INVESTIGATION ON MOISTURE MANAGEMENT PROPERTIES OF DIFFERENT WOVEN SHIRTING FABRICS

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Abstract: *Moisture management is the controlled movement of liquid from the skin surface to the environment through the fabric. It is an important factor in optimizing comfort and maximizing performance. Transfer of perspiration from the skin to the atmosphere regulates the body temperature and maintains heat balance thus controlling the comfort level of environmental conditions and activity. Moisture management finishes improve the ability of textiles to absorb humidity from the skin, transport it to their outer surface and release it into the surrounding air. In a way, moisture management finishes increase the moisture-holding power of the fibres. The new generation of novel softening agents which form part of moisture management finishes is capable of improving garment performance to a great extent. This study, the influence of functional finishes on the moisture management property of different woven shirting fabrics had been carried out. For the study, three different woven fabrics of 100% cotton, Polyester / Cotton and Polyester/viscose blend with three different GSM levels (100, 130 and 160) and three concentration level has been selected. The result shows that in the case of finished fabric at a certain concentration level, as the fabric GSM increases the value of Accumulative one-way transport index (O.T.I) % decreases but same time drying rate increases. The 100% cotton, Polyester/cotton and Polyester/viscose composition follow a similar trend.*

Keywords: *Air permeability, Fabrics thickness, Moisture management, Dry rate performance.*

1. Introduction

The Moisture Management Tester is used to test the liquid water transfer and distribution properties of fabrics. The principle of the apparatus design is that when moisture transports through a fabric, the contact electrical resistance of the fabric will be changed. The value of the resistance change depends on two factors: the components of the water and the water content in the fabric. When the influence of the water components is fixed, the electrical resistance measured is related to the water content in the fabric [1]. The length of time for a fabric to dry depends mainly upon the amount of initial liquid water retained by the fabric per unit area for evaporation. Also, the drying process seems to be related to capillary penetration and porosity of the fabrics. The most significant influence of fiber properties was believed to be the manner in which fiber shape and surface reflect increased or decreased capillarity of the fabric, which in turn causes and enhanced or diminished water uptake on wetting and water retention on drying [2]. Moisture management properties of fabrics are influenced by various constructional parameters of the fabric which give woven fabric a porous structure. Total porosity of a woven fabric comprises two types of porosity, viz. micro porosity caused by void spaces among the fibres in the yarns and the macro porosity, which is a consequence of void spaces amongst the yarns. The air permeability, UV transmission and screen printing depend on the macro porosity; absorption of liquids and capillary phenomenon depend on micro porosity; and thermal resistance and water vapour permeability of fabric depends on both micro- and macro porosity [3-5]. When a synthetic material is subjected to this moisture management treatment, it develops improved hydrophilicity followed by very fast drying behavior. In case of synthetic blends subjected to this treatment, their drying rate becomes much faster. In the case of natural fibres it is the reverse - very good absorbency and slow drying rate. The drying rate of polyester is four times greater than cotton. P/C blends subjected to moisture management treatment will have increased absorbency. The polyester will dry more quickly than cotton and while it dries it keeps on absorbing from cotton and quickens the drying process. Wicking, wetting and drying rate are test methods through which we can find out moisture management efficiency. This analyzed the results of wicking tests done on plain woven fabrics with different blend proportion of polyester/viscose fibres [6-7]. They observed that polyester being hydrophobic in nature does not form bonds with water molecules, but due to its positive contact angle (75^{o}), liquid surface is dragged very smoothly, which offers high wicking in case of polyester. So, when a small proportion of polyester is added in the system, it acts as a channel to the water which comes in the capillary and enhances the wicking phenomena. When sweat production is high, a higher proportion of polyester fiber will be helpful. Small viscose proportion will act for the quick absorption of the perspiration from the skin and higher polyester proportion will help to spread the absorbed liquid to the outer surface of the fabric, due to its high wicking property [8]. So here in this study various combinations of fabrics with moisture management finish have been and concentration level studied for its improvement in moisture management behaviours. The noted finish on a fabric is the most important consideration when developing a dynamic fabric system, as the initial uptake of water depends on the presence of a hydrophilic finish on the fabric surface. This initial uptake is the rate-determining step of the wicking action and a hydrophilic surface finish enhances the moisture management capabilities of fabrics [9-10].

2. Material & Methods

2.1 Titles and subtitles

Three different woven shirting fabrics of 100% cotton, Polyester / Cotton and Polyester / viscose blend were used for the study with three different GSM (100, 130 and 160). The fabrics used are scoured, bleached and ready for dyeing (RFD fabrics).

2.2 Moisture management finishing

The fabrics of different type and different GSM are finished with Evo soft HDS finish. In Evo soft HDS finish Silicone micro emulsion is done which increases the hydrophilic and moisture management characteristics of the fabric.

2.3 Test methods

2.3.1 Application of finishes

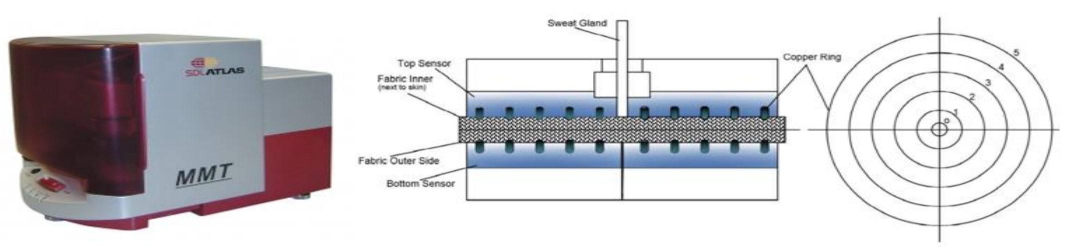
Various finishes are applied on ready for dyeing fabrics, as per the following methodology. For treating the samples with HDS (i.e. to give moisture management finishing) solutions of 10 gpl and 20 gpl concentrations were prepared. For 10 gpl concentration, 10 grams of HDS was added to 1 gpl of acetic acid and 1 litter of water. Whereas, for 20 gpl concentration of finishing, 10 grams of HDS was added to 1 gpl of acetic acid and 1 litter of water. The same procedure was followed for preparing solution for other two finishes. Samples of dimension (25x 25) cm were prepared and treated with 100 ml of prepared solution by immersing it in the solution contained in a beaker for 10 minutes. Then the sample was taken out & sand with between two transparent sheets & was passed through the padding mangle to squeeze out the solution. The squeezed samples were dried at 150 0c for 1 minute in oven dryer. The same procedure was repeated for 2 samples for each level. The whole experimental work was carried out for 100, 130, 160 GSM Cotton, polyester / Cotton, polyester / Viscose fabrics. The variation in fabric index properties after applying finishes and their concentration (level) of finish is tabulated in the table.

2.4 Moisture management parameters tested

Properties which influencing the Moisture Management behavior of fabric is tested using moisture management testing and Drying rate testing. The samples were kept under standard atmospheric condition for 24 hours before testing.

2.4.1 Moisture management tester

Moisture management testing was carried out in moisture management tester using AATCC 195 standard. 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.



(i) (ii)

Figure 1: Moisture Management Tester (i) Equipment, (ii) Schematic diagram of MMT apparatus testing

2.4.2 Drying rate testing

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. Sample size of 15 x 15 cm was used for the study, to which 2 ml water was added on its surface and allowed 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. Result and discussions

Table 1: Sample Specifications

Sample & blend ratio	Cotton (100%)			Polyester/ Cotton (67/33) %			Polyester/ Viscose (67/33) %		
GSM (g/m^2)	**100**	**130**	**160**	**100**	**130**	**160**	**100**	**130**	**160**
EPI	92	103	134	91	93	103	93	94	134
PPI	74	79	74	72	72	73	68	61	89
Warp Crimp%	2.9	2.4	2.4	2.4	1.96	1.43	1.1	1.96	1.2
Weft Crimp%	13	10.3	11	3.3	3.3	2.4	2.4	4.3	2.4
Warp Count (Tex)	15	13.7	15.46	20	20.4	14.7	18	18.4	15.7
Weft Count (Tex)	15	15	15.3	21.5	21.2	17.4	21	18.2	16.5
Fabric cover factor	20.36	21.23	24.40	22.41	22.51	21.45	21.69	20.98	23.32

Table 2: Moisture management properties of standard samples without finish

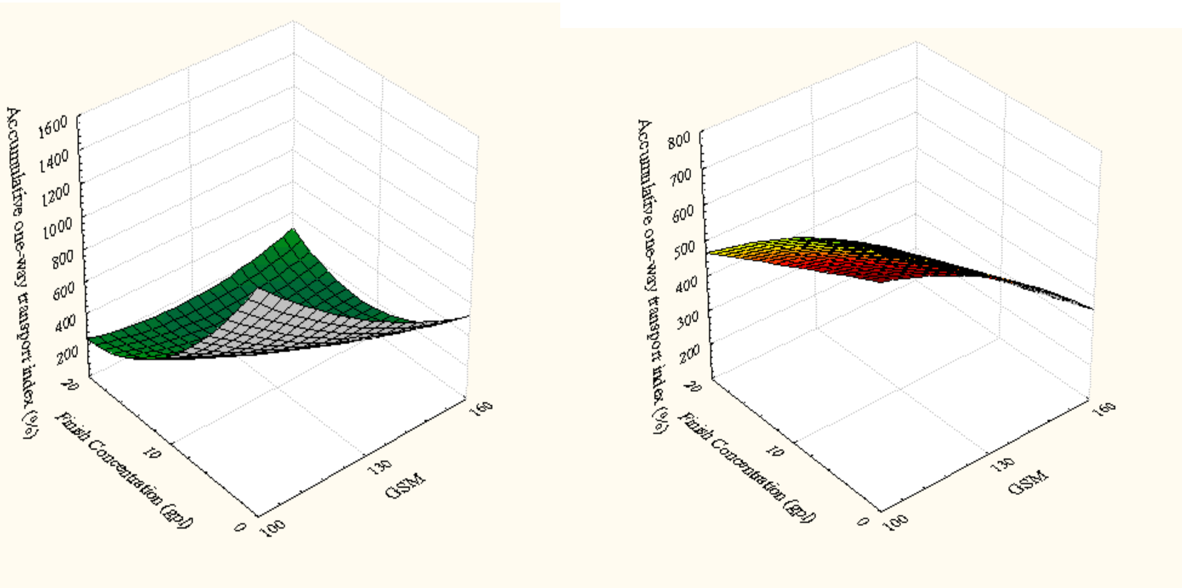
Fabric mass (GSM)	Material	Fabric thickness (mm)	Air Permeability (Cm^3/Cm^2/Sec)	Rate of drying (mg/min*inch^2)	Accumulative one-way transport index (%)
100	Cotton	0.28	25.2	0.0396	1521.15
	PC	0.27	46.2	0.0424	757.48
	PV	0.26	4.6	0.0446	649.27
130	Cotton	0.29	33.2	0.0425	691.83
	PC	0.29	39.4	0.0466	568.02
	PV	0.27	40.5	0.0832	410.4
160	Cotton	0.30	16.0	0.043	524.74
	PC	0.31	42.5	0.0477	363.7
	PV	0.29	5.1	0.0861	260.1

3.1 Influence of HDS finish on fabric Moisture management properties

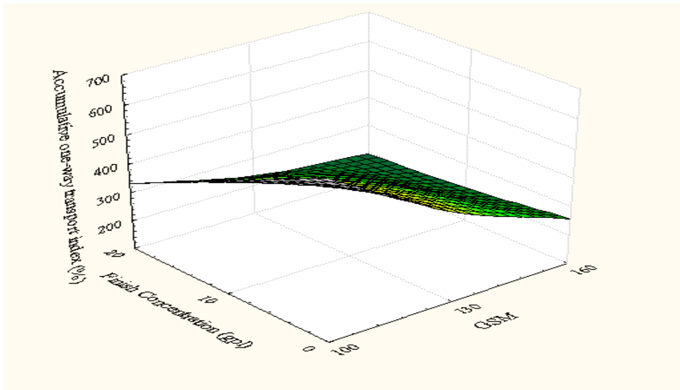
Influence of hydrophilic and moisture (HDS) finish on Moisture management properties at different fabrics: In case of 100% cotton fabric it can be observed from the figure 2 that as the fabric GSM increases from 100 to 160 grams, the value of Accumulative one-way transport index (OTI) % decreases. It is due to the increase in the thickness of the fabric with the increase in GSM as shown on the table 3. The increased thickness offers more restriction to the flow of moisture across the plane of fabric (reduced conductivity), which reduces the OTI %. Also, it was observed that the increased finishing concentration decreases the OTI% of cotton fabric. It is due to the increased decreased pore size after finishing. HDS finish provides a surface finish on the fibre surface to increase its moisture management property. Since the finish is applied on the surface of the fibre, the fibre diameter increases and pore size decreases after finishing. The decreased pore size also decreases the air permeability of the fabric as shown in the table 3. it can be seen that other fabric PC and PV also follows the similar trend but the rate of reduction in pore size and OTI% was different for different fabrics. Basically, the HDS softness to penetrate deeply into fibres with amorphous structure to create and increase core hydrophilicity and softness to the fabrics

Table 3: Influence of variation in HDS finish on moisture management properties of fabrics

Fabric mass (GSM**)**	**Fabric**	**HDS finish conc.**	**Fabric thickness (mm)**	**Air Permeability (Cm³/Cm²/Sec)**	**Rate of drying (mg/min*inch²)**	**Accumulative one-way transport index (%)**
100	Cotton	10	0.32	28.6	0.201	357.09
		20	0.31	21.7	0.201	280.42
	PC	10	0.31	50.7	0.222	569.94
		20	0.30	47.8	0.224	470.47
	PV	10	0.29	7.3	0.262	490.99
		20	0.27	6.8	0.281	332.27
130	Cotton	10	0.31	39.6	0.182	330.16
		20	0.30	31.7	0.204	226.92
	PC	10	0.30	49.8	0.403	499.36
		20	0.30	40.2	0.534	382.61
	PV	10	0.35	50	0.322	367.67
		20	0.31	47.4	0.376	235.45
160	Cotton	10	0.31	21.5	0.189	265.74
		20	0.31	17.8	0.198	185.37
	PC	10	0.32	50.6	0.418	286.51
		20	0.32	47.2	0.519	154.49
	PV	10	0.31	8	0.322	216.13
		20	0.30	7.3	0.376	196.41



(a) 100% Cotton (b) Polyester-Cotton

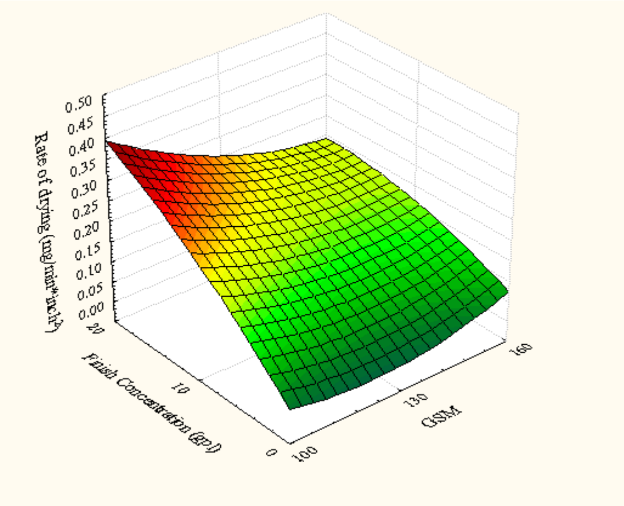


(c) Polyester- Viscose

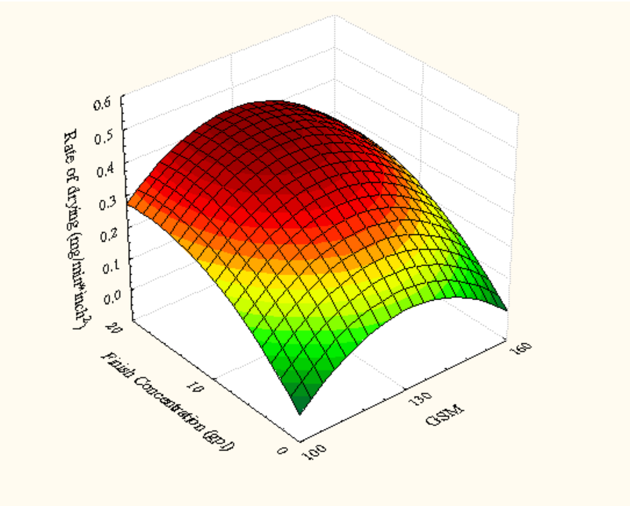
Figure 2: Effect of HDS finish concentration and fabric GSM on OTI% in fabrics

3.2 Influence of hydrophilic and moisture (HDS) finish on drying rate of different fabrics

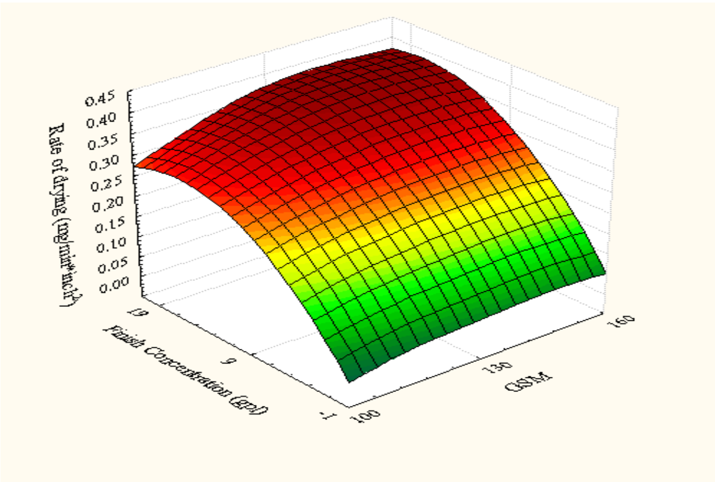
In case of 100% cotton fabric it can be observed from the figure 3 that as the fabric GSM increases from 100 to 160 grams, the value of drying rate increases. This is because of the increase in the thickness of the fabric with the increase in GSM. Increase in the thickness causes the water to spread in wider volume which causes the fabric to dry easily. Further with the increase of finish concentration level, drying rate increases. It is due to the blocking of pores of the fabric and so water remains on surface of the fabric not inside the pores and facilitating easy drying. It can be seen that other fabric PC and PV also follows the similar trend but the rate of increment is different due to its different physical properties than cotton.



(a) 100% Cotton



(b) Polyester- Cotton



(c) Polyester- Viscose

Figure 3: Effect of HDS finish concentration and fabric GSM on rate of drying in fabrics

4. Conclusions

In present study an attempt was made to study the influence of various finishes on the moisture management behavior, dry rate performance properties on different woven shirting fabrics. Therefore, from the various combinations of fabrics, GSM, finishes and finish concentration level the following conclusions are drawn:

- It was observed that the properties are much influenced by the GSM and finishing concentration. The moisture management property of the fabric was increased when the one -way transport index (OTI) %, dry rate performance increases in the fabric.

- When the moisture management finishes (HDS) are applied on the cotton, polyester/ cotton and polyester/ viscose blend fabrics, the OTI% is much influenced by the GSM and finishing concentration. At higher GSM and finishing concentration, OTI% reduced due to increased thickness and decreased pore size.

- Whereas the dry rate performance increases with increased GSM and finishing concentration which is due to more area for moisture spreading and evaporation from the fabrics.

5. References

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