- section and other construction parameters also have a significant influence on soil release property of fabric. A soil release finish does not prevent soil from entering the fabric but it simply allows it to leave faster. It removes soil from the fabric and transfers it to the detergent; it protects the fiber from attack by soiling matter; it prevents redisposition of soil, which has been dissolved or dispersed, and lastly it prevents dust from being attracted and held by electrical charges on the fabric surface. Thus, soil-release finish reduces the problem of perspiration and body odor, increases the absorbency and wicking action of a fabric for superior comfort in sportswear [14].

Moisture management finish is one among the methods for achieving comfort in sportswear. Moisture management in textiles can be defined as the engineered or inherent transport of water vapor or aqueous liquid (perspiration) through top and bottom surfaces of textile [15]**.** The main purpose of a moisture management finish is to develop the ability of textiles to absorb humidity from the skin, transport it to their outer surface and release it into the surrounding air. But the focus of this research is the resultant influence of this finish on comfort parameters of the textiles [16, 17].

So, encapsulating above literature, the four finishes undertaken in this study has a significant scope and application in sportswear field. It seemed to be essential to investigate the moisture management parameters affected due to these finishes to assert performance of sportswear in terms of disease protection, faster sweat absorption, relief from bad odors and so on.

Table 1. Characteristics of polyester sheath and lycra core yarn used

	Material	Fineness (tex)	No. of filaments in cross-section	Fineness of filament
Micro Polyester Filament yarn	100% PES	11.11	144	0.0771
Texturized Polyester Filament yarn	100% PES	11.11	72	0.1543
Core spun Polyester elastane Filament yarn	96% PES 4% EL	11.11	72(Sheath)/(Core)	0.1543
Micro Polyester Filament yarn	100% PES	11.11	144	0.0771

Table 2. Settings of the ring spinning frame (PES/EL)

Filaments pre- tension (N)	0.16
Traveler (rpm)	15.000
Break draft	1/25
Total draft	33.68
Twist ‘m^{-1}’	530
Fineness of EL (tex)	3.33

Table 3. Yarn mechanical properties

	Breaking force (kgf)	Tenacity (cN/kg)	Elongation (%)	Unevenness (%)
Micro Polyester Filament yarn	0.6232	22.692	13.85	12.92
Texturized Polyester Filament yarn	0.6463	23.888	14.70	13.86
Core spun Polyester Elastane Filaments yarn	0.5784	19.338	16.82	11.13

2. MATERIALS AND METHODS

2.1 Fiber, Yarn and Fabric Characteristics

Weft Knitted fabric samples are prepared on circular knitting machine with single jersey fabrics using three different filament yarns with details mentioned in (tables 1, 2,3).All fabrics were knitted on Mayer & Cie Relanit circular knitting machine with 26 inches in diameter, gauge 18 and 36 feeders at constant machine settings and at the same tension. The fabric details measured were: wales per inch (WPI), course per inch (CPI), linear density of yarn (denier), fabric mass per unit area (g/m^2) and fabric thickness (mm). WPI and CPI were measured according to the ASTM D- 3887 Standard.

2.2 Chemical Finishing

All three types of yarns are chemically processed to make the ready for dyeing (RFD fabrics). For this the scouring and bleaching process is carried out followed by application of four functional finishes mentioned in table 4. The method used for finish application is padding mangle with 100% wet pick up.

Table 4. Functional finishes applied on fabrics

Functional Finishes	Chemical characteristics	pH level	Ionic nature
Ecofinish AB 1000 antimicrobial finish	Quatarnery ammonium compound	6	Cationic
Ecofinish UV 1000 ultra violet finish	Benzotriazole	6	Non-ionic
Evo Fin PSR soil release finish	Modified Polyurethane	6-8	Non-ionic
Evo soft HDS Moisture management finish	Hydrophilic Silicone Softener	4-5	Non-ionic

2.2.1 Procedure to Apply Functional Finishes

The three fabric samples are cut into four pieces each and conditioned in standard atmospheric conditions. Then the 12 fabrics of size 30 X 30 $cm^2$are cut from the fabrics and are prepared for uniform application of finish as per below steps:

a. The solutions of all four finishes prepared as per prescribed in TDS (Technical Detail Sheet) provided by the chemical manufacturer.
b. The cut pieces are immersed in prepared solutions and 1% citric acid binder one by one for 5 min each.
c. The padding mangle is switched on and set for a speed of 0.25 m/s and roller squeeze pressure of 98.0665 kPa. This pressure is enough spread out the solution evenly on fabric surface and remove excess amount.
d. The fabric samples are then taken out of solution and passed through padding mangle. A 100% wet pick-up was maintained for all of the treatments.
e. Then fabric is placed into an air-dry curing oven (which has already been set at 140℃ temperature). This process is known as curing and carried out for proper fixing of finish on the surface of fabric sample. Curing is done for 2 min only.
f. After curing, the fabric sample is immersed into a pre-prepared solution of 2 g/l sodium lauryl sulphate to remove unbound nanoparticles for 5 min.
g. At last, the fabric samples are rinsed with water to remove soap solution followed by air-drying.

The fabric samples thus prepared are set for conditioning and testing.

2.3 Laundering

Clothing intended for repeated use must be able to be laundered. Thus, it is important to investigate any change in moisture management properties that may occur as a result of laundering. The investigation is carried out for samples without finished and laundered 10 times to record changes occurring in moisture management property after wash.

The finished fabric samples are washed according to JIS-L 1089 [18-21]. This standard gives the most common method employed for laundering using a neutral powder type detergent. The durability of finishes has also been assessed along with moisture management capability for all fabrics. The laundering was carried out in electric laundry machine based in the washer was set on the regular setting for fabrics with hot water, 30° ±5°C for 10 minutes washing time and subsequently, the sample was tumble dried at 60° ±6°C or 5 minutes. Further laundering was repeated after conditioning of the fabric samples for 10 cycles.

3. Methods

3.1 Testing Procedures

The knitted fabrics were conditioned in standard atmospheric RH (65+/-2%) and temperature (27+/-2ºC) for 24 hours before testing. The fabrics were tested first for their fabric particulars and index properties and then moisture management properties.

3.2 Index Properties Testing

In this study, physical properties such as fabric thickness, air permeability and porosity, pore diameter are considered as important properties, which directly influence the fabric moisture management properties; here these all mentioned as index properties for the same reason.

3.2.1 Thickness Testing

Thickness testing was carried out as per BS EN ISO 9073-2 using the electronic thickness tester at 0.25 KPa pressure. For each sample, 30 readings were taken to get the result at 95% confidence level.

3.2.2. Air Permeability Testing

The air permeability of a fabric is closely related to the construction characteristics of the yarns and fabrics in which large volumes are occupied by air. The air permeability of a fabric is a measure of how well it allows the passage of air through it and is defined as the volume of air passed in one second through 100 square.mm of the fabric at a pressure difference of 10 mm of water Air permeability was carried out as per ASTM D737 using FX 3300 air permeability tester. Testing was carried out in a circular test head of diameter 15.07 at test pressure of 98 Pa. The rate of air flow through the fabric was obtained in terms $cm^3/ cm^2/s$.

3.2.3 Porosity (%)

(ISO, 1996) Porosity value were calculated using the equation (1) given below

Porosity (%) = 100((1-M))/(h*p) ……... (1)

Where, M = fabric weight (g/m^2), h = fabric thickness (cm), p = fiber density (g/cm^3)

3.2.4 Capillary Flow Porometer

ASTM F-316-03 standard, the PMI capillary flow porometer, a fully automated through pore analysis machine, gives information on bubble point, pore size distribution, mean flow pore size. The capillary flow porometer allows you test samples under compression dry and wet condition.

3.3 Moisture Management Properties

3.3.1 Moisture Management Tester

The knitted fabric (Untreated and treated) samples were tested on SDL ATLAS M290 Moisture Management Tester (MMT) according to AATCC Test Method 195–2009, 2011. The accumulative one-way transport index (OWTI) and the overall moisture management capacity (OMMC) measured by using the (moisture management tester) MMT provide an insight about the liquid moisture transmission performance of fabrics. OWTC is the difference in the accumulative moisture content between the two surfaces of the fabric. OWTC reflects the one-way liquid transport capacity from the top (inner next to the skin) to the bottom (outer) surface of the fabric. OMMC is an index of the overall capability of a fabric to transport liquid moisture and is calculated by combining three measured attributes of performance: the liquid moisture absorption rate on the bottom surface (ARb), the one-way liquid transport capability (R) and the maximum liquid moisture spreading speed on the bottom surface (SSb).

MMT according to AATCC test method 195-2011; the (table 3.6) indices are graded and converted from value to grade based on a five-grade scale (1–5). The five grades of indices represent the following: 1 – poor; 2 – fair; 3 – good; 4 – very good; 5 – excellent.

Table 1: Grading Table of all indices on moisture management properties

Index		Grade				
		1 (Poor)	2 (Fair)	3 (Good)	4 (Very Good)	5 (Excellent)
Wetting time (s)	Top	≥120	20-119	5-19	3-5	<3
	Bottom	≥120	20-119	5-19	3-5	<3
Absorption (%/s)	Top	0-9	10-29	30-49	50-100	>100
	Bottom	0-9	10-29	30-49	50-100	>100
Max wetted radius (mm)	Top	0-7	8-12	13-17	18-22	>22
	Bottom	0-7	8-12	13-17	18-22	>22
Spreading speed (mm/s)	Top	0.0-0.9	1.0-1.9	2.0-2.9	3.0-4.0	>4.0
	Bottom	0.0-0.9	1.0-1.9	2.0-2.9	3.0-4.0	>4.0
OWTC (One-way transport Capability)		<50	50-99	100-199	200-400	>400
(Overall Moisture management capability) OMMC		0.00-0.19	0.20-0.39	0.40-0.59	0.60-0.80	>0.80

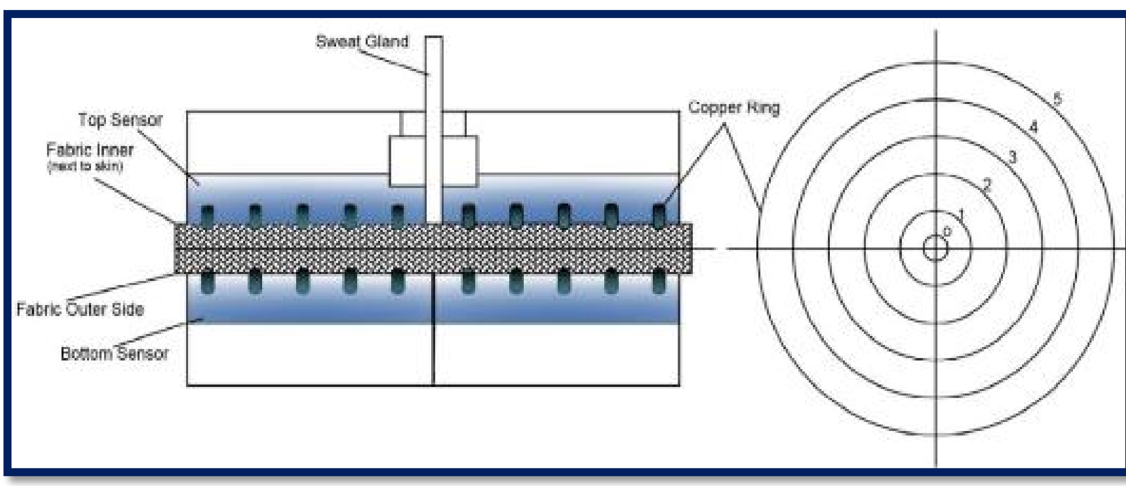


Figure 1. Schematic diagram of MMT apparatus testing

<u>Procedure</u>: In this tester, fabric specimen is held flat by top and lower sensors at a certain pressure. A certain known volume of a pre-defined test solution is then put into the sweat gland and introduced onto the top surface of the fabric. This instrument in integrated with a computer with moisture management software, which records the change in resistance between each couple of proximate metal rings individually at the top and lower sensors. The salted solution transfers in three directions after arriving on the fabric specimen top surface:

A. Spreading outward on top surface transfer
B. From top surface to the bottom surface and
C. Spreading outward on bottom surface.

The resistance of each couple of proximate metal rings changes due to solution, which can conduct electricity. Thus, it tests the dynamic moisture transport properties of fabrics in terms of moisture absorbing rate of a fabrics inner and outer surfaces, one-way transportation Capability from inner to outer surface and the moisture spreading [24, 25].

3.3.2 Drying rate tester

Dry rate testing was carried out using dry rate tester, which evaluates the weight of water evaporated in given time from the fabric.

This device can be used independently to find a drying rate or in conjunction with the SDL Atlas Moisture Management Tester (MMT) in order to obtain a more complete understanding of the moisture management properties of a performance fabric.

Procedure: Sample size of 15 cm x 15 cm was used for the study, positioned horizontally on the balance. A measurement is taken in dry state and then 1 ml water is added on its surface and placed back on the balance. The software is initiated and sample is allowed to dry for required amount of time in the room conditions. The difference between initial and final weight gives the dry rate % of the fabric sample.

3.3.3 Water Vapor Permeability Tester

Water vapor permeability testing is carried out to determine the resistance of textiles and textile composites (particularly action wear fabrics) to water vapor penetration using testing standard BS 3424. This is carried out in the water vapor permeability tester, which consists of 8 containers with water reservoirs, a standard permeable fabric cover, sample holder ring and precision drive system. The water vapor permeability (WVP) of the fabric is calculated in g/m²/day is using the equation (2).

$$WVP = \frac{24\,M}{At} g/m^2/day \qquad \ldots (2)$$

Where, M= Loss of water (g) through fabric, A= Internal area of the fabric (m^2), t =Time of testing (24 hours).

3.3.4 Vertical wicking

The vertical wicking test of the fabric was carried out according to standard DIN 53924 -strip test method through an apparatus developed in institute lab and the results were measured in terms of wicking height in centimeters'.

Procedure: In this test, a strip of fabric was suspended vertically with its lower edge in a reservoir of distilled water. The rate of rise of water through the leading edge was then monitored. To detect the position of the waterline, a dye was added to water. The measured height of rise in a given time was taken as a direct indication of the wick-ability of the test fabric. The sample size is 20 cm X 2.5 cm and the measurement is recorded 4 times after every 5 min i.e. at 5 min, 10 min, 15 min and 20 min in the wale's direction.

4. RESULTS AND DISCUSSION

The fabric parameters and index properties are represented graphically in figures (2, 3, 4). Also mean values of various moisture management properties are calculated and analyzed graphically and using statistical tools.

4.1 Fabric Characterization

The results of index properties are compared using column graphs in figures (2, 3, 4). The areal density of fabric samples is increased after treatment with different finishes. The increase in areal density is retained up to 10 washes i.e. there is no significant loss. Similar trend is observed in case of porosity and air permeability, but the increase is highest when treated with moisture management finish (MMF). When compared within different fiber types, areal density of polyester spandex yarn is found highest as compared to other two, while porosity and air permeability is the lowest for polyester spandex. This shows the compactness of structure due to the presence of spandex in the structure. Porosity of texturized polyester and fabric with polyester spandex is almost same when treated with antimicrobial and ultra violet finish. Also, micro polyester shows lesser areal density and more porosity due to fine structure and better packing capability than texturized polyester. The effect of above observations will be used to explain moisture management properties in later sections.

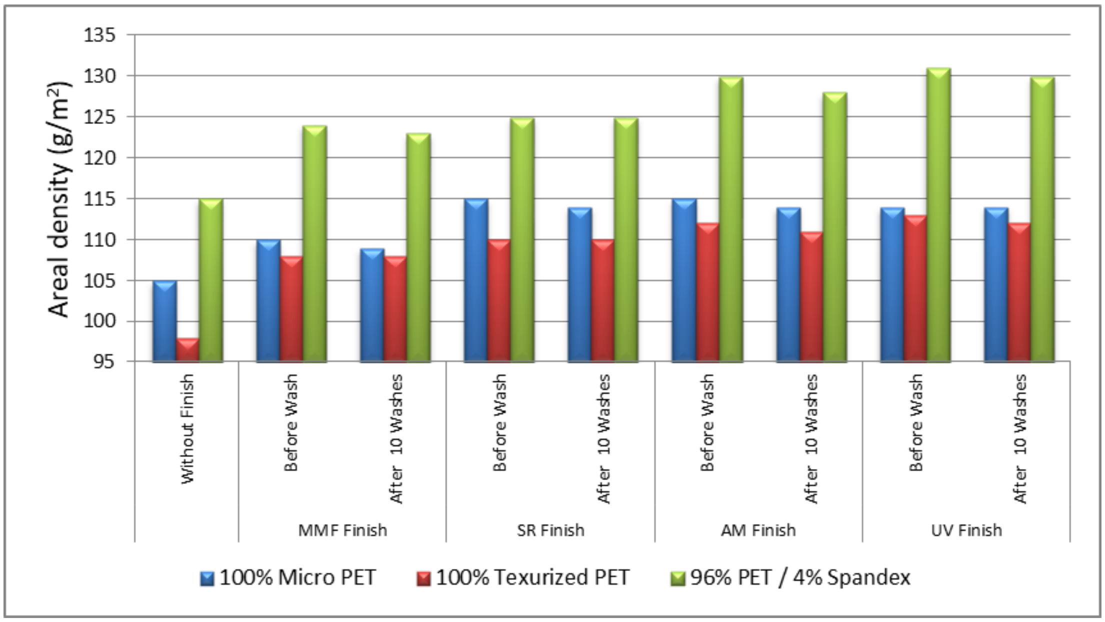


Figure 2. Comparison of area density of samples (before and after treatment and washing)

4.2 Moisture Management Properties

The moisture management properties are evaluated on the basis of wetting time, absorption percentage, maximum wetted radii and spreading speed of moisture in top and bottom layer of fabric. Then one-way transport capability and overall moisture management capability values are evaluated to investigate the comparison of overall moisture management property of fabric samples. Comparative analysis is carried for the contribution percentages of independent variable in figure 5.

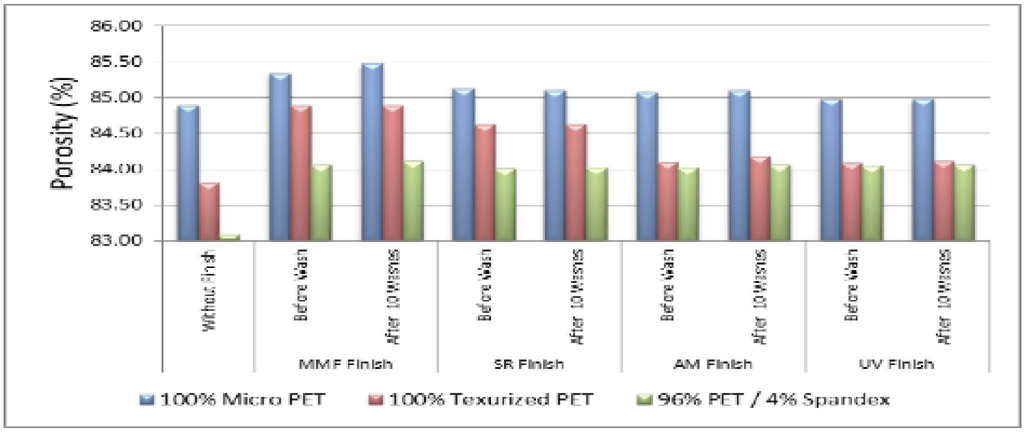


Figure 3. Comparison of porosity of samples (before and after treatment and washing)

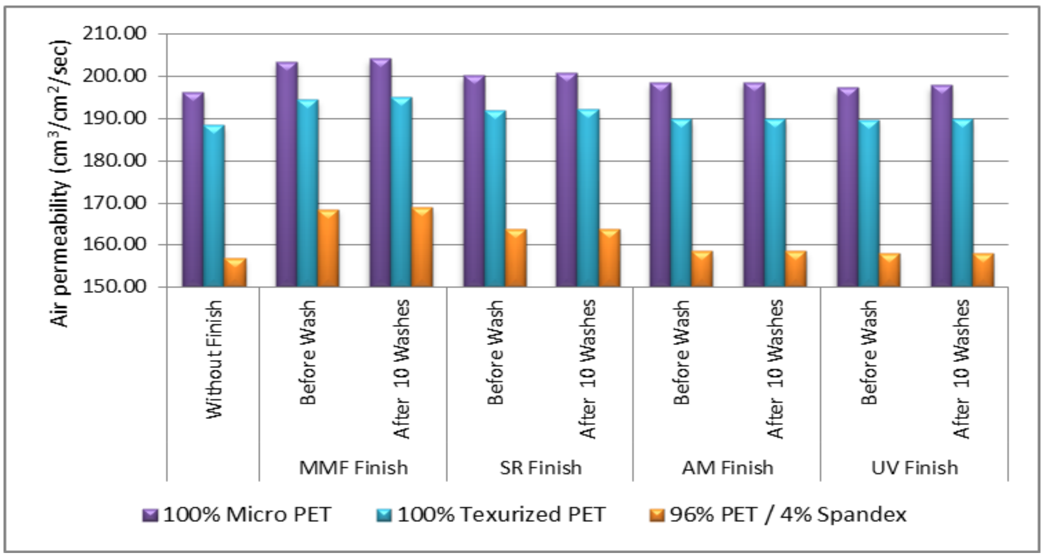


Figure 4. Comparison of Air Permeability of samples (Before and after treatment and washing)

4.2.1 Wetting Time

From figure 5, the wetting time for both top and bottom surface is found to be in range of 'Good -3' to 'Excellent – 5'. As observed from contribution percentage, all the independent variables i.e. fiber content, finished before wash and finished after wash influence the wetting time of both top surface and bottom surface [26]. The highest influence is from finish type – before finish 13.49% (WTT) / 21.48% (WTB) and after finish - 16.99% (WTT) / 21.23% (WTB) shown in figure 5. This is also explained from the figure 7, where wetting time is always highest for polyester spandex fabric followed by texturized polyester and micro polyester. This is due to the fact of more fabric thickness, lower porosity and blocked flow of moisture while transfer from top to bottom layer in case of spandex fabric. Finish type also contributes to wetting time as in case of samples finished with UV finish are taking higher wetting time resulting in lower transport of moisture from top surface to bottom surface of fabric. In our samples wetting time for bottom layer does not varies from wetting time of top layer significantly because all the samples contain 11.11 tex polyester multifilament yarns which are almost equally participating in moisture transport.

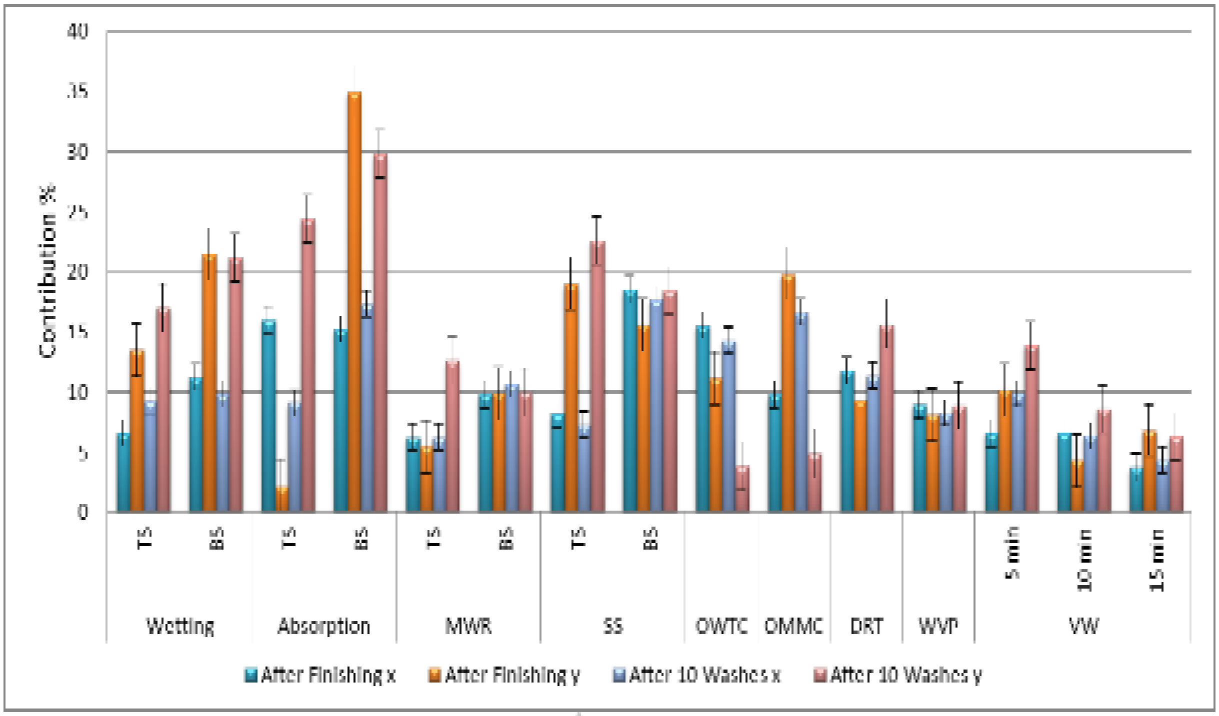


Figure 5. Contribution percentages of independent variables and their interaction on various moisture management properties

4.2.2 Absorption Percentage per second

According to finger prints obtained from MMT in figure 6, the absorption rate for both top and bottom surface ranges from 'Fair-2' to 'Very Good-4'. The fiber type and finish type both are contributing more for bottom layer as observed from figure 5. The contribution is less for top surface absorption percentages. This is explained further by figure 8. There is a significant increase in absorption rate of both top and bottom layer after treatment with moisture management finish, soil release finish and antimicrobial finish. But the samples treated with UV finish are not influenced significantly for absorption percentage. Observing at fiber type, absorption rate for samples treated with same 3 finishes is the highest for 100% micro polyester fiber samples. While in case of samples treated with UV finish, texturized polyester sample is showing higher absorption rate. When comparing between samples before wash and after wash, there is no significant change in absorption rate has been observed. The absorption rates of bottom layer are always lesser then top layer which indicates the moisture is transferred slowly from the top layer to the bottom layer. This difference is not very significant but always possessing a lesser value for bottom layer.

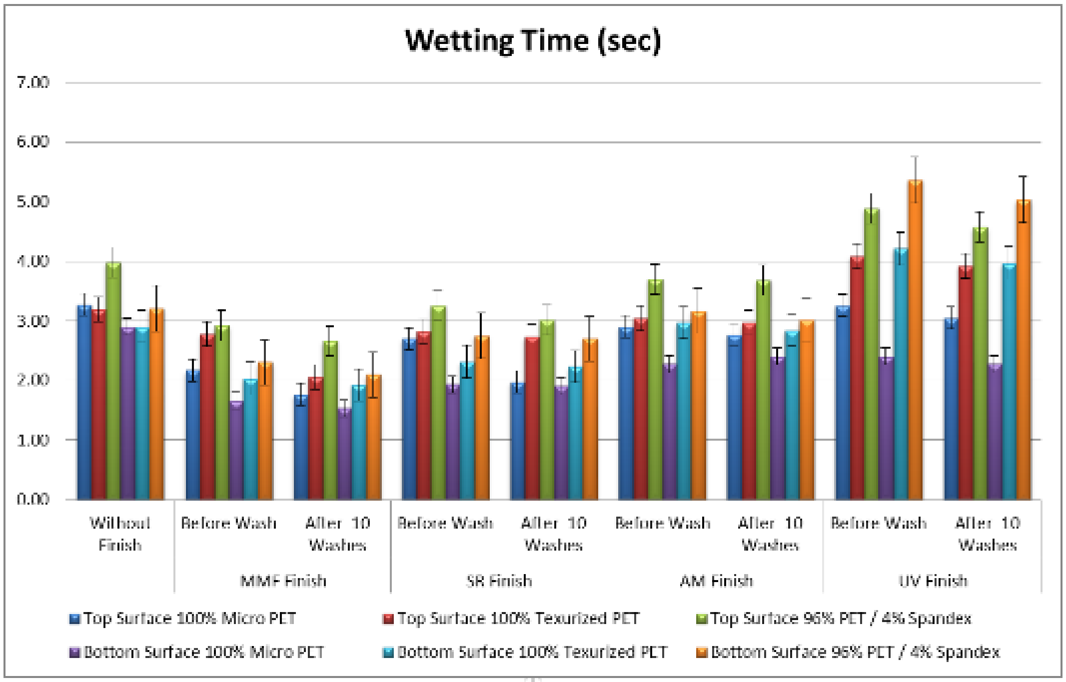


Figure 7. Wetting time of all samples for top surface and bottom surface

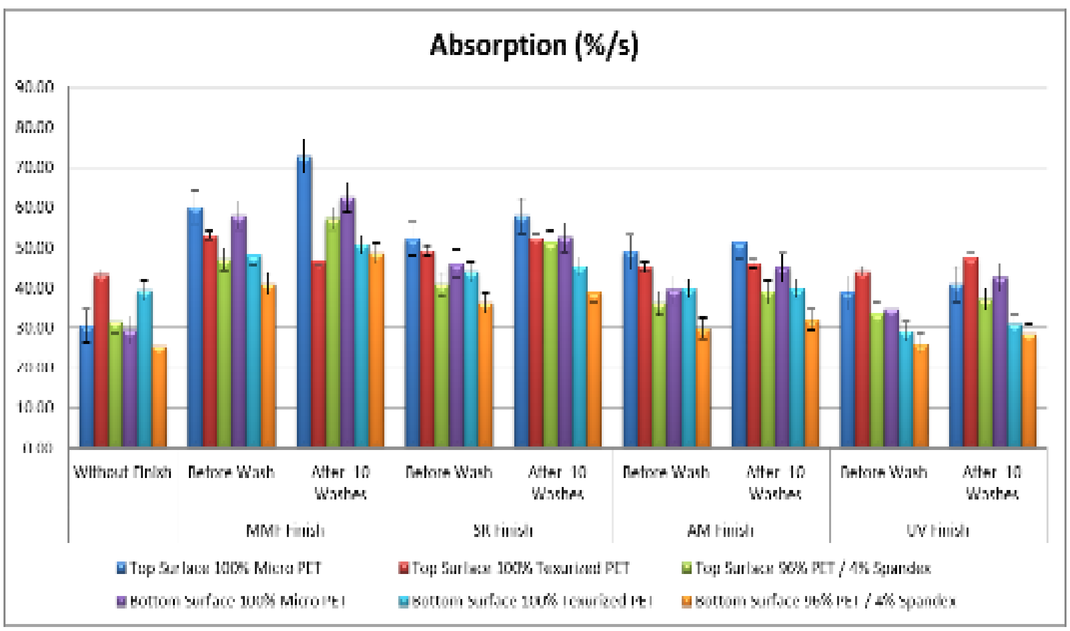
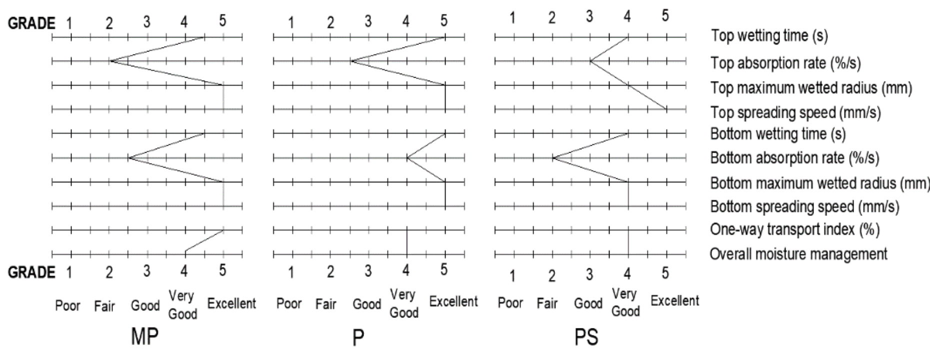
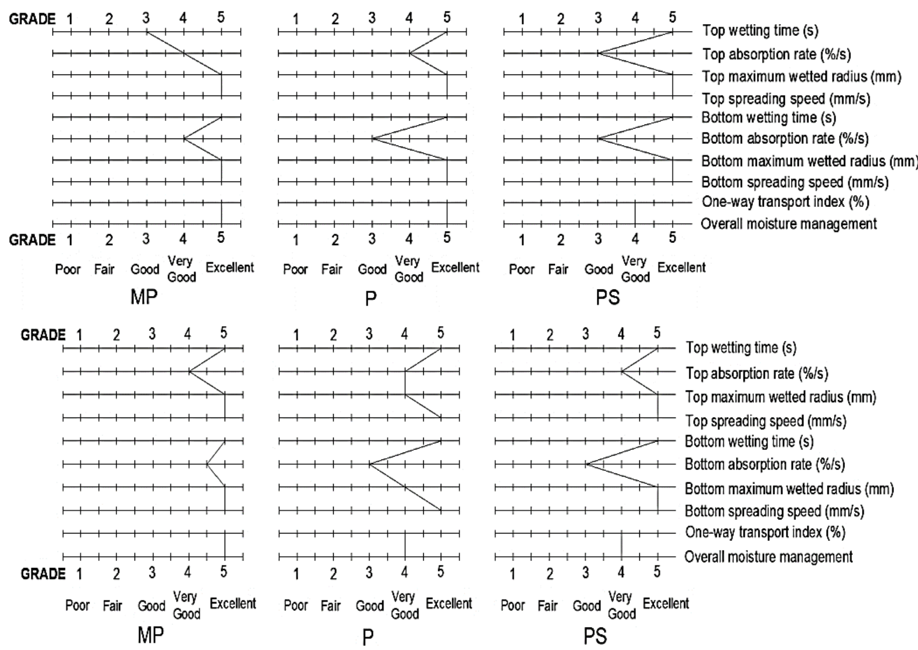


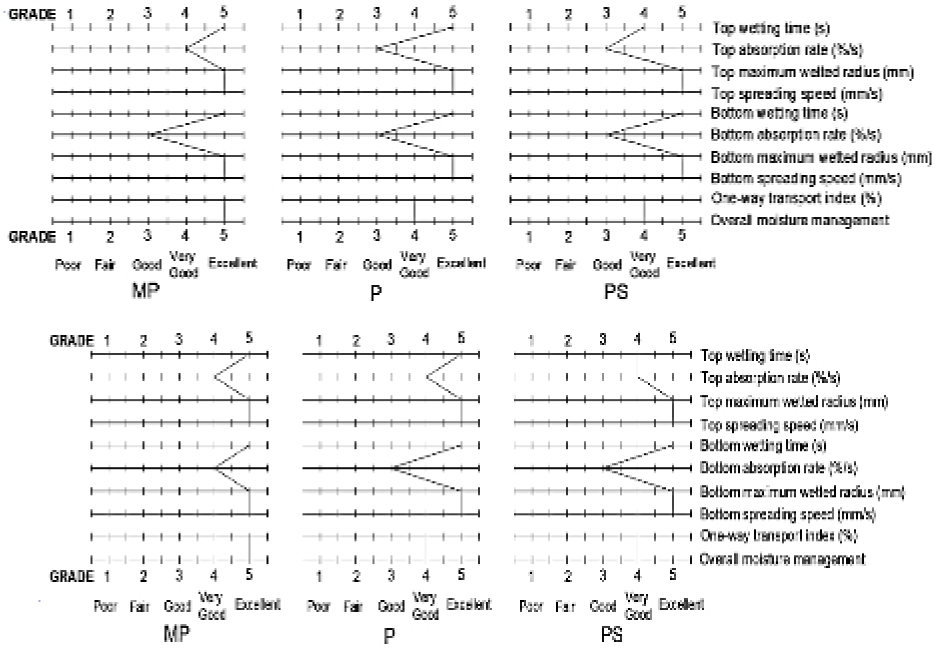
Figure 8. Absorption percentage/ sec of all samples for top surface and bottom surface



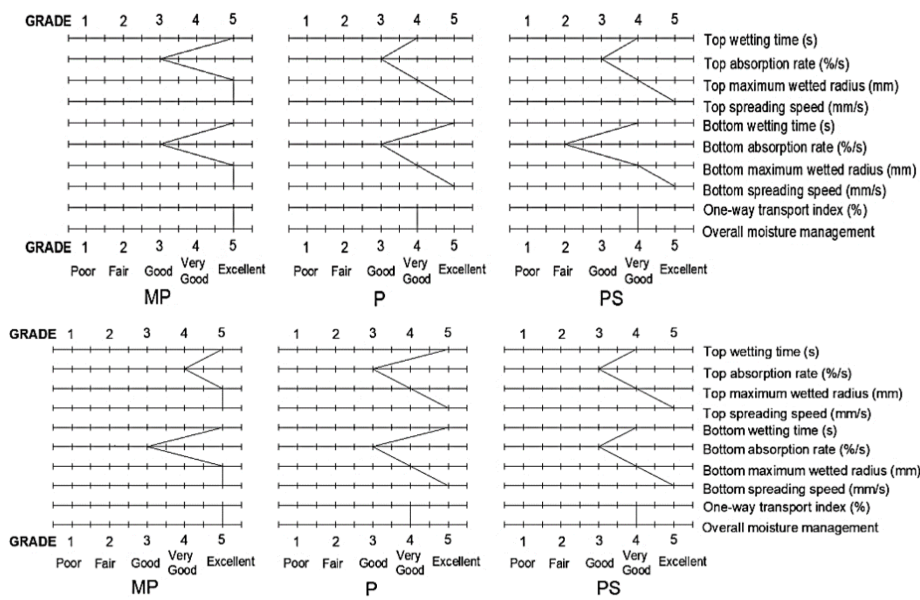
I) Fingerprint of without finish Single Jersey knitted fabric



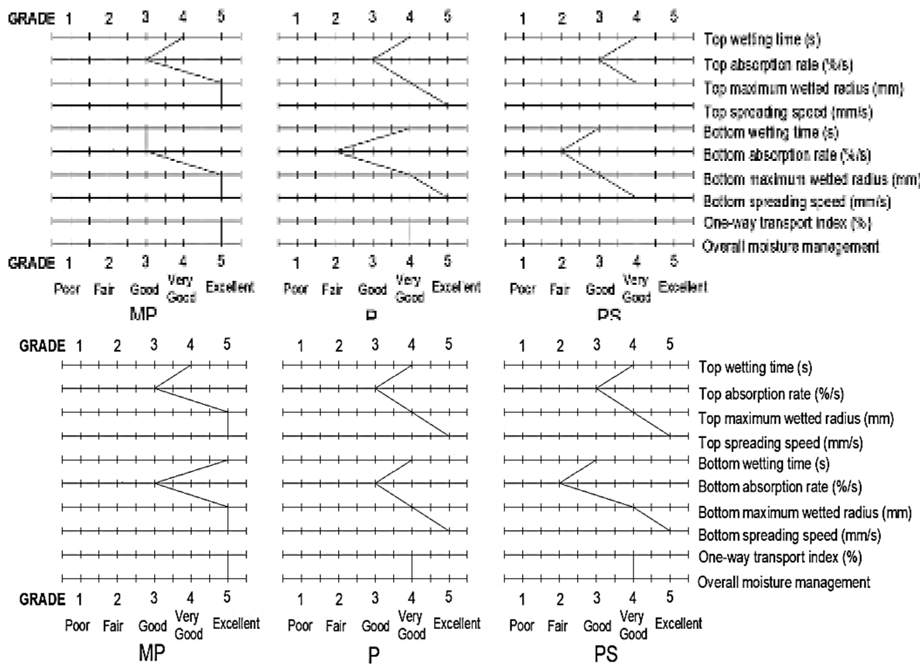
II) Moisture management finish: (a) Before laundering (b) After 10 laundering cycles



III) Soil Release finish: (a) Before laundering (b) After 10 laundering cycles



IV) Antimicrobial finish: (a) Before laundering (b) After 10 laundering cycles



V) Ultraviolet finish: (a) Before laundering (b) After 10 laundering cycles

Figure 6. Finger Print graphs of Moisture management parameters for I) Without finishing, II) Moisture management finish, III) Soil Release Finish, IV) Antimicrobial Finish and V) Ultraviolet Finish – before and after laundering (These images are also given in Appendix C as enlarged view
***MP- Micro Polyester *P-Texturized Polyester *PS- Polyester- Elastane**

4.2.3 Max Wetted Radius and Spreading Speed

The effect of finish type is contributing more as compared to fiber content figure 5. Finger prints of maximum wetted radii and spreading speed shows the moisture management capability to a wide range from 'Good-3' to 'Excellent-5' for different samples.

As observed from water location versus time images in figure 9, the fact observed in case of wetting time and absorption rate has been again verified. Micro polyester fabric for all finish types show highest wetted radii, thus higher surface area to carry evaporation [27]. But actually, there is no significant change with finish treatments on micro polyester fabric. For other two fiber contents, wetted radii have been reduced in case of UV finish. Spreading speed is also calculated and observed similar trend as above parameters (shown graphically in figure 10). The spreading speed has significantly increased only after moisture management finish. Rest of the combinations does not show any significant changes.

4.2.4 One-Way Transport Capability (OWTC)

Figure 11. is given with OWTC values of all fabric samples and the statistical contribution of fabric structure, fiber content and their interaction is observed from figure 5. The contribution percentage is higher for fiber type in comparison to finish type. The OWTC is highest for the samples treated with moisture management finish and no significant change is observed for other treatments. This overall effect is also supported by different moisture management properties studied in above sections.

4.2.5 Overall Moisture Management Capability (OMMC)

All fabric samples show 'Very Good to Excellent' OMMC finger prints. Also, from figure 5, contribution percentage of finish type is higher than fiber content. Which is justified by figure 12, where there is a significant increase in OMMC after treatment with finishes, while the trend of OMMC due to change in fiber content remains the same for all cases.

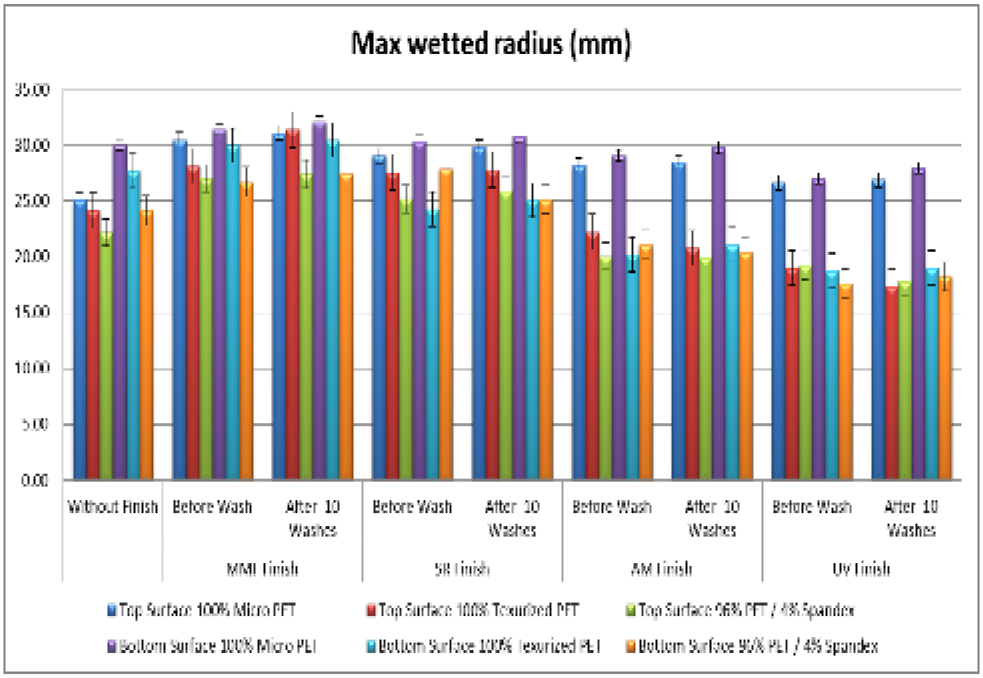


Figure 9. Maximum wetted radii of all samples for top surface and bottom surface

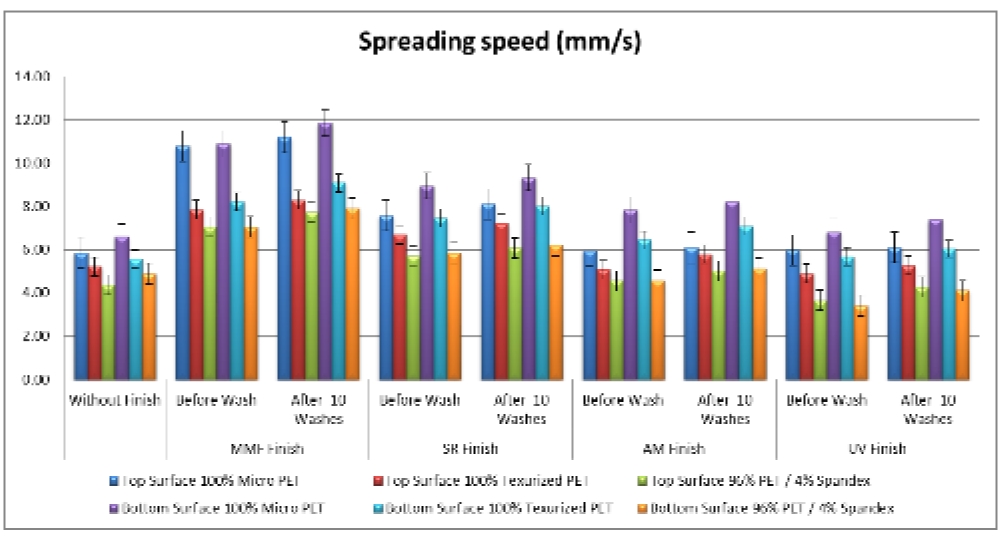


Figure 10. Spreading Speed of all samples for top surface and bottom surface

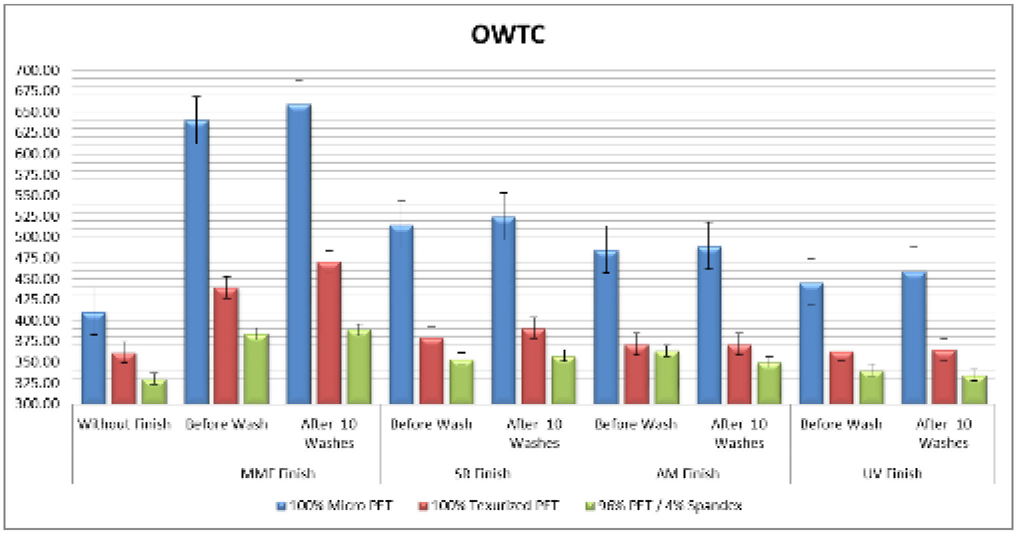


Figure 11. One-Way Transport Capability of all samples

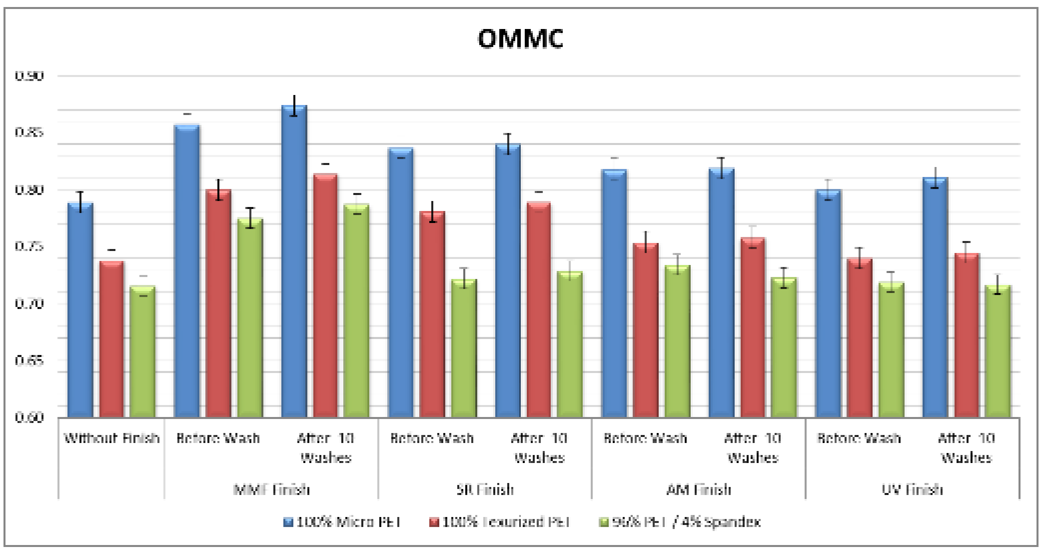


Figure 12. Overall Moisture Management Capability of all samples

4.3 Drying Rate Testing (DRT) and Water Vapor Permeability (WVP)

According results in the DRT and WVP values are uniformly decreasing when fiber content is changed from micro polyester to texturized polyester and then polyester elastics. Both the variables have significant contribution for influencing the properties of samples. These results also support the MMT results indicating moisture management finish has the maximum influence among all four finish treatments and micro polyester is showing the best moisture management properties figures (13,14). This is due to the fact that thickness of fabric is less, porosity is high and the capillary channels formed are not obstructed at any stage [28]. However, it will not be wrong to say that micro polyester has the maximum drying rate and water vapor permeability followed by texturized polyester and polyester spandex, because of more capillary channels available in micro polyester than texturized polyester [29].

4.4 Vertical Wicking (VW)

In case of vertical wicking, the contribution percentage of finish type is higher; but it is influencing only until 10 min. The vertical wicking of micro polyester fabric is faster in each case [30, 31]. But as we move from micro polyester to texturized polyester, due to decrease in density of capillary channels, vertical wicking process is slower and water rise happened significantly faster only up to 10 minutes.

From figure 15, the moisture management finish has a very significant influence on all the three fabric types. There is increase in vertical wicking of samples finished with moisture management finish is further enhanced after washing.

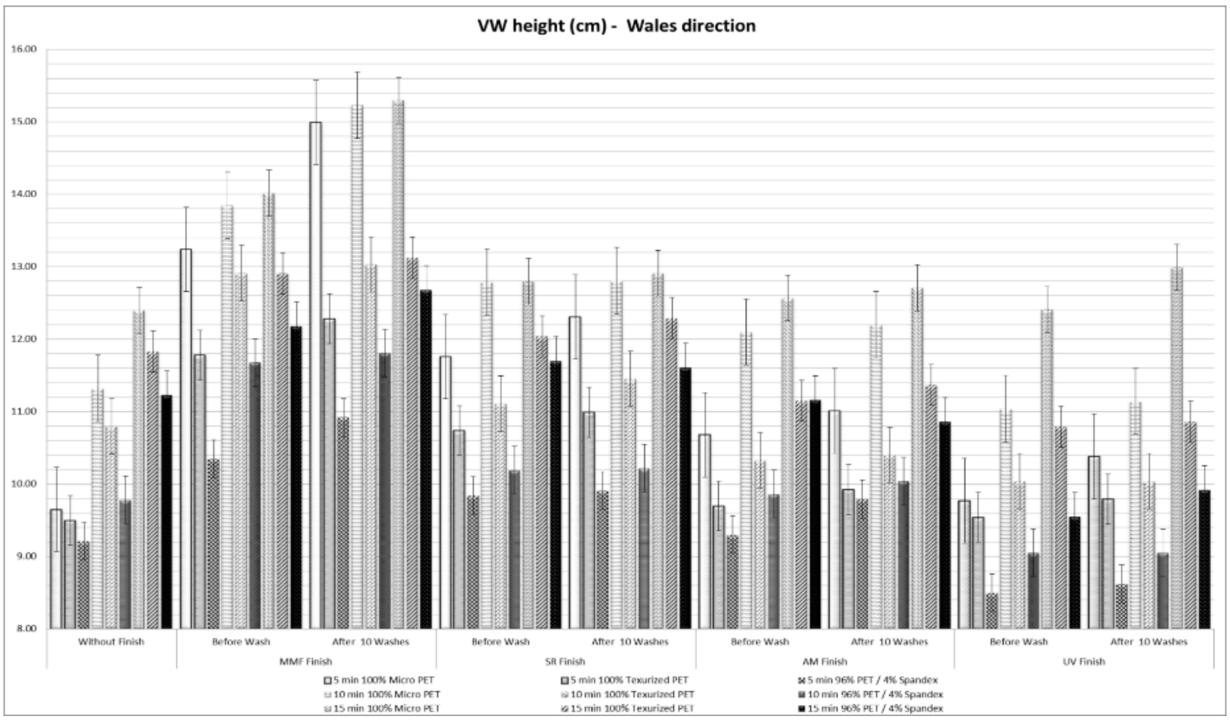


Figure 15. Vertical Wicking of all samples at 3 different time intervals - 5 min, 10 min & 15 min

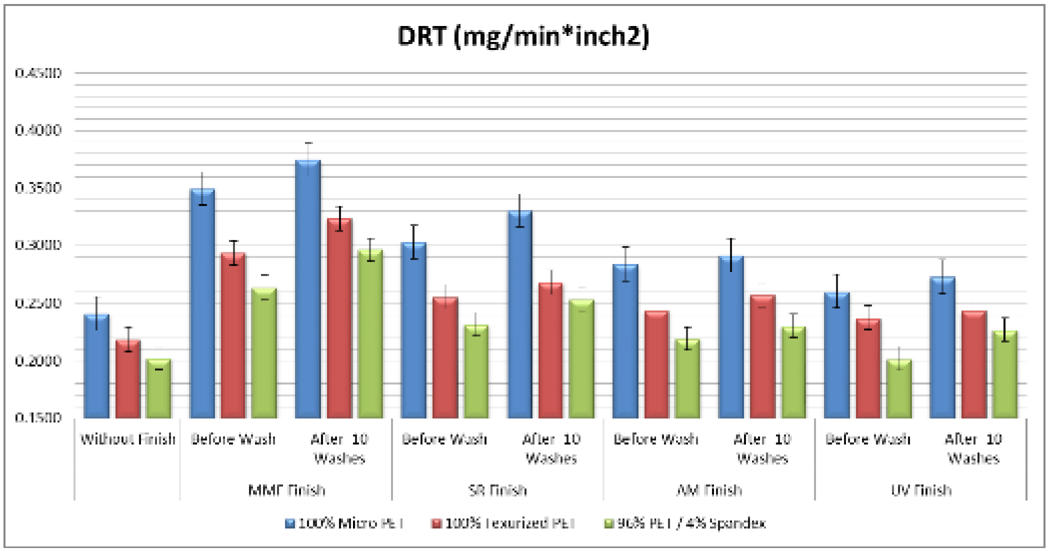


Figure 13. Drying Rate Performance of all samples

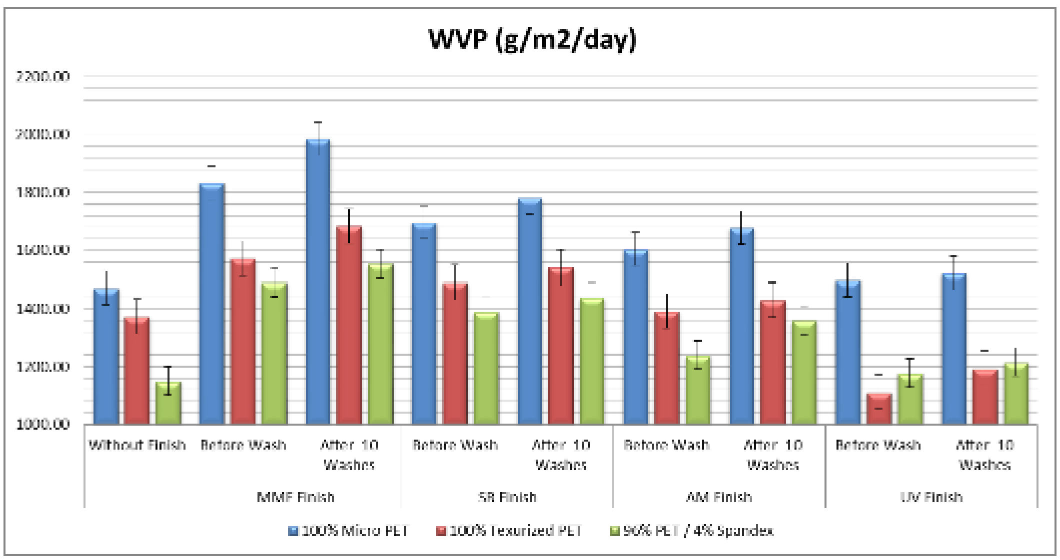


Figure 14. Water Vapor Permeability of all samples

5. CONCLUSIONS

- In this chapter, the effect of independent variables - fiber content and finish type are evaluated through moisture management properties and supporting factors like thickness of fabric, porosity, drying rate test, water vapor permeability and vertical wicking. The following conclusion can be drawn:
- All the parameters are significantly affected after treatment with moisture management finish, but less influenced by soil release and antimicrobial finish.
- The UV resistance finish does influence significantly to the moisture management properties of polyester samples.
- The overall results strengthen the fact derived in last chapter that micro polyester provides a very good moisture management property due to minute capillary channels for effective liquid transport.

- Thus, it can be concluded that the sportswear fabrics made of micro polyester treated with various functional finishes can provide outrageous advantage in a sports person's performances.
- The moisture comfort properties of clothes are also affected by the spreading speed of the fabrics. The maximum wetting radius of a fabric affects the spreading area of sweat on the fabric surface. Thus, increasing the maximum wetted radius decreases the drying time of the fabric as well as the air permeability of fabrics affected the porosity of fabrics. High moisture absorbing fabrics are preferred for sporting apparel because they quickly release perspiration from the skin to keep the wearer dry. Lower wetting times indicate quick absorption of sweat by the fabric and changes with compactness of fabric.
- Moreover, because of its good moisture management properties, it keeps the wearer dry. This makes the material more comfortable than the other fabrics.
- This experimental also stated that after ten laundering cycle, there is increase in the value of all measured comfort properties.
- SEM images at the uniform coating of the textured polyester fabrics with a particle size ranging 10 nm. This similar trend is also found for the micro polyester and polyester elastane blend.
- The impregnation of finishes coating on polyester knitted fabrics was also confirmed by FTIR spectroscopy.
- Finally, it is concluded that functional finishing chemicals as found non-toxic can be useful for the sportswear knitted fabric finishing for improving its functional performance.

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