4. RESULTS & DISCUSSION

4. Results and Discussion

INTRODUCTION

Ultraviolet radiation has become an increasing problem in recent years. It causes many injuries in human giving rise to the need for protection against ultraviolet radiation which can be provided by textiles with a high protection factor[152]. Garments that have been tested and rated to UPF 50^+, a practice that is becoming standard for companies with outdoor workers[49]. Present work focuses on to engineering a yarn and woven fabric which provides sufficient protection from the UV rays present in the sunlight specially for those who are exposed to sunlight for long time due to their occupation. Work include Statistical analysis using Multiple regression equation, Analysis of variance (ANOVA), and Pearson's correlation to correlate between various parameters and to know the significance.

Materials

In the present work the different type of raw materials i.e. polyester, viscose and Lycra were chosen and with these raw materials four different blends and three different counts from each blend were made, which is given in Table 4.1.

Table 4.1: Varieties of materials

Sr. No.	Material Type	Yarn Tex		
1	Polyester/ Viscose (75/25)	37	20	13
2.	Polyester/ Viscose (60/40)	37	20	13
3.	Polyester/ Viscose (45/55)	37	20	13
4.	Polyester/ Viscose/Lycra (70/25/5)	37	20	13

These yarns are used as weft yarns and the warp was taken as polyester / viscose blended yarn of 20 tex and the ends per inch was kept constant, i.e. 125 for all fabric samples. For each blend three different weft density were taken and maintained the same weft density for all blends. With these setting two different weave structures, 5-Satin and 2/3 twill, were made. All samples of ready for dyeing (RFD) have been dyed further to study the effect of dyeing.

The fabric Samples are named as RS_1 to RS_{36} for RDF Satin Samples, RT_1 to RT_{36} for RDF twill samples, DS_1 to DS_{36} for dyed Satin samples and DT_1 to DT_{36} for Dyed Twill samples. Results and discussion for Satin and Twill fabric samples includes:

i. Effect of yarn count on UV shielding property;

ii. Effect of blend ratio on UV shielding property;

iii. Effect of PPI on UV shielding property;

iv. Effect of dyeing on UV shielding property;

v. Study of percentage transmittance value;

vi. Effect of weave on UV shielding property.

Further discussion includes analysis of moisture management property of the fabric.

4.1. UPF Analysis of Satin fabric

When incident radiation contacts a fabric, part of that radiation is scattered from the surface and the remainder is absorbed by or penetrates through the fabric. A fraction of the radiation passes through the fibres and the spaces between the yarns. The absorbed radiation is taken up by the chromophores in the fibres as well as by other materials present (Dyes, delustrants, optical brighteners, finishes)[155]. The spaces between the yarns are dependent on air permeability. It is also significantly influenced by a fabric material and structural properties, such as shape and value of pores of the fabric and yarn, which in turn are dependent on the structural parameters of the fabric, such as fabric weave, the raw material of the yarns, the set of yarns and others[151, 156]. The yarn spacing is also dependent on the count of the yarn, which is turn affects the air permeability.

4.1.1 Effect of Yarn Count on UV shielding property

From table 4.2, it is clear that the UPF value gradually increases with the decrease of air permeability value. It shows that for every blend ratio as count becomes finer fabric cover decreases hence less resistance to air flow also as yarn is becoming finer yarn twist is also increasing so yarn compactness increases which increases the porosity of fabric, so air permeability increases and UPF value decreases as can be referred from the readings and thus supports the well established fact. Gabrijelčič et al (2009) also observed that the influence of the surface openness/closeness is a deciding factor in a fabrics UV protection[87]. 65 PPI is common for all three count groups and hence effect of count on air permeability and UPF for all blend ratio can be studied for all blend ratios. It was observed that as the yarn is coarser the UPF value increases hence increase of the UV shielding property. UV-B value shows not much variation and the UV-A is changing with the change of yarn count. Percent transmission is more in finer count and less in coarser count which is attributed to more cover in courser count.[40]

Table 4.2: Fabric parameters, experimental air permeability and UPF values for Ready for dyeing (RFD) Satin samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	Air-permeability ($l/m^2/s$)	UV-A	UV-B	UPF
RS_1	75/25	37	55	463.8	5.40	0.05	211.82
RS_5			65	236.2	4.92	0.05	255.07
RS_9			70	164.0	3.45	0.05	372.58
RS_{13}		20	65	649.0	7.88	0.06	128.14
RS_{17}			80	143.8	5.99	0.05	218.14
RS_{21}			95	129.2	3.87	0.06	316.99
RS_{25}		13	65	777.20	8.56	0.08	109.44
RS_{29}			95	270.4	6.99	0.05	157.02
RS_{33}			105	152.6	4.38	0.05	267.51
RS_2	60/40	37	55	521	5.09	0.05	209.18
RS_6			65	253	4.05	0.05	262.03
RS_{10}			70	166.6	3.99	0.05	311.39
RS_{14}		20	65	493	6.45	0.06	153.96
RS_{18}			80	264	5.32	0.05	214.53
RS_{22}			95	128.8	5.01	0.05	248.50
RS_{26}		13	65	691.8	7.12	0.09	123.12
RS_{30}			95	204.75	5.76	0.05	197.76
RS_{36}			105	129.8	5.85	0.05	196.94
RS_3	45/55	37	55	488.8	5.34	0.05	199.36
RS_7			65	225.4	4.01	0.05	297.80
RS_{11}			70	145.8	3.49	0.05	325.18
RS_{15}		20	65	638.4	6.10	0.06	156.14
RS_{19}			80	311.8	4.95	0.05	216.12
RS_{23}			95	145.8	4.41	0.05	271.06
RS_{27}		13	65	800.2	6.45	0.07	137.62
RST_{31}			95	226.8	4.68	0.06	234.21
RS_{35}			105	169.8	5.08	0.05	227.03
RS_4	70/25/5	37	55	109.2	2.20	0.05	593.55
RS_8			65	43.72	1.89	0.05	667.99
RS_{12}			70	40.6	1.92	0.05	654.83
RS_{16}		20	65	91.32	2.81	0.05	465.23
RS_{20}			80	41.14	6.65	0.05	503.92
RS_{24}			95	30.06	2.45	0.05	535.86
RS_{28}		13	65	123	3.60	0.05	346.98
RS_{32}			95	46.12	3.20	0.05	428.95
RS_{36}			105	38.84	2.79	0.05	470.69

*Warp count = 20Tex; 75/25; P/V; EPI: 125

The blended yarn is used which contains the component of Polyester and Viscose. Polyester due to its large conjugated aromatic polymer system is very effective in blocking UV-B radiation[23]. Polyester is less effective against the UV-A radiation because its UVR transmission increases significantly at 313 nm which is close to the boundary between the UV-B and UV-A spectral regions.

4.1.2 Effect of blend ratio on UV shielding property

From the table 4.2, it can be seen that as the proportion of Polyester in the blend decreases (75/25, 60/40, 45/55) the UPF value also decreases for all the samples woven with 37 Tex weft, using 55 pick per inch. It may be attributed to large conjugated aromatic polymer system of Polyester which is very effective in blocking UV-B radiation[23]. However, for samples woven with 20 Tex and 13 Tex shows change in the UPF value, but the direction of change does not show clear trend which may be due to the combined effect of blend and count.

Among all samples, samples woven using 37 Tex with 72/25 blend and 70 picks per inch shows highest UPF values owing to more proportion of Polyester, coarser count and higher weft density.

By addition of 5 percent Lycra to 75/25 blend, i.e. 70/20/5 it has been observed that UPF increases drastically for all the counts and respective weft densities because addition of Lycra reduces the pore area and also blend of synthetic fibre (Polyester) with Lycra gives the double advantage of protection against UV radiation due to the chemical nature of fibre (aromatic compound) and highly stretchable Lycra fibre gives higher cloth cover[23].

4.1.3 Effect of PPI on UV shielding property

It can be seen from table 4.3 that there is positive correlation between picks per inch, fabric weight and UPF value of the fabric.

Table 4.3: Fabric parameters, weight and UPF values for Ready for dyeing (RFD) Satin samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	Weight (g/m^2)	UV-A	UV-B	UPF
RS$_1$	75/25	37	55	212.25	5.40	0.05	211.82
RS$_5$			65	234.76	4.92	0.05	255.07
RS$_9$			70	244.36	3.45	0.05	372.58
RS$_{13}$		20	65	171	7.88	0.06	128.14
RS$_{17}$			80	199	5.99	0.05	218.14
RS$_{21}$			95	205.18	3.87	0.06	316.99
RS$_{25}$		13	65	148.21	8.56	0.08	109.44
RS$_{29}$			95	173.40	6.99	0.05	157.02
RS$_{33}$			105	181.84	4.38	0.05	267.51
RS$_2$	60/40	37	55	211.62	5.09	0.05	209.18
RS$_6$			65	233.79	4.05	0.05	262.03
RS$_{10}$			70	247.07	3.99	0.05	311.39
RS$_{14}$		20	65	178.99	6.45	0.06	153.96
RS$_{18}$			80	194.28	5.32	0.05	214.53
RS$_{22}$			95	216.04	5.01	0.05	248.50
RS$_{26}$		13	65	152.58	7.12	0.09	123.12
RS$_{30}$			95	181.79	5.76	0.05	197.76
RS$_{36}$			105	188.98	5.85	0.05	196.94
RS$_3$	45/55	37	55	218.13	5.34	0.05	199.36
RS$_7$			65	235.82	4.01	0.05	297.80
RS$_{11}$			70	249.62	3.49	0.05	325.18
RS$_{15}$		20	65	173.97	6.10	0.06	156.14
RS$_{19}$			80	193.85	4.95	0.05	216.12
RS$_{23}$			95	218.13	4.41	0.05	271.06
RS$_{27}$		13	65	152.89	6.45	0.07	137.62
RST$_{31}$			95	180.95	4.68	0.06	234.21
RS$_{35}$			105	181.70	5.08	0.05	227.03
RS$_4$	70/25/5	37	55	347.46	2.20	0.05	593.55
RS$_8$			65	382.61	1.89	0.05	667.99
RS$_{12}$			70	357.93	1.92	0.05	654.83
RS$_{16}$		20	65	252.43	2.81	0.05	465.23
RS$_{20}$			80	288.26	6.65	0.05	503.92
RS$_{24}$			95	299.02	2.45	0.05	535.86
RS$_{28}$		13	65	209.9	3.60	0.05	346.98
RS$_{32}$			95	245.22	3.20	0.05	428.95
RS$_{36}$			105	246.81	2.79	0.05	470.69

*Warp count = 20Tex; 75/25; P/V; EPI: 125

All the thirty six samples of Satin weave shows increasing trend for weight and UPF values with increase in picks per inch. Also with the increase in the weight percentage transmission through the fabric decreases[28]. Algaba, Pepió, Riva (2008) also observed that UPF is strongly correlated with weight per surface unit[16].

As weft density increases for every count, weight increases means more fibre in the path of radiation which reduces the total fabric porosity and results in the reduction of the direct transmission of UV rays through the pores of fabric, in addition to that blended yarn is used which contains the component of Polyester and Viscose in different proportion. Polyester due to its large conjugated aromatic polymer system is very effective in blocking UV-B radiation[23]. Polyester is less effective against the UV-A radiation because its UVR transmission increases significantly at 313 nm which is close to the boundary between the UV-B and UV-A spectral regions. However, researcher succeeded in rectifying this drawback by increasing the weft density to optimum value and by adding small percentage of Lycra (5 percent) which is quite evident from the results obtained.

4.1.4 Effect of dyeing on UV shielding property

All Dyed Satin fabrics shows (see table 4.4 and 3.13) significant increase in UPF value (around 2000) compared to RFD samples which itself falls into the range of excellent sun shielding fabrics. All Dyed fabrics shows very good protection from UVA and UVB rays as percent transmittance ranges from 0.05 to 0.1 percent for all samples. As the absorption band for all dye, extends into the UVR radiation band (290 to 400 nm) and hence dye act as effective UVR absorber. The extinction coefficients of the dyes in the UVR spectral band determine their ability to increase fabric protectiveness against UV radiation[23]. The decrement in air-permeability is not in very large proportion as compared to huge increment in UPF value, which can be well understood from the values and thus without much sacrificing air permeability excellent UV shielding properties were obtained in all dyed fabric samples. Thus Ultraviolet (UV) protection of fabric can be considerably improved by coloration.

Table 4.4: Fabric parameters and UPF values for RFD & Dyed Satin samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	(RFD) UV-A	UV-B	UPF	(Dyed) UV-A	UV-B	UPF
RS_1	75/25	37	55	5.40	0.05	211.82	0.05	0.05	2000
RS_5			65	4.92	0.05	255.07	0.05	0.05	2000
RS_9			70	3.45	0.05	372.58	0.05	0.05	2000
RS_{13}		20	65	7.88	0.06	128.14	0.09	0.05	1890.98
RS_{17}			80	5.99	0.05	218.14	0.05	0.05	2000
RS_{21}			95	3.87	0.06	316.9	0.05	0.05	2000
RS_{25}		13	65	8.56	0.08	109.44	0.17	0.05	1689.77
RS_{29}			95	6.99	0.05	157.02	0.05	0.05	2000
RS_{33}			105	4.38	0.05	267.51	0.05	0.05	2000
RS_2	60/40	37	55	5.09	0.05	209.18	0.05	0.05	2000
RS_6			65	4.05	0.05	262.03	0.05	0.05	2000
RS_{10}			70	3.99	0.05	311.39	0.05	0.05	2000
RS_{14}		20	65	6.45	0.06	153.96	0.10	0.05	1886.46
RS_{18}			80	5.32	0.05	214.53	0.05	0.05	2000
RS_{22}			95	5.01	0.05	248.50	0.05	0.05	2000
RS_{26}		13	65	7.12	0.09	123.12	0.23	0.05	1523.30
RS_{30}			95	5.76	0.05	197.76	0.05	0.05	2000
RS_{36}			105	5.85	0.05	196.94	0.05	0.05	2000
RS_3	45/55	37	55	5.34	0.05	199.36	0.05	0.05	2000
RS_7			65	4.01	0.05	297.80	0.05	0.05	2000
RS_{11}			70	3.49	0.05	352.18	0.05	0.05	2000
RS_{15}		20	65	6.10	0.06	156.14	0.08	0.05	1928.59
RS_{19}			80	4.95	0.05	216.12	0.05	0.05	2000
RS_{23}			95	4.41	0.05	271.06	0.05	0.05	2000
RS_{27}		13	65	6.41	0.07	137.62	0.20	0.05	1621.44
RST_{31}			95	4.68	0.06	234.21	0.05	0.05	2000
RS_{35}			105	5.08	0.05	227.03	0.05	0.05	2000
RS_4	70/25/5	37	55	22.20	0.05	593.55	0.05	0.05	2000
RS_8			65	1.89	0.05	667.99	0.05	0.05	2000
RS_{12}			70	1.92	0.05	654.83	0.05	0.05	2000
RS_{16}		20	65	2.81	0.05	465.23	0.05	0.05	2000
RS_{20}			80	2.65	0.05	503.92	0.05	0.05	2000
RS_{24}			95	2.45	0.05	535.86	0.05	0.05	2000
RS_{28}		13	65	3.60	0.05	346.98	0.05	0.05	1991.84
RS_{32}			95	3.20	0.05	428.95	0.05	0.05	2000
RS_{36}			105	2.79	0.05	470.69	0.05	0.05	2000

*Warp count = 20Tex; 75/25; P/V; EPI: 125

4.1.5. Study of percentage transmittance value

Table 4.5, 4.7 and 4.9 (see appendix) and figure 4.1, 4.2 and 4.3 exhibits percentage transmission value for wave length (290nm to 400nm at an interval of 5nm wave length) of woven fabric of RFD Satin samples of 37 Tex, 20 Tex and 13 Tex weft respectively.

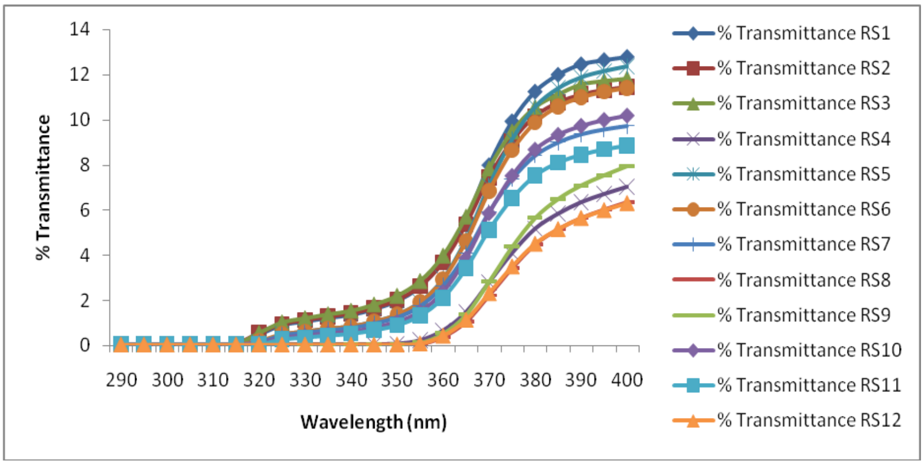

Figure 4.1: Percentage Transmittance values of Woven Satin RFD samples woven using 37 Tex weft

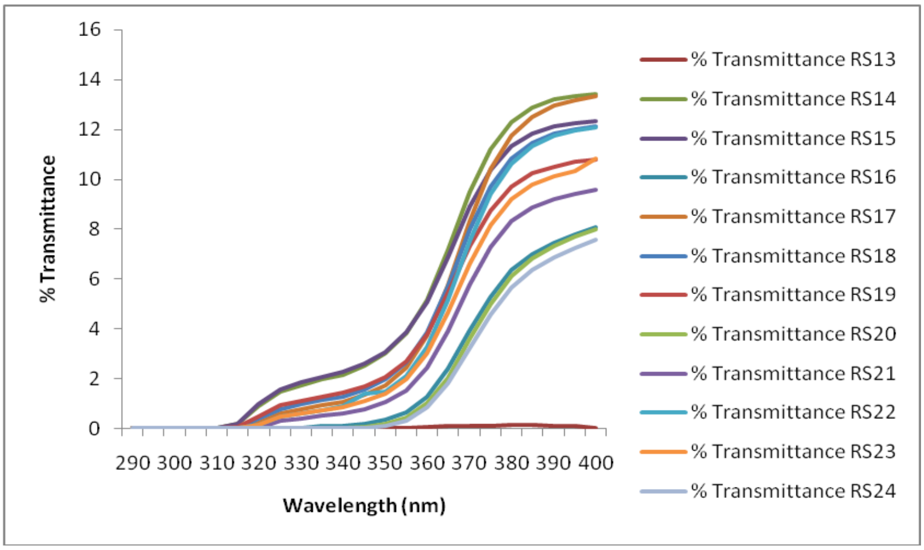

Figure 4.2: Percentage Transmittance values of Satin RFD samples woven using 20 Tex weft

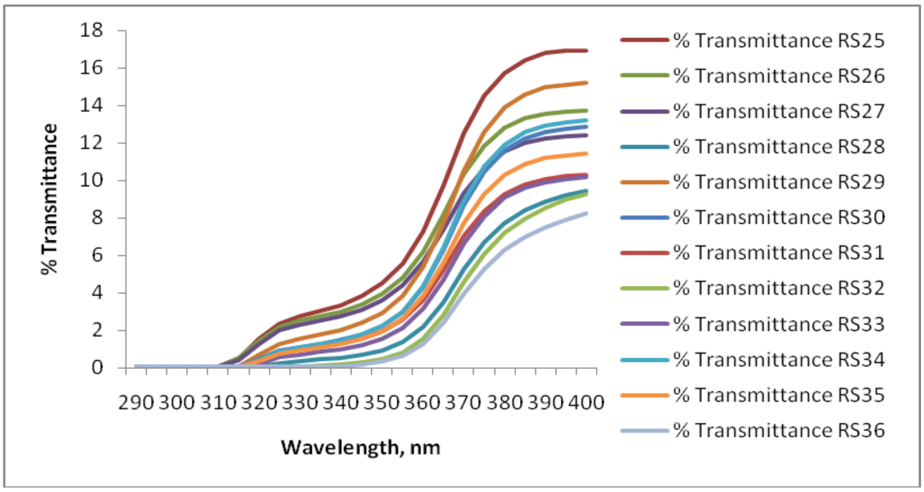

Figure 4.3: Percentage Transmittance values of Satin RFD samples woven using 13 Tex weft

It can be observed that all the samples shows increasing trend in percentage transmittance from 290 nm to 400 nm owing to longer wavelength. Wavelength range for UV-A is 320 to 400 nm and for UV-B 280 to 320 nm. From the graph it is clear that percentage transmittance for UV-B region is zero and hence provides best protection from UV-B which are more hazardous radiation. For UV-A radiation percentage transmittance ranges from 0 to 16 percent at the most for all samples.

The percentage transmittance is required for UPF calculation. Average percentage transmittance in the region 290 – 320 nm gives the mean UV-B value and average percentage transmittance in the region 320-400 nm give the mean UV-A value. Values of the percentage transmittance were considered at an interval of 5nm in a range of 290 – 400 nm.

For all dyed samples the percentage transmittance is almost zero (0.05) in the UV-A and UV-B region which shows that all the dyed samples exhibit excellent protection from UV-A and UV-B (see Table 4.6, 4.8 and 4.10).

4.1.6. Statistical Analysis

To address a mathematical relationship between the weft density, yarn tex, blend ratio and Sun shielding property of fabric, Linear Regression analyses were made between Sun shielding property and these parameters for each count – 13 Tex, 20 Tex and 37 Tex respectively. For each count 04 equation were established for 4 different blend ratio. So for Satin fabric total 12 equations and for Twill fabric total 12 equations were derived using MINITAB17. To deduce whether the parameters were significant or not, p values were examined. Ergun emphasized that if p value of a parameter is greater than 0.05 ($p>0.05$), parameter will not be important and should be ignored[157].

The best regression equation for UPF of Satin RFD fabric woven using 37 Tex weft for different blend ratio is given in Table 4.18. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 98.20%. Together, blend ratio and picks per inch accounted for 98.20% of the variance in the UPF (see table 4.17). R^2 (predicted) = 94.72%, which indicates that the model explains 94.72% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.17: Regression Analysis of Satin RFD fabric woven using 37 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-212.6	87.5	-2.43	0.046
PPI	7.78	1.36	5.73	0.001
Blend ratio				
2	-19.0	23.9	-0.79	0.454
3	3.3	23.9	0.14	0.895
4	358.9	23.9	15.01	0.000
S = 29.2921	R^2= 98.20%	R^2 (adjusted) = 97.17%	R^2 (predicted) = 94.72%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	327493	81873.1	95.42	0.000
PPI	1	28211	28210.6	32.88	0.001
Blend ratio	3	299282	99760.7	116.27	0.000
Residual Error	7	6006	858.0		
Total	11	333499			

Table 4.18: General Regression Equation of Satin RFD fabric woven using 37 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation		
Blend ratio		
(Polyester/Viscose)	1	UPF = -212.6 + 7.78 PPI
(Polyester/Viscose)	2	UPF = -231.6 + 7.78 PPI
(Polyester/Viscose)	3	UPF = -209.3 + 7.78 PPI
(Polyester/Viscose/Lycra)	4	UPF = 146.4 + 7.78 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Satin RFD fabric woven using 20 Tex weft for different blend ratio is given in Table 4.20. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 98.14%. Together, blend ratio and picks per inch accounted for 98.14% of the variance in the UPF (see table 4.19). R^2 (predicted) = 93.73%, which indicates that the model explains 93.73% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.19: Regression Analysis of Satin RFD fabric woven using 20 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-91.5	47.5	-1.93	0.095
PPI	3.908	0.567	6.89	0.000
Blend ratio				
2	-15.4	19.6	-0.79	0.458
3	-6.6	19.6	-0.34	0.745
4	280.6	19.6	14.28	0.000
S = 24.0636	R^2= 98.14%	R^2 (adjusted) = 97.08%	R^2 (predicted) = 93.73%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	214392	53398.0	92.56	0.000
PPI	1	27488	27488.1	47.47	0.000
Blend ratio	3	186904	62301.3	107.59	0.000
Residual Error	7	4053	579.1		
Total	11	218446			

Table 4.20: General Regression Equation of Satin RFD fabric woven using 20 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -91.5 + 3.908 PPI
(Polyester/Viscose)	2	UPF = -107.0 + 3.908 PPI
(Polyester/Viscose)	3	UPF = -98.2 + 3.908 PPI
(Polyester/Viscose/Lycra)	4	UPF = 189.0 + 3.908 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Satin RFD fabric woven using 13 Tex weft for different blend ratio is given in Table 4.22. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 96.78%. Together, blend ratio and picks per inch accounted for 96.78% of the variance in the UPF (see table 4.21). R^2 (predicted) = 91.17%, which indicates that the model explains 91.17% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.21: Regression Analysis of Satin RFD fabric woven using 13 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-62.1	42.7	-1.46	0.189
PPI	2.718	0.451	6.03	0.001
Blend ratio				
2	-5.4	21.7	-0.25	0.811
3	21.6	21.7	1.00	0.352
4	237.6	21.7	10.96	0.000
S = 26.5435	R^2= 96.78%	R^2 (adjusted) = 94.93%	R^2 (predicted) = 91.17%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	148079	37019.8	52.54	0.000
PPI	1	25608	25608.1	36.35	0.001
Blend ratio	3	122471	40823.7	57.94	0.000
Residual Error	7	4932	704.6		
Total	11	153011			

Table 4.22: General Regression Equation of Satin RFD fabric woven using 13 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -62.1 + 2.718 PPI
(Polyester/Viscose)	2	UPF = -67.5 + 2.718 PPI
(Polyester/Viscose)	3	UPF = -40.5 + 2.718 PPI
(Polyester/Viscose/Lycra)	4	UPF = 175.5 + 2.718 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Satin RFD fabric for different blend ratio is given in Table 4.24. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 94.07%. Together, blend ratio, yarn tex and picks per inch accounted for 94.07% of the variance in the UPF (see table 4.23). R^2 (predicted) = 91.31%, which indicates that the model explains 91.31% of the variation in UPF when used for prediction. The p-value for the blend ratio, yarn tex and picks per inch is less than α-level 0.05, which means that the effect of blend ratio, yarn tex and picks per inch on UPF is significant.

Table 4.23: Regression Analysis of Satin RFD fabric: UPF versus Weft density, Yarn tex for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-245.5	56.9	-4.32	0.000
PPI	3.487	0.525	6.64	0.000
Yarn Tex	8.680	0.851	10.20	0.000
Blend ratio				
2	-13.3	18.7	-0.71	0.485
3	6.1	18.7	0.32	0.748
4	292.4	18.7	15.60	0.000
S = 39.7645	R^2= 94.07%	R^2 (adjusted) = 93.08%	R^2 (predicted) = 91.31%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	752636	150527	95.20	0.000
PPI	1	69815	69815	44.15	0.000
Yarn Tex	1	164365	164365	103.95	0.000
Blend ratio	3	588194	196065	124.00	0.000
Residual Error	30	47437	1581		
Total	35	800072			

Table 4.24: Multiple Linear regression equation of Satin RFD fabric: UPF versus Weft density, Yarn tex for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -245.5 + 3.487 PPI + 8.680 Yarn Tex
(Polyester/Viscose)	2	UPF = -258.8 + 3.487 PPI + 8.680 Yarn Tex
(Polyester/Viscose)	3	UPF = -239.4 + 3.487 PPI + 8.680 Yarn Tex
(Polyester/Viscose/Lycra)	4	UPF = 46.9 + 3.487 PPI + 8.680 Yarn Tex

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

4.2. UPF Analysis of Twill fabric

4.2.1 Effect of Yarn count on UV Shielding property

Effect of count on UV-A, UV-B and UPF exhibits similar trend to that obtained in Satin samples (see table 4.25). Only there is change in magnitude of values.

Table 4.25: Fabric parameters, experimental air permeability and UPF values for Ready for dyeing (RFD) Twill samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	Air- permeability ($l/m^2/s$)	UV-A	UV-B	UPF
RT_1	75/25	37	55	547	5.60	0.05	177.48
RT_5			65	283.4	3.69	0.05	334.93
RT_9			70	157	3.61	0.05	356.95
RT_{13}		20	65	509.2	5.60	0.05	177.48
RT_{17}			80	206.2	5.17	0.05	220.10
RT_{21}			95	88.46	4.71	0.05	268.04
RT_{25}		13	65	582.8	6.0	0.06	156.60
RT_{29}			95	136.4	5.59	0.05	202.06
RT_{33}			105	97.36	5.17	0.05	232.45
RT_2	60/40	37	55	581	5.73	0.05	188.62
RT_6			65	230.2	4.58	0.05	266.26
RT_{10}			70	169.4	4.67	0.05	271.17
RT_{14}		20	65	471.2	6.72	0.06	151.71
RT_{18}			80	220.4	5.74	0.05	195.93
RT_{22}			95	85	4.70	0.05	269.21
RT_{26}		13	65	521.8	7.75	0.07	122.60
RT_{30}			95	134	6.0	0.05	188.41
RT_{36}			105	107.4	6.17	0.05	190.26
RT_3	45/55	37	55	473.8	6.52	0.05	162.91
RT_7			65	230.4	4.32	0.05	273.56
RT_{11}			70	124.6	4.51	0.05	279.24
RT_{15}		20	65	445.2	6.22	0.06	161.02
RT_{19}			80	201.6	6.81	0.05	161.89
RT_{23}			95	80.94	4.78	0.05	249.31
RT_{27}		13	65	544.6	6.75	0.14	135.28
RT_{31}			95	126	7.0	0.05	153.43
RT_{35}			105	101.08	5.69	0.05	199.65
RT_8	70/25/5	37	65	53.08	2.18	0.05	595.65
RT_{16}		20	65	81.72	2.88	0.05	452.75
RT_{20}			80	42.24	2.81	0.05	466.41
RT_{24}			95	18.92	2.57	0.05	511.48
RT_{28}		13	65	105.96	3.48	0.05	357.51
RT_{32}			95	37.28	3.21	0.05	403.71
RT_{36}			105	24.82	3.11	0.05	423.22

*Warp count = 20Tex; 75/25; P/V; EPI: 125

4.2.2 Effect of blend ratio on UV shielding property

From the table 4.25 it can be seen that as the proportion of Polyester in the blend decreases (75/25, 60/40, 45/55) the UPF value also decreases for all the samples of 20 Tex using 80 and 95 picks per inch and of 13 Tex using 95 pick per inch. It may be attributed to large conjugated aromatic polymer system of Polyester which is very effective in blocking UV-B radiation[23]. However other sample shows change in UPF value, but the direction of change does not show clear trend which may be due to combined effect of blend and count.

Similar to Satin samples in the Twill samples also samples woven with 72/25 blend 37 Tex, 70 picks per inch shows highest UPF values owing to more proportion of Polyester, coarser count and higher weft density. All these findings are in confirmation with the results reported by the other researchers[52]. Similar to Satin samples, it has been observed that addition of 5 percent Lycra (70/20/5) to 75/25 blend increases the UPF value to large amount.

4.2.3 Effect of PPI on UV shielding property

From table 4.26 it is clear that the trend regarding to effect of pick per inch on weight and UPF value is similar to that observed in Satin samples.

4.2.4 Effect of Dyeing on UV shielding property

All Dyed Twill fabrics shows (table 4.27) significant increase in UPF value (around 2000) compared to RFD samples which itself falls into the range of excellent sun shielding fabrics. All Dyed fabrics shows very good protection from UVA and UVB rays as percent transmittance ranges from 0.05 to 0.1 percent for all samples. Thus all dyed Twill samples shows similar trend as observed for Satin weave.

Table 4.26: Fabric parameters, weight and UPF values for Ready for dyeing (RFD) Twill samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	Weight (g/m^2)	UV-A	UV-B	UPF
RT$_1$	75/25	37	55	211.21	5.60	0.05	177.48
RT$_5$			65	235.30	3.69	0.05	334.93
RT$_9$			70	243.4	3.61	0.05	356.95
RT$_{13}$		20	65	173.80	5.60	0.05	177.48
RT$_{17}$			80	187.17	5.17	0.05	220.10
RT$_{21}$			95	222.81	4.71	0.05	268.04
RT$_{25}$		13	65	153.16	6.0	0.06	156.60
RT$_{29}$			95	175.70	5.59	0.05	202.06
RT$_{33}$			105	187.03	5.17	0.05	232.45
RT$_2$	60/40	37	55	213.98	5.73	0.05	188.62
RT$_6$			65	238.39	4.58	0.05	266.26
RT$_{10}$			70	245.30	4.67	0.05	271.17
RT$_{14}$		20	65	182.05	6.72	0.06	151.71
RT$_{18}$			80	191.73	5.74	0.05	195.93
RT$_{22}$			95	215.31	4.70	0.05	269.21
RT$_{26}$		13	65	153.70	7.75	0.07	122.60
RT$_{30}$			95	178.73	6.0	0.05	188.41
RT$_{34}$			105	188.13	6.17	0.05	190.26
RT$_3$	45/55	37	55	213.36	6.52	0.05	162.91
RT$_7$			65	236.64	4.32	0.05	273.56
RT$_{11}$			70	249.88	4.51	0.05	279.24
RT$_{15}$		20	65	171.81	6.22	0.06	161.02
RT$_{19}$			80	191.19	6.81	0.05	161.89
RT$_{23}$			95	215.46	4.78	0.05	249.31
RT$_{27}$		13	65	156.13	6.75	0.14	135.28
RT$_{31}$			95	180.60	7.0	0.05	153.43
RT$_{35}$			105	185.36	5.69	0.05	199.65
RT$_8$	70/25/5	37	65	383.84	2.18	0.05	595.65
RT$_{16}$		20	65	270.45	2.88	0.05	452.75
RT$_{20}$			80	274.29	2.81	0.05	466.41
RT$_{24}$			95	311.16	2.57	0.05	511.48
RT$_{28}$		13	65	215.89	3.48	0.05	357.51
RT$_{32}$			95	235.43	3.21	0.05	403.71
RT$_{36}$			105	249.30	3.11	0.05	423.22

*Warp count = 20Tex; 75/25; P/V; EPI: 125

Table 4.27: Fabric parameters and UPF values for RFD & Dyed Twill samples

Sample Code	Blend ratio P/V	Weft Count (Tex)	Picks/ inch Nominal	(RFD) UV-A	(RFD) UV-B	(RFD) UPF	(Dyed) UV-A	(Dyed) UV-B	(Dyed) UPF
RT$_1$	75/25	37	55	5.60	0.05	177.48	0.05	0.05	2000
RT$_5$			65	3.69	0.05	334.93	0.05	0.05	2000
RT$_9$			70	3.61	0.05	356.95	0.05	0.05	2000
RT$_{13}$		20	65	5.60	0.05	177.48	0.06	0.05	1976.41
RT$_{17}$			80	5.17	0.05	220.10	0.05	0.05	2000
RT$_{21}$			95	4.71	0.05	268.04	0.05	0.05	2000
RT$_{25}$		13	65	6.0	0.06	156.60	0.13	0.05	1795.08
RT$_{29}$			95	5.59	0.05	202.06	0.05	0.05	2000
RT$_{33}$			105	5.17	0.05	232.45	0.05	0.05	2000
RT$_2$	60/40	37	55	5.73	0.05	188.62	0.05	0.05	1999.98
RT$_6$			65	4.58	0.05	266.26	0.05	0.05	2000
RT$_{10}$			70	4.67	0.05	271.17	0.05	0.05	2000
RT$_{14}$		20	65	6.72	0.06	151.71	0.07	0.05	1947.07
RT$_{18}$			80	5.74	0.05	195.93	0.05	0.05	2000
RT$_{22}$			95	4.70	0.05	269.21	0.05	0.05	2000
RT$_{26}$		13	65	7.75	0.07	122.60	0.14	0.05	1767.88
RT$_{30}$			95	6.0	0.05	188.41	0.05	0.05	2000
RT$_{34}$			105	6.17	0.05	190.26	0.05	0.05	2000
RT$_3$	45/55	37	55	6.52	0.05	162.91	0.05	0.05	2000
RT$_7$			65	4.32	0.05	273.56	0.05	0.05	2000
RT$_{11}$			70	4.51	0.05	279.24	0.05	0.05	2000
RT$_{15}$		20	65	6.22	0.06	161.02	0.06	0.05	1967.24
RT$_{19}$			80	6.81	0.05	161.89	0.05	0.05	2000
RT$_{23}$			95	4.78	0.05	249.31	0.05	0.05	2000
RT$_{27}$		13	65	6.75	0.14	135.28	0.14	0.05	1775.23
RT$_{31}$			95	7.0	0.05	153.43	0.05	0.05	2000
RT$_{35}$			105	5.69	0.05	199.65	0.05	0.05	2000
RT$_8$	70/25/5	37	65	2.18	0.05	595.65	0.05	0.05	2000
RT$_{16}$		20	65	2.88	0.05	452.75	0.05	0.05	2000
RT$_{20}$			80	2.81	0.05	466.41	0.05	0.05	2000
RT$_{24}$			95	2.57	0.05	511.48	0.05	0.05	2000
RT$_{28}$		13	65	3.48	0.05	357.51	0.05	0.05	2000
RT$_{32}$			95	3.21	0.05	403.71	0.05	0.05	2000
RT$_{36}$			105	3.11	0.05	423.22	0.05	0.05	2000

*Warp count = 20Tex; 75/25; P/V; EPI: 125

4.2.5 Study of percentage Transmittance value

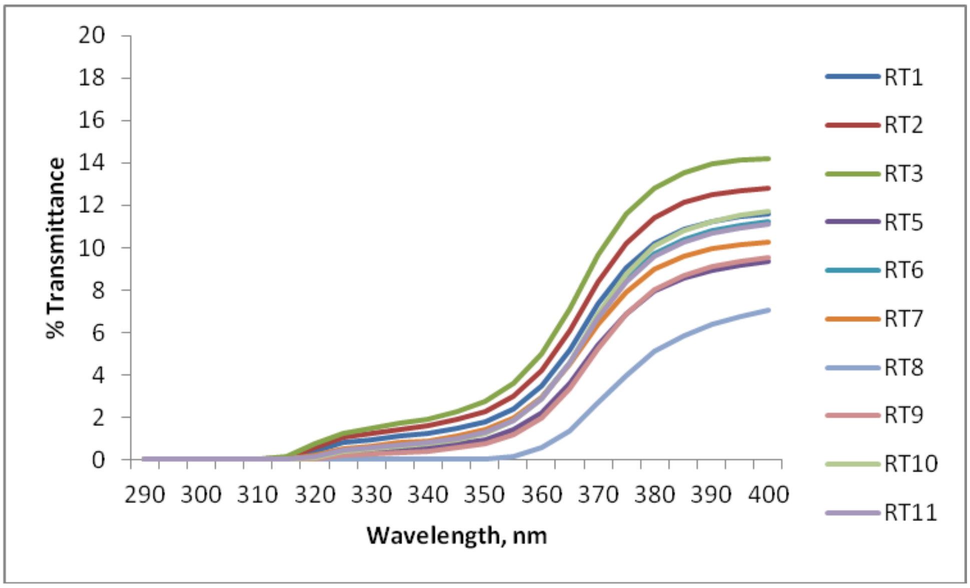

Figure 4.4: Percentage Transmittance values of Woven Twill RFD samples of 37 Tex Weft

Table 4.11, 4.13 and 4.15 (see appendix) and figure 4.4, 4.5 and 4.6 exhibits percentage transmission value for wave length (290nm to 400nm at an interval of 5nm wave length) of woven fabric for RFD Twill samples respectively of 37 Tex, 20 Tex and 13 Tex weft. It can be observed from figure 4.4, 4.5 and 4.6 that all the samples shows increasing trend similar to that observed in Satin fabrics for UV-A and UV-B percentage transmittance. A radiation percentage transmittance ranges from 0-15 percent at the most in all samples.

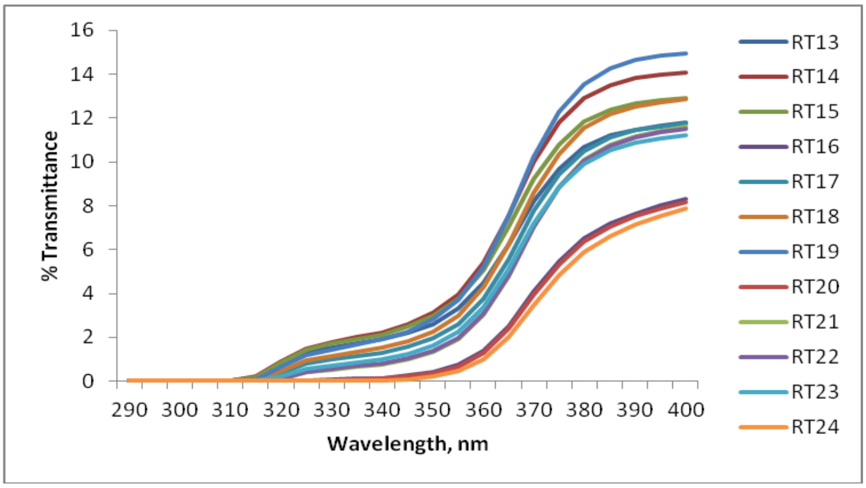

Figure 4.5: Percentage Transmittance values of Woven Twill RFD samples of 20 Tex Weft

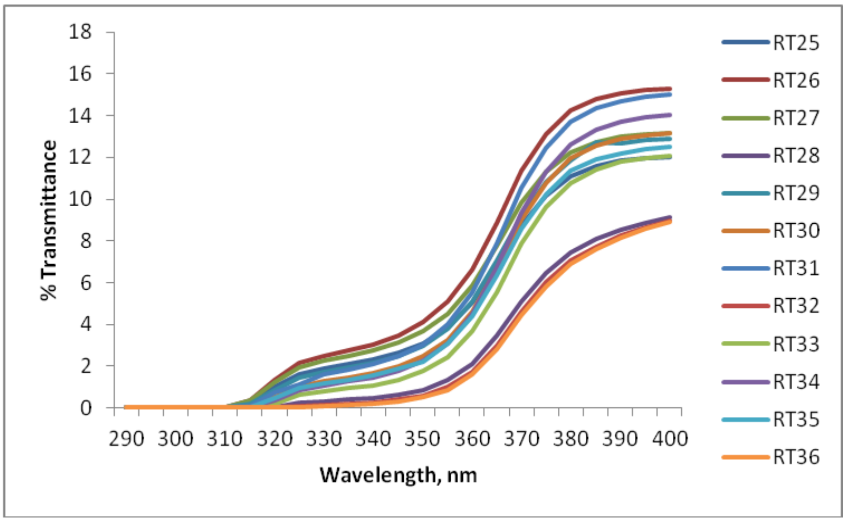

Figure 4.6: Percentage Transmittance values of Woven Twill RFD samples of 13 Tex Weft

For all dyed samples the percentage transmittance is almost zero (0.05) in the UV-A and UV-B region which shows that all the dyed samples exhibit excellent protection from UV-A and UV-B (see Table 4.12, 4.14 and 4.16).

4.2.6 Effect of weave on UV shielding property

It has been observed that Satin weave samples shows higher UPF values compared to Twill weave in general. This may be attributed to specific arrangement of floats in Satin weave which helps to obtain higher thread density and tend to group together which further reduces the free space area and hence higher sun shielding property with better air permeability[33, 88]. Dimitrovski, Sluga & Urbas (2010) also observed that the yarn position within the fabric structure has a corresponding influence on UPF values[83]. Wilson et al (2008) observed that fabric type is likely to modify UV as a result of structural and fibre type differences with interactions between fabric structure and fibre content likely[150].

Particularly when comparison is made between samples of all the blends of Twill and Satin weave, Satin samples woven with 37 Tex shows higher UPF values (ranging from 4.2 to 20.7 percent). Similarly for 20 Tex the increment in the UPF value ranges from 4.55 to 25.09 percent and for 13 Tex the increment ranges from 0.4 to 34.49 percent for Satin samples.

4.2.7 Statistical Analysis

Table 4.28: Regression Analysis of Twill RFD fabric woven using 37 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-271	104	-2.59	0.049
PPI	8.85	1.63	5.45	0.003
Blend ratio				
2	-47.8	24.8	-1.92	0.112
3	-51.2	24.8	-2.06	0.094
4	291.1	24.8	8.27	0.000
S = 30.4023	R^2= 96.71%	R^2 (adjusted) = 94.07%	R^2 (predicted) = 94.07%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	135692	33922.9	36.70	0.001
PPI	1	27432	27431.8	29.68	0.003
Blend ratio	3	98785	32928.5	35.63	0.001
Residual Error	5	4622	924.3		
Total	9	140313			

Table 4.29: General Regression Equation of Twill RFD fabric woven using 37 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -271 + 8.85 PPI
(Polyester/Viscose)	2	UPF = -319 + 8.85 PPI
(Polyester/Viscose)	3	UPF = -322 + 8.85 PPI
(Polyester/Viscose/Lycra)	4	UPF = 20 + 8.85 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Twill RFD fabric woven using 37 Tex weft for different blend ratio is given in Table 4.29. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 96.71%. Together, blend ratio and picks per inch accounted for 96.71% of the variance in the UPF (see table 4.28). R^2 (predicted) = 94.07%, which indicates that the model explains 94.07% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.30: Regression Analysis of Twill RFD fabric woven using 20 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-14.8	36.7	-0.40	0.698
PPI	2.959	0.439	6.75	0.000
Blend ratio				
2	-16.3	15.2	-1.07	0.320
3	-31.1	15.2	-2.05	0.080
4	255.0	15.2	16.78	0.000
S = 18.6088	R^2= 98.69%	R^2 (adjusted) = 97.94%	R^2 (predicted) = 96.18%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	182218	45554.4	131.55	0.000
PPI	1	15760	15760.2	45.51	0.000
Blend ratio	3	166457	55485.8	160.23	0.000
Residual Error	7	2424	346.3		
Total	11	184642			

Table 4.31: General Regression Equation of Twill RFD fabric woven using 20 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -14.8 + 2.959 PPI
(Polyester/Viscose)	2	UPF = -31.1 + 2.959 PPI
(Polyester/Viscose)	3	UPF = -46.0 + 2.959 PPI
(Polyester/Viscose/Lycra)	4	UPF = 240.2 + 2.959 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Twill RFD fabric woven using 20 Tex weft for different blend ratio is given in Table 4.31. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 98.69%. Together, blend ratio and picks per inch accounted for 98.69% of the variance in the UPF (see table 4.30). R^2 (predicted) = 96.18%, which indicates that the model explains 96.18% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.32: Regression Analysis of Twill RFD fabric woven using 13 Tex weft: UPF versus Weft density for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	51.0	18.2	2.81	0.026
PPI	1.653	0.192	8.62	0.000
Blend ratio				
2	-29.95	9.22	-3.25	0.014
3	-34.25	9.22	-3.71	0.008
4	197.78	9.22	21.45	0.000
S = 11.2934	R^2= 99.26%	R^2 (adjusted) = 98.84%	R^2 (predicted) = 97.98%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	119647	29911.7	234.53	0.000
PPI	1	9473	9473.1	74.28	0.000
Blend ratio	3	110174	36724.6	287.94	0.000
Residual Error	7	893	127.5		
Total	11	120540			

Table 4.33: General Regression Equation of Twill RFD fabric woven using 13 Tex weft: UPF versus Weft density for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = 51.0 + 1.653 PPI
(Polyester/Viscose)	2	UPF = 21.1 + 1.653 PPI
(Polyester/Viscose)	3	UPF = 16.8 + 1.653 PPI
(Polyester/Viscose/Lycra)	4	UPF = 248.8 + 1.653 PPI

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Twill RFD fabric woven using 13 Tex weft for different blend ratio is given in Table 4.33. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 99.26%. Together, blend ratio and picks per inch accounted for 99.26% of the variance in the UPF (see table 4.32). R^2 (predicted) = 97.98%, which indicates that the model explains 97.98% of the variation in UPF when used for prediction. The p-value for the blend ratio and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.34: Regression Analysis of Twill RFD fabric: UPF versus Weft density, Yarn tex for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	-111.6	52.6	-2.12	0.043
PPI	2.515	0.484	5.19	0.000
Yarn Tex	6.585	0.813	8.10	0.000
Blend ratio				
2	-31.3	17.1	-1.83	0.078
3	-38.9	17.1	-2.27	0.031
4	237.6	18.5	12.85	0.000
S = 36.3347	R^2= 92.09%	R^2 (adjusted) = 90.68%	R^2 (predicted) = 87.95%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	430303	86061	65.19	0.000
PPI	1	35600	35600	26.97	0.000
Yarn Tex	1	86555	86555	65.56	0.000
Blend ratio	3	376381	125460	95.03	0.000
Residual Error	28	36966	1320		
Total	33	467269			

Table 4.35: Multiple Linear regression equation of Twill RFD fabric: UPF versus Weft density, Yarn tex for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	UPF = -111.6 + 2.515 PPI + 6.585 Yarn Tex
(Polyester/Viscose)	2	UPF = -143.0 + 2.515 PPI + 6.585 Yarn Tex
(Polyester/Viscose)	3	UPF = -150.5 + 2.515 PPI + 6.585 Yarn Tex
(Polyester/Viscose/Lycra)	4	UPF = 125.9 + 2.515 PPI + 6.585 Yarn Tex

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for UPF of Twill RFD fabric for different blend ratio is given in Table 4.35. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 92.09%. Together, blend ratio, yarn tex and picks per inch accounted for 92.09% of the variance in the UPF (see table 4.34). R^2 (predicted) = 87.95%, which indicates that the model explains 87.95% of the variation in UPF when used for prediction. The p-value for the blend ratio, yarn tex and picks per inch is less than α-level 0.05, which means that the effect of blend ratio, yarn tex and picks per inch on UPF is significant.

4.3 Moisture management properties

Fabric liquid moisture transport properties in multi-dimensions, called moisture management properties influence the human perception of moisture sensations significantly. Moisture management often refers to the transport of both moisture vapour and liquid away from the body. A series of indexes are defined and calculated to characterize liquid moisture management performance of the test specimen, viz: Absorption rate; Spreading speed; Wetting time; Accumulative one-way transport capability; Maximum wetted radius; and Overall (liquid) moisture management capability. Based on result evaluation MMT can distinguish seven major types of fabrics: Water Proof; Water Repellent; Slow Absorbing and Slow Drying; Fast Absorbing and Slow Drying; Fast Absorbing and Quick Drying; Water Penetration and Moisture Management Fabric.

4.3.1.Moisture management properties of Satin fabric samples woven using 37 Tex, 20 Tex and 13 Tex weft

Liquid moisture transport test results of ready for dyeing and dyed Satin samples woven using 37 Tex weft in value are given in Tables 4.36 and 4.38 respectively and the results converted into grades are given in Tables 4.37 and 4.39 respectively where grades range from 1 to 5 – poor to excellent. Liquid moisture transport test results of ready for dyeing and dyed Satin samples woven using 20 Tex weft in value are given in Tables 4.40 and 4.42 respectively and the results converted into grades are given in Tables 4.41 and 4.43 respectively. Liquid moisture transport test results of ready for dyeing and dyed Satin samples woven using 13 Tex weft in value are given in Tables 4.44 and 4.46 respectively and the results converted into grades are given in Tables 4.45 and 4.47 respectively.

Wetting time

Comfort properties of textiles are extremely important. It is sometimes more important than the aesthetic properties when the garments are next to skin. Among all comfort properties good absorption and easy drying is one of the major requirements. When we do some physical work, we sweat. Garments which are next to skin should absorb this sweat quickly and transport it to the surface of the garment. All these desired phenomenon come under the term “Moisture Management”. It is clear that absorption of water and its transport to different parts of textiles followed by its evaporation is the major requirement. Transport of water to different parts of fabric is called ‘Wicking’.

Table 4.36: MMT results of ready for dyeing Satin Samples woven using 37 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RS_1	Mean	3.089	3.351	51.7017	52.7066	20	20	4.1961	4.0748	50.6361	0.4761
	CV	0.0371	0.0606	0.0146	0.0092	0	0	0.0581	0.0570	0.1343	0.0153
RS_2	Mean	3.1636	3.8374	45.097	40.7294	20	19	3.9992	3.3272	-27.8375	0.3039
	CV	0.1055	0.1390	0.1776	0.1657	0	0.1177	0.0701	0.1486	-0.5465	0.1675
RS_3	Mean	2.752	3.5568	48.0652	41.8783	20	19	4.1629	3.3209	-92.3773	0.2820
	CV	0.1168	0.1632	0.1502	0.1602	0	0.1177	0.0915	0.1735	-0.1632	0.2354
RS_4	Mean	4.1883	3.978	44.0844	37.0710	15	15	2.6934	2.8400	-7.5136	0.2757
	CV	0.0715	0.1128	0.0284	0.0435	0	0	0.0575	0.0656	-1.5034	0.0429
RS_5	Mean	1.7974	1.8348	34.3586	32.4971	16	17	3.8021	3.7285	14.7266	0.3288
	CV	0.6784	0.7488	0.3091	0.3223	0	0.1315	0.2638	0.2464	1.2452	0.1822
RS_6	Mean	3.3132	4.0434	45.5673	36.4479	20	19	3.7900	3.3227	73.1307	0.4038
	CV	0.2177	0.2329	0.2361	0.2590	0	0.1177	0.0906	0.1279	0.9393	0.0706
RS_7	Mean	2.9016	2.0592	61.8478	5.4195	20	8	4.0471	2.5709	1874.2039	0.6309
	CV	0.0322	0.0911	0.0247	0.2534	0	0.3423	0.0285	0.1996	0.0096	0.0678
RS_8	Mean	4.1415	3.8608	45.7952	36.4963	15	15	2.6770	2.7652	-28.4352	0.2447
	CV	0.0699	0.0996	0.0146	0.0260	0	0	0.0515	0.0702	-0.3248	0.1038
RS_9	Mean	3.3228	3.3228	49.0818	43.9311	20	20	3.8874	3.9088	-2.3206	0.3783
	CV	0.1293	0.1519	0.1677	0.1253	0	0	0.0819	0.1134	-11.0131	0.0724
RS_{10}	Mean	2.8266	3.5942	51.7168	42.7161	20	20	3.8956	3.2421	-98.8436	0.2777
	CV	0.0360	0.0234	0.0118	0.0154	0	0	0.0283	0.0145	-0.1110	0.0158
RS_{11}	Mean	3.2384	4.0996	44.7952	38.4989	20	19	3.8572	3.1805	-33.4368	0.2795
	CV	0.0401	0.0238	0.0415	0.0251	0	0	0.0339	0.0210	-0.7022	0.0763
RS_{12}	Mean	4.5302	4.6238	41.7550	32.565	15	15	2.4012	2.421	-25.5626	0.2100
	CV	0.1320	0.1624	0.2155	0.2017	0	0	0.1071	0.1371	-0.8174	0.1460

Table 4.37: MMT results of ready for dyeing Satin Samples woven using 37 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RS_1	4.7	4.4	3.5	3.5	4	4	4.9	4.8	2	2.4
RS_2	4.6	4	3.3	3	4	3.8	4.7	3.8	1.6	1.9
RS_3	4.9	4.3	3.4	3	4	3.8	4.8	3.8	1	1.8
RS_4	4	4.1	3.1	3	3	3	3.3	3.4	1.8	2
RS_5	4.7	4.6	3	2.9	4	4.2	4.6	4.7	2	2.5
RS_6	4.6	4	3.3	2.8	4	3.8	4.4	3.8	2.4	2.5
RS_7	5	5	3.7	1	4	1.6	4.8	3.1	5	3.6
RS_8	4	4.1	3.4	3	3	3	3.1	3.3	1.5	1.8
RS_9	4.6	4.5	3.3	3.2	4	4	4.6	4.5	1.8	2.5
RS_{10}	5	4.1	3.5	3	4	4	4.7	3.7	1	2
RS_{11}	4.7	4.2	3.2	2.8	4	3.8	4.6	3.6	1.5	1.8
RS_{12}	3.8	3.8	3.1	2.6	3	3	2.9	2.9	1.5	1.4

(WTt : Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.38: MMT results of Dyed Satin Samples woven using 37 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DS_1	Mean	7.77	3.24	76.42	35.45	17.00	11.00	1.85	3.20	675.87	0.75
	CV	0.45	0.63	0.20	0.32	0.45	0.38	0.34	0.45	0.18	0.15
DS_2	Mean	4.62	8.54	59.20	44.64	14.00	17.00	2.25	4.04	697.84	0.80
	CV	0.85	1.73	0.36	0.51	0.47	0.39	0.62	0.56	0.13	0.21
DS_3	Mean	2.23	4.02	62.94	72.39	16.00	22.00	2.93	3.45	325.32	0.74
	CV	0.48	0.72	0.03	0.21	0.14	0.26	0.23	0.42	0.47	0.24
DS_4	Mean	10.65	8.61	246.54	12.56	5.00	9.00	0.52	1.39	738.09	0.57
	CV	0.48	0.64	0.70	0.68	0.00	0.25	0.29	0.81	0.22	0.14
DS_5	Mean	8.12	3.31	103.11	41.93	15.00	15.00	1.79	2.71	240.59	0.55
	CV	0.09	0.80	0.14	0.66	0.00	0.00	0.16	0.25	0.68	0.26
DS_6	Mean	5.43	26.45	75.09	46.44	13.00	14.00	1.68	2.40	373.37	0.66
	CV	0.63	1.98	0.17	0.56	0.34	0.64	0.37	0.70	0.39	0.39
DS_7	Mean	3.39	27.99	69.71	52.72	13.00	8.00	2.26	1.85	790.09	0.71
	CV	0.73	1.84	0.11	0.63	0.34	0.56	0.41	0.57	0.16	0.17
DS_8	Mean	5.92	65.33	158.57	3.33	5.00	3.00	1.53	0.17	-794.06	0.06
	CV	0.72	0.80	1.27	1.30	0.00	0.91	0.87	1.40	-0.93	2.22
DS_9	Mean	9.81	27.97	157.06	15.13	11.00	7.00	4.39	1.96	1095.08	0.61
	CV	0.62	1.84	0.50	0.83	0.50	0.64	1.79	1.00	0.35	0.20
DS_{10}	Mean	8.80	19.19	148.32	7.87	8.00	7.00	0.76	1.56	996.23	0.59
	CV	0.13	1.37	0.72	0.92	0.56	0.64	0.33	1.08	0.10	0.20
DS_{11}	Mean	9.17	5.09	94.31	49.63	16.00	14.00	1.40	2.43	132.28	0.45
	CV	0.57	1.31	0.38	0.36	0.14	0.16	0.39	0.18	1.32	0.33
DS_{12}	Mean	9.36	31.66	350.30	4.27	5.00	5.00	0.53	0.77	1161.99	0.52
	CV	0.11	1.58	0.40	1.10	0.00	0.71	0.10	1.23	0.12	0.10

Table 4.39: MMT results of Dyed Satin Samples woven using 37 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DS_1	3.5	4.5	4	2.8	3.2	2.2	2.2	3.7	5	4.4
DS_2	4.3	4.5	3.7	3	2.8	3.4	2.6	4.2	5	4.6
DS_3	4.8	4.5	3.9	4.1	3.2	4.2	3.5	3.7	4.1	4.2
DS_4	3.3	3.5	4.7	1.6	1	1.8	1	2	5	3.3
DS_5	3.5	4.7	4.8	2.8	3	3	2.3	3.2	3.5	3.2
DS_6	3.9	3.9	4	3	2.6	3	2.1	3.1	4.4	4
DS_7	4.7	3.7	3.9	3.2	2.6	1.8	2.7	2.4	5	4.1
DS_8	4	2	3.7	1.1	1	1	2	1	1.5	1.2
DS_9	3.4	3.6	4.7	1.7	2.2	1.6	2.2	2.5	5	3.6
DS_{10}	3.3	3.5	4.6	1.2	1.6	1.6	1.1	2.2	5	3.4
DS_{11}	3.5	4.5	4.3	3.2	3.2	2.8	1.8	3.1	2.9	2.7
DS_{12}	3.30	3.10	5.00	1.10	1.00	1.20	1.00	1.40	5.00	3.10

(WTt : Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

Table 4.40: MMT results of ready for dyeing Satin Samples woven using 20 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RS_{13}	Mean	2.9953	3.0887	53.7916	49.2682	25	25	5.5537	5.5950	-10.1383	0.4033
	CV	0.3926	0.3884	0.4971	0.4967	0.5	0.4974	0.4763	0.4780	-0.7290	0.2743
RS_{14}	Mean	2.733	2.0968	67.1399	11.9728	25	6	5.1282	2.1872	1592.0939	0.6044
	CV	0.0153	0.0510	0.0329	0.1252	0	0.3727	0.0375	0.1566	0.0342	0.0470
RS_{15}	Mean	3.089	3.1825	54.0642	45.3265	25	20	5.0418	4.5812	15.0115	0.4204
	CV	0.0426	0.0415	0.0153	0.0133	0	0	0.0262	0.0365	0.3495	0.0178
RS_{16}	Mean	4.3434	4.0998	55.9163	43.7870	19	19	3.5324	3.7481	-24.0690	0.3518
	CV	0.2862	0.2456	0.2256	0.1365	0.1177	0.1177	0.1768	0.1819	-1.18467	0.1659
RS_{17}	Mean	3.136	3.0655	55.4134	50.4321	21.25	20	4.4752	4.4066	-0.4422	0.4173
	CV	0.0752	0.0521	0.0166	0.0514	0.1176	0	0.0823	0.02607	-55.0249	0.0811
RS_{18}	Mean	2.8454	3.2194	54.9678	46.7695	23	20	4.5195	4.0511	-79.6103	0.3507
	CV	0.0597	0.0332	0.0405	0.0664	0.1191	0	0.0400	0.0313	-0.0921	0.0264
RS_{19}	Mean	3.0418	3.2523	54.4287	49.2417	23.75	20	4.5987	4.1687	-41.5111	0.36845
	CV	0.0178	0.0492	0.0258	0.0747	0.1053	0	0.0736	0.0248	-0.2496	0.0581
RS_{20}	Mean	4.6614	4.2682	53.9523	42.3304	15	19	2.8109	3.4052	-17.1957	0.3267
	CV	0.2183	0.1915	0.0912	0.0720	0	0.1177	0.1195	0.1042	-0.7435	0.0404
RS_{21}	Mean	3.8752	3.875	38.1947	42.8209	19	15	3.2444	2.9293	115.4449	0.4262
	CV	0.2282	0.2419	0.3410	0.4037	0.3431	0.6236	0.4440	0.5944	0.3440	0.3205
RS_{22}	Mean	3.2063	2.9953	55.5877	47.6783	20	22.5	3.8505	4.0233	28.6317	0.4353
	CV	0.0767	0.0765	0.0337	0.0346	0	0.1283	0.0406	0.0629	0.1991	0.0245
RS_{23}	Mean	3.1262	3.2946	55.9475	48.6709	20	20	3.9096	3.7543	-40.7253	0.3510
	CV	0.0401	0.0238	0.0415	0.0251	0	0	0.0339	0.0210	-0.7022	0.0763
RS_{24}	Mean	3.9876	4.3618	42.7911	33.2514	16	18	2.7818	3.0091	-29.4962	0.2561
	CV	0.0918	0.2635	0.3293	0.2620	0.1400	0.1521	0.1223	0.1645	-0.7794	0.1414

Table 4.41: MMT results of ready for dyeing Satin Samples woven using 20 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RS_{13}	4.8	4.8	3.5	3.5	5	5	5	5	1.8	2.5
RS_{14}	5	5	4	1.5	5	1.2	5	2.7	5	3.6
RS_{15}	4.8	4.5	3.5	3.3	5	4	5	5	2	2.5
RS_{16}	3.9	3.9	3.6	3.1	3.8	3.8	4	4.4	1.5	2.4
RS_{17}	4.6	4.8	3.5	3.5	4.3	4	5	5	1.8	2.6
RS_{18}	4.9	4.5	3.5	3.4	4.6	4	5	4.8	1	2.3
RS_{19}	4.8	4.5	3.5	3.5	4.8	4	5	5	1.5	2.5
RS_{20}	3.7	3.9	3.5	3.1	3	3.8	3.2	3.9	1.6	2
RS_{21}	4.2	4.2	2.9	3	3.8	3	3.7	3.4	2.8	2.6
RS_{22}	4.5	4.9	3.5	3.5	4	4.5	4.4	4.8	2	2.5
RS_{23}	4.7	4.5	3.5	3.5	4	4	4.5	4.3	1.3	2.1
RS_{24}	4	4.1	3.1	2.7	3.2	3.6	3.2	3.5	1.6	1.7

(WTt : Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.42: MMT results of Dyed Satin Samples woven using 20 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DS_{13}	Mean	8.12	3.14	80.87	42.59	18.75	17.50	1.90	3.43	456.33	0.74
	CV	0.11	0.43	0.19	0.47	0.40	0.49	0.37	0.11	0.41	0.18
DS_{14}	Mean	6.50	14.10	128.33	39.07	13.00	19.00	1.45	4.13	749.96	0.76
	CV	0.48	1.82	0.90	0.50	0.44	0.29	0.66	0.56	0.29	0.20
DS_{15}	Mean	6.87	52.53	68.68	44.10	7.00	12.00	1.25	1.76	635.64	0.65
	CV	0.56	0.85	0.46	0.91	0.64	0.56	1.05	0.75	0.51	0.36
DS_{16}	Mean	10.30	9.66	289.99	8.75	5.00	9.00	0.49	1.50	528.48	0.56
	CV	0.21	0.98	0.58	0.46	0.00	0.25	0.20	0.74	0.18	0.11
DS_{17}	Mean	8.82	3.13	107.29	19.52	20.00	9.00	1.64	2.29	738.53	0.63
	CV	0.29	0.25	0.21	0.04	0.31	0.25	0.23	0.42	0.26	0.13
DS_{18}	Mean	9.96	7.90	124.80	60.81	15.00	16.00	1.08	2.06	316.22	0.51
	CV	0.35	1.07	0.53	0.62	0.33	0.26	0.28	0.45	1.04	0.46
DS_{19}	Mean	4.64	2.28	75.47	63.93	15.00	23.00	1.88	4.21	449.32	0.89
	CV	0.48	0.18	0.13	0.05	0.00	0.12	0.42	0.07	0.06	0.02
DS_{20}	Mean	9.04	26.00	368.12	14.05	8.00	5.00	0.58	1.59	762.53	0.58
	CV	0.09	1.80	0.28	0.81	0.34	1.00	0.08	1.30	0.16	0.20
DS_{21}	Mean	9.57	3.78	126.83	22.81	17.00	10.00	1.45	3.02	814.24	0.70
	CV	0.25	0.73	0.21	0.09	0.26	0.00	0.20	0.18	0.33	0.06
DS_{22}	Mean	10.48	7.23	116.42	18.35	13.00	9.00	1.01	2.62	886.56	0.64
	CV	0.32	1.56	0.42	0.58	0.34	0.25	0.22	0.55	0.43	0.29
DS_{23}	Mean	6.95	3.02	88.05	37.98	20.00	17.50	1.52	2.44	266.90	0.55
	CV	0.47	0.42	0.39	0.07	0.00	0.29	0.20	0.39	0.21	0.24
DS_{24}	Mean	9.32	29.71	234.60	4.44	5.00	1.00	0.53	0.11	865.09	0.50
	CV	0.06	0.57	0.50	0.61	0.00	2.24	0.06	2.24	0.14	0.00

Table 4.43: MMT results of Dyed Satin Samples woven using 20 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DS_{13}	3.4	4.6	4.1	3.0	3.5	3.3	2.4	4.0	4.6	4.4
DS_{14}	3.7	4.1	3.9	2.9	2.6	3.8	1.9	3.9	5	4.5
DS_{15}	3.6	2.4	3.8	2.8	1.4	2.6	1.7	2.4	4.7	3.8
DS_{16}	3.1	3.8	4.7	1.2	1	1.8	1	2	4.9	3.4
DS_{17}	3.2	4.5	4.8	2	3.8	1.8	2.1	2.6	5	3.7
DS_{18}	3.2	4.1	4.4	3.5	3	3.2	1.3	2.6	3.5	2.9
DS_{19}	4.1	5	4	3.9	3	4.6	2.5	4.8	5	5
DS_{20}	3.1	3.5	5	1.7	1.6	1.4	1	2.2	5	3.4
DS_{21}	3.4	4.5	5	2.1	3.4	2	2	3.5	5	4.1
DS_{22}	3.3	4.5	4.5	1.9	2.6	1.8	1.4	3.3	4.7	3.8
DS_{23}	3.5	4.5	4.3	3	4	3.5	2.1	2.9	3.8	3.3
DS_{24}	3	2.6	5	1	1	1	1	1	5	3

(WTt : Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

Table 4.44: MMT results of ready for dyeing Satin Samples woven using 13 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RS_{25}	Mean	2.7522	2.7522	53.2086	50.8974	30	29	6.9686	6.8698	15.3948	0.4363
	CV	0.1455	0.1810	0.1149	0.1221	0	0.0771	0.0574	0.1010	1.7828	0.0846
RS_{26}	Mean	2.4098	2.3865	52.3788	49.2560	26.25	26.25	9.6789	7.0540	16.8297	0.4333
	CV	0.1832	0.1710	0.1285	0.1442	0.0952	0.0952	0.7541	0.2737	0.3947	0.0301
RS_{27}	Mean	2.808	2.8456	55.1334	48.8305	26	25	6.0582	5.8302	4.1075	0.418
	CV	0.0333	0.0374	0.0101	0.0129	0.0860	0	0.0343	0.0108	2.2018	0.0260
RS_{28}	Mean	4.2122	4.2686	61.2491	45.9699	22	22	4.1010	4.2513	-56.3126	0.3323
	CV	0.2006	0.2140	0.0726	0.0285	0.1245	0.1245	0.1841	0.2125	-0.2434	0.0507
RS_{29}	Mean	3.744	3.5567	50.3486	47.8170	25	25	5.2200	5.1903	0.2154	0.4108
	CV	0.5522	0.5482	0.5597	0.5501	0.5201	0.5477	0.5245	0.5404	152.7625	0.4729
RS_{30}	Mean	3.0322	3.2006	57.1702	49.1889	25	20	4.8437	4.1701	-83.09	0.3505
	CV	0.0990	0.1159	0.1044	0.1088	0	0	0.0872	0.0914	-0.2062	0.0934
RS_{31}	Mean	3.07	3.1824	49.6549	50.3182	25	23	4.6400	4.3180	-24.6799	0.3885
	CV	0.0452	0.0624	0.0798	0.1243	0	0.1191	0.0516	0.0656	-0.4223	0.0727
RS_{32}	Mean	4.3056	4.081	49.2779	37.7504	19	19	3.3052	3.5101	-15.1833	0.3240
	CV	0.1498	0.1509	0.2292	0.2105	0.1177	0.1177	0.1765	0.1556	-1.9365	0.1120
RS_{33}	Mean	3.5192	3.8	42.2821	31.8436	19	18	4.055	3.3040	482.0455	0.6897
	CV	0.6068	0.3742	0.4124	0.4462	0.4708	0.4213	0.5743	0.4426	0.4695	0.2572
RS_{34}	Mean	3.5756	4.0622	54.8789	47.0992	23	19	4.0398	3.3487	-74.6553	0.2950
	CV	0.2646	0.3128	0.1932	0.2685	0.1191	0.1177	0.1543	0.3194	-0.1224	0.4037
RS_{35}	Mean	3.2382	3.332	52.3960	49.4611	22	20	3.9211	3.6826	-17.1340	0.3697
	CV	0.0258	0.0511	0.0262	0.0598	0.1245	0	0.0423	0.0628	-1.5031	0.0897
RS_{36}	Mean	4.025	3.65	53.61	40.3905	20	20	3.4331	3.5839	-22.6919	0.3301
	CV	0.045	0.064	0.078	0.123	0	0.1191	0.0516	0.0656	-0.4223	0.0727

Table 4.45: MMT results of ready for dyeing Satin Samples woven using 13 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RS_{25}	4.9	4.9	3.4	3.4	5	5	5	5	1.9	2.7
RS_{26}	5	5	3.4	3.4	5	5	5	5	2	2.5
RS_{27}	5	5	3.5	3.5	5	5	5	5	2	2.5
RS_{28}	3.9	3.9	3.8	3.4	4.4	4.4	4.4	4.4	1.2	2.1
RS_{29}	4.2	4.5	3.3	3.3	5	5	5	5	1.8	2.5
RS_{30}	4.8	4.6	3.5	3.4	5	4	5	4.8	1	2.4
RS_{31}	4.7	4.7	3.5	3.3	5	4.6	5	4.9	1.5	2.4
RS_{32}	3.7	4	3.3	2.8	3.8	3.8	3.9	4.1	1.6	2.1
RS_{33}	4.3	4.2	3	2.6	3.6	3.6	4	3.7	4.6	4
RS_{34}	4.4	4.1	3.5	3.3	4.6	3.8	4.6	3.8	1	1.9
RS_{35}	4.5	4.4	3.5	3.5	4.4	4	4.6	4.1	1.6	2.4
RS_{36}	4	4	3.5	3	4	4	4	4	1.5	2

(WTt : Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.46: MMT results of Dyed Satin Samples woven using 13 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DS_{25}	Mean	7.70	3.32	77.80	25.80	15.00	15.00	1.58	3.41	855.99	0.74
	CV	0.08	0.12	0.12	0.15	0.00	0.27	0.22	0.16	0.15	0.06
DS_{26}	Mean	3.35	2.64	37.75	40.11	21.00	14.00	2.77	3.65	886.02	0.77
	CV	0.79	0.67	0.31	0.19	0.26	0.39	0.38	0.39	0.18	0.08
DS_{27}	Mean	2.43	2.45	47.00	51.26	16.00	18.00	2.78	4.46	1077.48	0.85
	CV	0.40	0.38	0.23	0.07	0.14	0.15	0.20	0.18	0.13	0.02
DS_{28}	Mean	13.44	2.21	336.20	33.26	7.00	14.00	0.42	3.19	888.80	0.72
	CV	0.28	0.69	0.51	0.57	0.39	0.30	0.29	0.50	0.20	0.17
DS_{29}	Mean	8.72	4.42	106.42	24.49	17.00	10.00	1.59	2.52	874.69	0.67
	CV	0.34	0.57	0.50	0.13	0.53	0.00	0.50	0.27	0.48	0.09
DS_{30}	Mean	12.86	7.94	171.03	25.90	13.00	14.00	0.73	3.31	1141.96	0.72
	CV	0.22	1.78	1.00	0.43	0.34	0.30	0.19	0.43	0.14	0.09
DS_{31}	Mean	5.52	3.76	93.75	60.38	19.00	20.00	2.14	3.82	458.58	0.85
	CV	0.79	0.29	0.25	0.07	0.22	0.00	0.32	0.21	0.10	0.04
DS_{32}	Mean	10.48	7.69	145.85	13.88	5.00	9.00	0.48	1.20	1241.36	0.56
	CV	0.19	0.95	0.59	0.77	0.00	0.25	0.18	0.80	0.10	0.12
DS_{33}	Mean	9.79	3.54	122.41	24.25	20.00	10.00	1.67	2.55	917.40	0.67
	CV	0.24	0.54	0.30	0.25	0.31	0.00	0.19	0.45	0.41	0.16
DS_{34}	Mean	9.40	3.67	99.91	18.05	16.00	10.00	1.11	2.21	1005.59	0.64
	CV	0.23	0.64	0.55	0.66	0.56	0.00	0.32	0.50	0.18	0.12
DS_{35}	Mean	3.28	7.08	71.33	57.69	18.00	16.00	2.34	2.36	341.37	0.68
	CV	0.48	0.58	0.08	0.30	0.15	0.14	0.19	0.20	0.16	0.14
DS_{36}	Mean	9.02	68.78	259.25	1.67	5.00	0.00	0.54	0.00	526.63	0.50
	CV	0.07	0.79	0.39	0.91	0.00		0.06		0.16	0.00

Table 4.47: MMT results of Dyed Satin Samples woven using 13 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DS_{25}	3.50	4.38	4.13	2.13	3.00	3.00	2.13	3.88	5.00	4.38
DS_{26}	4.6	4.6	2.8	2.9	4	2.8	3.2	3.8	5	4.4
DS_{27}	4.8	4.8	3.2	3.5	3.2	3.6	3.4	4.6	5	5
DS_{28}	2.9	4.7	4.7	2.5	1.4	2.8	1	3.6	5	4.2
DS_{29}	3.4	4.2	4.4	2.3	3.2	2	2.1	3.1	4.9	3.7
DS_{30}	3.1	4.5	3.9	2.3	2.6	2.8	1	3.6	5	4.1
DS_{31}	4.2	4.2	4.4	3.6	3.8	4	2.7	4.2	4.9	5
DS_{32}	3.1	3.6	4.5	1.7	1	1.8	1	1.6	5	3.3
DS_{33}	3.2	4.6	4.8	2.1	3.8	2	2.2	3	5	3.9
DS_{34}	3.2	4.5	4.4	1.8	3	2	1.5	2.8	5	3.8
DS_{35}	4.5	3.7	4	3.5	3.6	3.2	2.8	2.9	4.4	4
DS_{36}	3.1	2	5	1	1	1	1	1	5	3

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

Wetting and wicking are two related processes. A liquid that does not wet the fibres cannot wick into a fabric. Wicking can only occur when fibres assembled with capillary spaces between them are wetted by a liquid. The resultant capillary forces drive the liquid into the capillary spaces. Fibre wettability is therefore a prerequisite for wicking. All the manmade fibres except rayon and acetate are hydrophobic in nature. The molecular structure of Viscose is more amorphous than that of Cotton or linen, making it more absorbent than the natural cellulosic fibres. Moisture regain is 13 percent in Viscose and accepts dyes readily because of its increased absorbency. The absorbency of the fibre makes clothing of Viscose comfortable to wear. Viscose will absorb twice as much water naturally from the air as Cotton does[82].

Wetting time (WTt – top surface, WTb - bottom surface) is the time period in which the top and bottom surfaces of the fabric just start to get wetted after the test commences, which are defined as the time in second (s), when the slope of total water content at the top and bottom surfaces become greater than Tan (15^0) respectively. As can be seen from Table 4.36, Table 4.38 and figure 4.7 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Satin fabrics woven using 37 Tex weft.

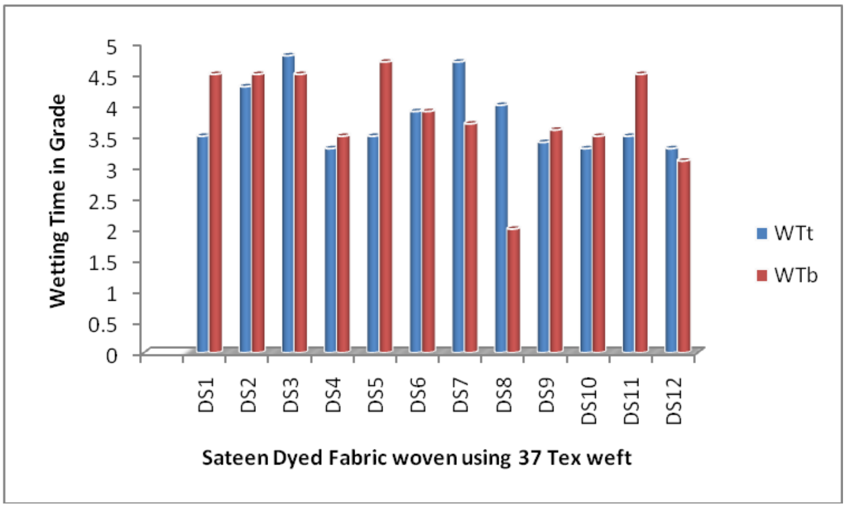

Figure 4.7: Top and bottom wetting time grade of Satin dyed fabrics woven using 37 Tex weft

Investigated Satin samples woven using 37 Tex weft demonstrated slow to fast wettability as the wetting time range from 3.24 to 65.33 seconds. The coefficient of variation of wetting time was 9 to 19.8 percent. DS_3 sample had fast wetting time for top surface and very fast for bottom surface due to the high attraction between the liquid and the fibre surface (known as the fibre surface energy: Viscose 200mJm^2; Polyester 43mJm^2). It has been observed that with increase in weft density the wetting time on both surfaces increases. Since wetting is directly related to the air proportion present within the fabric, lower air proportion due to high weft density could be the reason for the increase in the wetting times on both surfaces. This conclusion showed agreement with Behera et al (1997)[10], and Karahan & Eren (2006)[158].

The wetting time observed for 45/55 blend ratio was smaller compared to that observed for 75/25 and 60/40 blend ratio. Viscose fibre is a good moisture absorber. Contrary to Polyester fibre, it does not transport water from the surface by using the capillary, but uses the absorption method, which let water penetrate into the fibre. The result of that is generally wetting time of the bottom surfaces are higher than top surfaces for majority of fabrics as expected. In the scope of this explanation, it can be stated that, the wetting time value is related with the water absorbency of the fabric and increases as the proportion of Viscose fibre increases in the blend.

However, it is interesting to observe the differential behavior of the top and bottom surfaces of the Satin dyed fabric woven using 37 Tex weft: a comparison of the wetting time of the top surface (WTt) and that of the bottom surface (WTb) shows that the for samples DS_2, DS_3, DS_6, DS_7, DS_8,DS_{10}, and DS_{12} WTt is smaller than the WTb, suggesting that it took longer for the liquid water to be transferred to the bottom layer. These phenomena could be due to the factor that the moisture diffusion into a fabric through air gaps between yarns and fibers is a fast process, while moisture diffusion into fibres is coupled with the heat-transfer process, which is much slower and is dependent on the ability of fibres to absorb moisture[8]. It is notable that fabric DS_1 has the smallest mean WTb, demonstrating that it has a better liquid transfer ability from the top to the bottom layer. This could be owing to less weft density and higher proportion of polyester in the blend which results in improvement in moisture transport performance as polyester fibre creates water transfer channels with a wicking force. It can be observed that WTb values for the blend ratio 70/25/5 are highest among all blends studied for 37 Tex weft yarn.

As can be seen from Table 4.40, Table 4.42 and figure 4.8 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Satin fabrics woven using 20 Tex weft.

Investigated Satin samples woven using 20 Tex weft demonstrated slow to fast wettability as the wetting time range from 3.13 to 52.53 seconds. It has been observed that with increase in weft density the wetting time on both surfaces increases clearly for the blend ratio of 75/25 only.

The wetting time observed for 60/40 blend ratio was higher compared to that observed with 75/25 blend ratio which can be attributed to more proportion of Viscose fibre in 60/40 blend as the good ability of water molecule to penetrate and to be fixed in the interior of viscose fibre slow down the transfer from top to bottom.

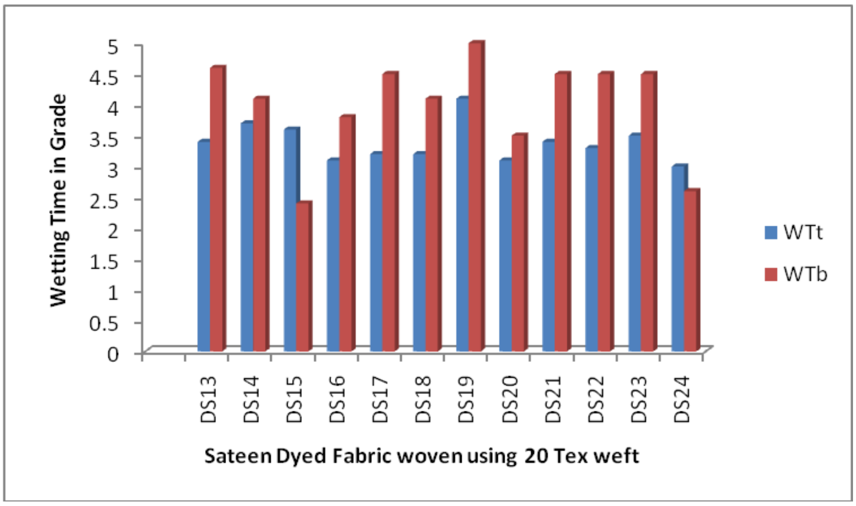

Figure 4.8: Top and bottom wetting time grade of Satin dyed fabrics woven using 20 Tex weft

As can be seen from Table 4.44, Table 4.46 and figure 4.9 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Satin fabrics woven using 13 Tex weft.

Investigated Satin samples woven using 13 Tex weft demonstrated slow to very fast wettability as the wetting time range from 2.2 to 68.78 seconds. DS_{27} sample had smallest mean WTt and small WTb, demonstrating that it has the fastest wetting time in top and very fast wetting time on bottom surface in all the three blend ratios of Polyester/Viscose compared – 75/25, 60/40 and 45/55 for 13 Tex which may be due to higher Viscose fibre content in the yarn.

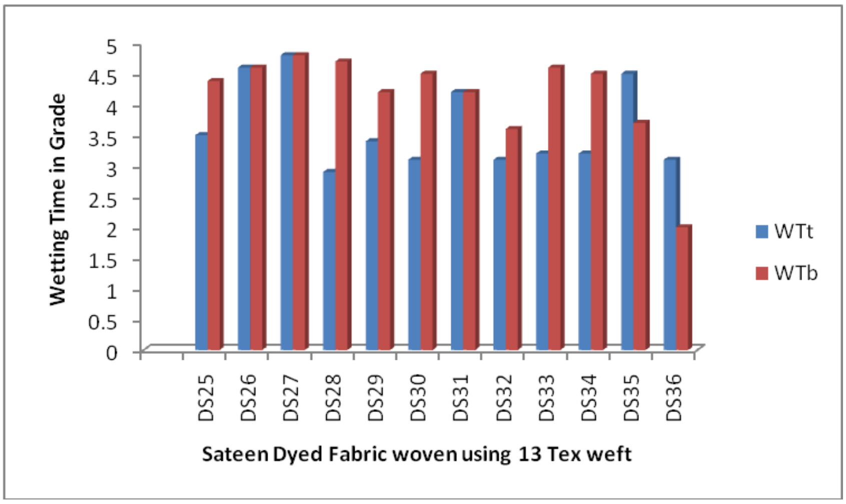

Figure 4.9: Top and bottom wetting time grade of Satin dyed fabrics woven using 13 Tex weft

It is notable that fabric DS_{28} has the smallest mean WTb, demonstrating that it has a better liquid transfer ability from the top to the bottom layer. It can be stated that finer the yarn, the lower the wetting time is. As the yarns get finer the thickness of the fabric decreases. When the results for 37 Tex, 20 Tex and 13 Tex fabrics from same blend proportion 75/25 compared, thinner fabrics shown faster WTb than thicker ones, when equal amount of water are applied. Since the number of fibres in finer yarns is less than coarse yarns, time of wetting decreases as well. So the fabric can be easily wetted by the liquid.

Absorption rates

Absorption rates on the top and bottom surfaces (% / sec) are the average moisture absorption ability of the specimen, in the pump time. The absorption of water molecule by fibre is going to be increased as the number of hydrophilic group will increase in material. On the other hand the amount of water taken up by the pores will be dependent on the porosity of the material. If the porosity increases water entrapment by the pores will also increase. Here as the cover of the fabrics are nearly similar, all the materials are having same porosity, so absorption rate mainly changed by the presence of hydrophilic group in the fabric. The absorption rates on top and bottom surface of fabrics are dependent on the blend ratios and increase with Viscose content in the blend.

It can also be seen from Table 4.36, 4.38 and figure 4.10 that the absorption rate values change according to the weft density and blend ratio. As can be seen from Table 4.36 and

4.38, the bottom absorption rates of the Satin dyed fabrics woven using 37Tex weft are generally lower than top surfaces (except DS_3).

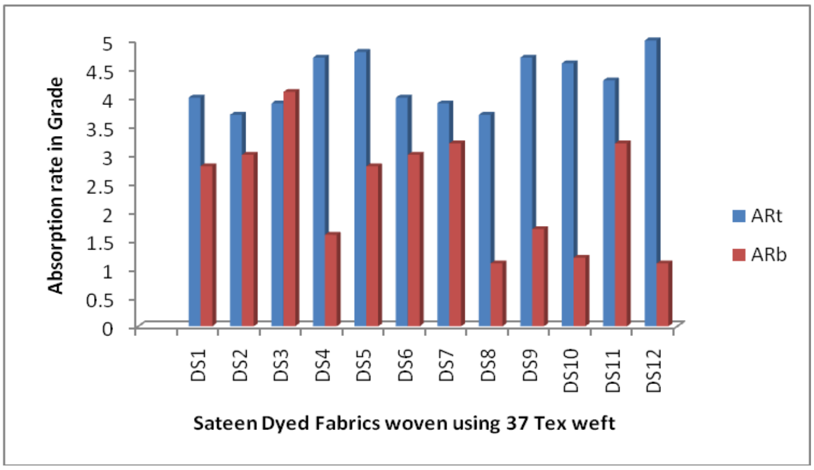

Figure 4.10: Top and bottom absorption rate grades of Satin dyed fabrics woven using 37 Tex

As can be seen from Table 4.40 and 4.42, and figure 4.11 the bottom absorption rates of the Satin dyed fabrics woven using 20Tex weft are generally lower than top surfaces.

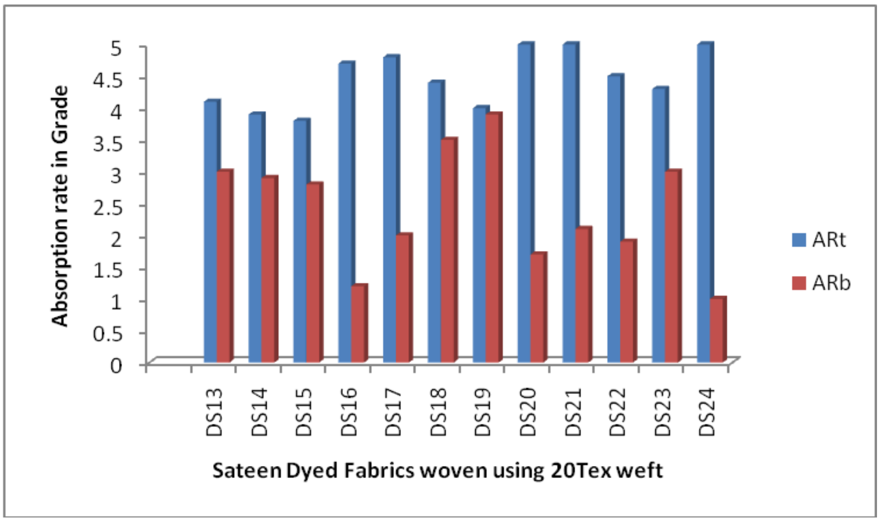

Figure 4.11: Top and bottom absorption rate grades of Satin dyed fabrics woven using 20 Tex

As can be seen from Table 4.44 and 4.46, and figure 4.12 the bottom absorption rates of the Satin dyed fabrics woven using 13Tex weft are generally lower than top surfaces (except DS_{26} and DS_{27}. Fabric DS_{12} , DS_{20} and DS_{28} have an extraordinarily higher absorption rate on top layer surface (ARt) which may be because of the liquid water accumulating on the top layer surface for a very short while, causing an obvious increase in the water content of the top surface (see figure 4.10, 4.11 and 4.12).

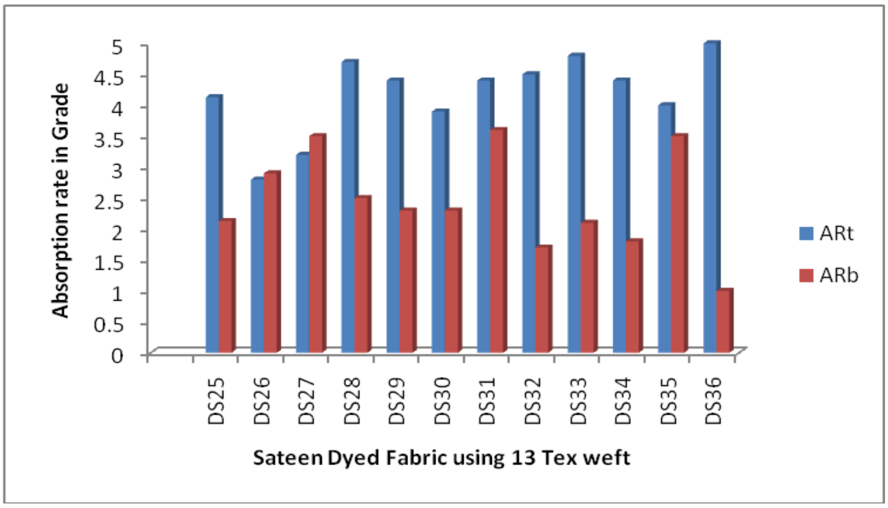

Figure 4.12: Top and bottom absorption rate grades of Satin dyed fabrics woven using 13 Tex

The thinner the fabric, the greater is the absorption rate as observed for the Satin samples woven in blend ratios 55/25, 60/40 and 45/55. The samples woven using blend ratio of Polyester/Viscose/Lycra:70/25/5 being thicker fabrics and also the content of Viscose is only 25 percent, the absorption rate on bottom surface were observed to be ranging from slow to very slow. The absorption rates of the bottom surfaces of the DS_3, DS_{26} and DS_{27} are generally higher than those of the top surfaces. This indicates that most of the liquid moisture gets distributed on the bottom surface of the fabric. Overall all the Satin samples shows absorption rate ranging from very slow to very fast.

Spreading speed

Spreading speed is associated with the moisture transport, which occurs parallel to the fabric surface. The liquid spreading rates are primarily affected by the manner and rate at which liquid migrates from yarn to yarn. Figure 4.13, 4.14 and 4.15 shows the top and bottom spreading speed grades of Satin dyed fabric woven with 37 Tex, 20 Tex and 13 Tex weft, respectively.

A decrease in the spreading speed is caused by a decrease in porosity (sample DS_8, DS_{24} and DS_{36}). Besides, the solution spreads faster on the fabrics that have the highest rates of surface energy, i.e fabrics woven with higher proportion of Viscose fibre in blend. Satin woven fabrics with blend ratio 75/20/5 shows very slow spreading speeds on both top and bottom surfaces due to low proportion of Viscose fibre compared to other blends in all the three counts.

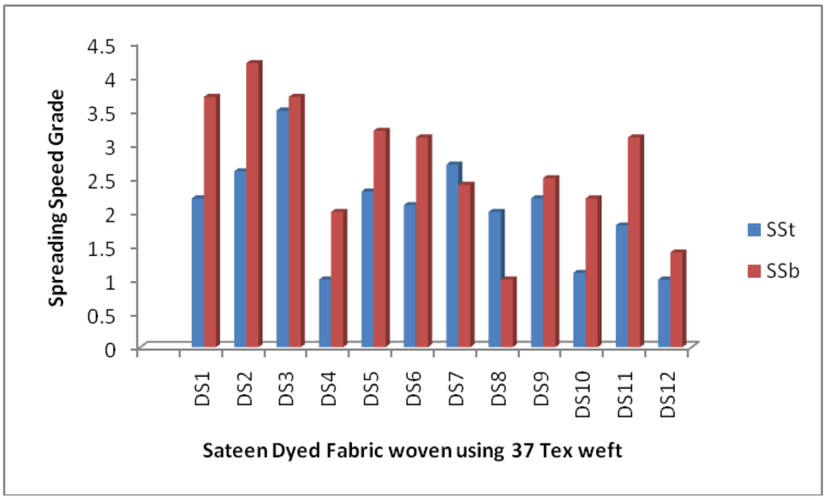

Figure 4.13: Top and bottom spreading speed grades of Satin dyed fabrics woven using 37 Tex weft

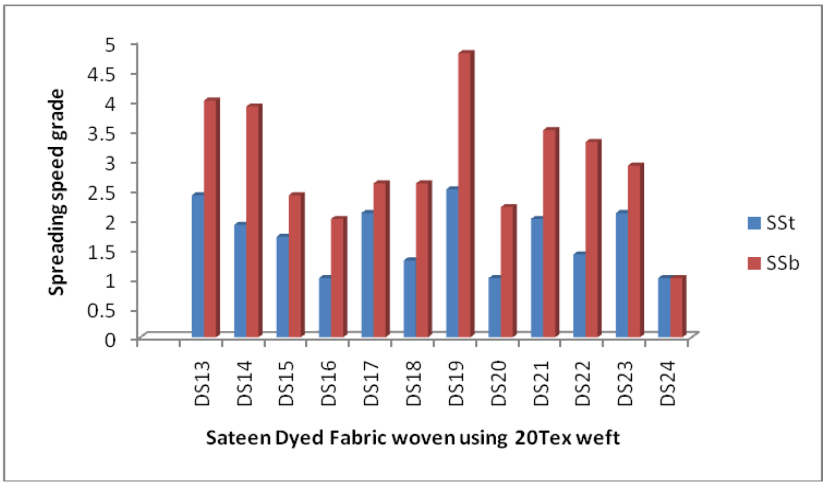

Figure 4.14: Top and bottom spreading speed grades of Satin dyed fabrics woven using 20Tex weft

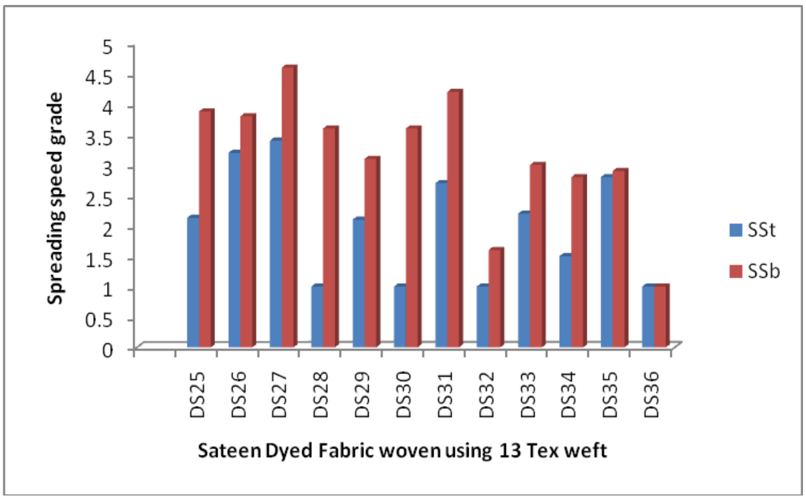

Figure 4.15: Top and bottom spreading speed grades of Satin dyed fabrics woven using 13Tex weft

Fabric DS_{27} with a low fabric cover, the fabric classification is 'fast-absorbing and quick drying fabric'. This is most likely due to the fabric's open-structure, so that it is easy for water to spread on the outer fabric surface with relatively high spreading speed. Fabric DS_{24} has very slow spreading speed grade among all the fabric samples studied which may be due to the presence of Lycra fibres and for a high fabric cover. This may be due to the fabric's close structure, so that it is not easy for liquid to spread on the outer surface (spreading speed is relatively low). Investigated Satin fabrics shows very slow to very fast spreading speed grades.

Overall spreading speed for (Polyester/Viscose) 45/55 blend fabrics are better than 75/25 and 60/40 blended fabrics observed for all the three fineness of weft, which holds when the yarns are finer, the wetting time decreases as mentioned before, consequently spreading speed for the wetting of the fabric shorten. Fabric DS_{27} has medium to fast spreading speed grade among others. Fabric DS_{36} has very slow spreading speed grade among all the fabric samples studied which may be due to the presence of Lycra fibres and high weft density.

Maximum wetted radius

In the test equipment the top surface is designed as inner surface that will be in touch with the human skin. Therefore, lower top MWR means lower wet touch, lower chilly feeling, and high skin comfort.

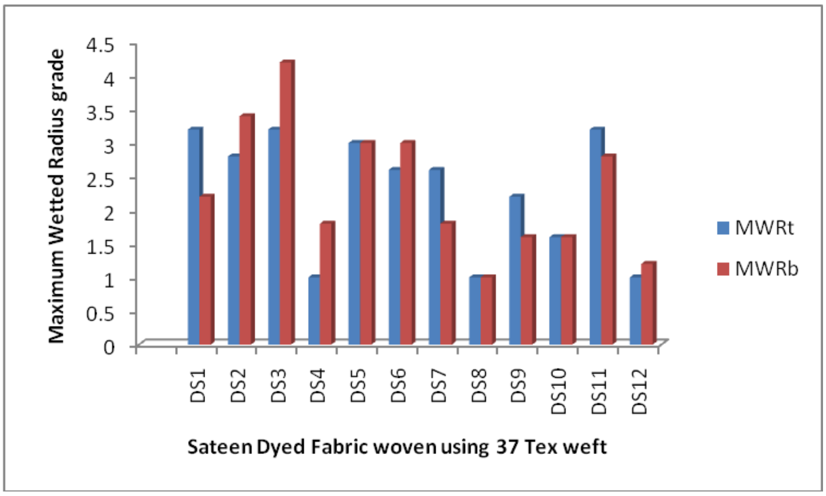

Figure 4.16: Top and bottom maximum wetted radius grades of Satin dyed fabrics of 37 Tex weft

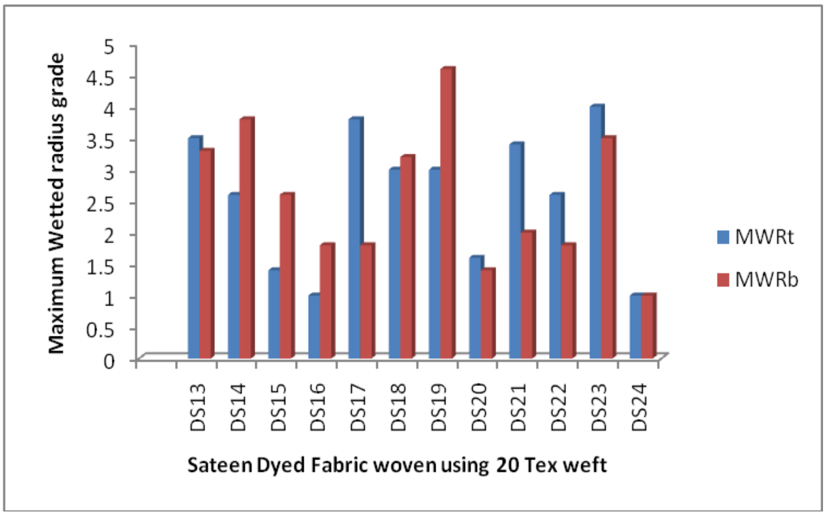

Figure 4.17: Top and bottom maximum wetted radius grades of Satin dyed fabrics of 20Tex weft

Analyzing the data presented in figure 4.16 and figure 4.17, it can be noticed that the DS_3 and DS_{13}, DS_{14} and DS_{23} have a large maximum wetted radius on the bottom surface, suggesting that this fabric had transferred and distributed more liquid water in the bottom layer than in the top layer; indicating that this fabric had a moisture management ability. Analyzing data presented in figure 4.17, it can be noticed that the samples DS_{13}, DS_{20} and DS_{23} have a large maximum wetted radius on the top surface, indicating that liquid sweat can be easily transported with a large wetted area by capillary forces. Since Fabric DS_4, DS_8, DS_{12},DS_{16} and DS_{24} have the lowest top wetted radius values, which also indicate their good moisture transport property, they will give a dry feeling.

Maximum wetted radius of top surface and spreading speed of top and bottom surface- poor: can be attributed to the inert nature of Polyester fibres due to their high crystalline molecular structure and lack of reactive groups. Accordingly, this prevents spreading of the liquid through-plane.

Analyzing the data presented in figure 4.18, it can be noticed that Satin samples woven with 13 Tex weft have the best maximum wetted radius on both the surfaces: large to very large, among all the fabrics investigated.

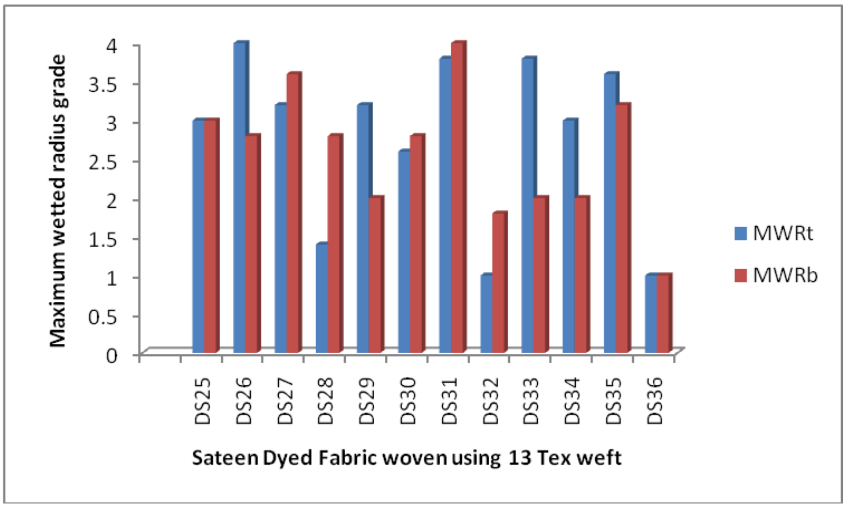

Figure 4.18: Top and bottom maximum wetted radius grades of Satin dyed fabrics of 13Tex weft

Accumulative one-way transport index grades and overall moisture management capacity

Water location versus time can be obtained as a colourful simulation which is given in figure 4.19 and figure 4.20 for DS_3 and DS_8 respectively. Figure 4.21 and 4.22 shows the typical liquid moisture content change versus test time on the fabrics top layer measured by the MMT for Satin dyed fabric DS_3 and DS_8 respectively woven with 37 Tex weft. This figures shows the dynamic moisture management process of a particular fabric during the test time. During the first 20 seconds, the tester was pumping to inject liquid water into the top surface of the fabric, and it could be observed that the water content increased sharply in this period.

The accumulative one-way transport of a fabric and its overall moisture management capacity are two important output results of moisture management tester. Figure 4.23 shows the accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics woven with 37 Tex weft.

Accumulative one-way transport index exhibits the liquid transport from top surface to bottom surface of fabric. If the AOTI value of one fabric is between 200 and 400 it means that the one-way transport is very good. Also for the fabric having the value higher than 400, one-way transport is defined as excellent. In light of this knowledge when table 4.38 and 4.40 examined AOTI values of DS_1, DS_2, DS_4, DS_7, DS_9, DS_{10} and DS_{12} showed excellent AOTI because values are approximately above 400.

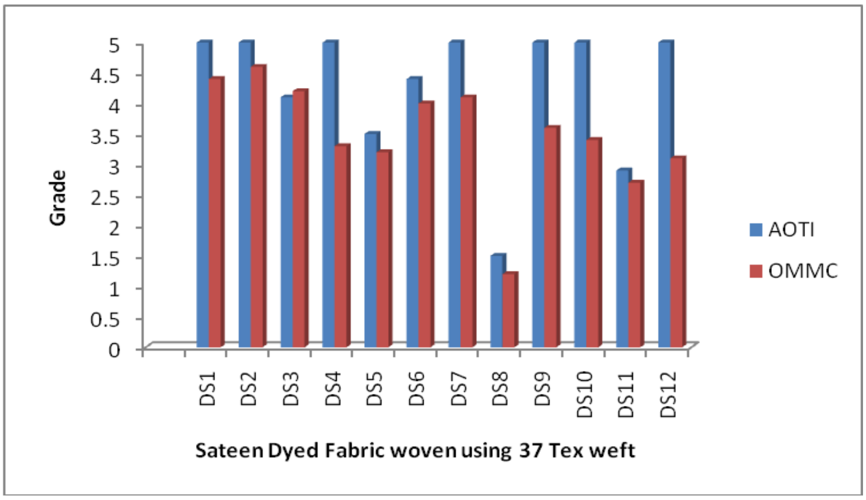

Figure 4.23: Accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics of 37 Tex weft

Overall moisture management capacity (OMMC) is an index to indicate the overall capability of the fabric to manage the transport of liquid moisture. The larger the OMMC is, the higher the overall moisture management capability of the fabric. Liquid moisture management capacity shows that liquid sweat can be easily and quickly transferred from next to the skin to the outer surface to keep the skin dry. If the OMMC of a fabric is in 0.6-0.8 range it means that the liquid moisture management capacity is very good. In light of this knowledge when table 4.38 and 4.40 examined OMMC values of R_7, DS_1, DS_3, DS_6, DS_7, DS_9 showed good OMMC because values are approximately above 0.6. Also, for the fabric having the value higher than 0.8, the overall capability of the fabric is defined as excellent (DS_2).

Table 4.38 and figure 4.23 reveal that almost all fabrics (except DS_8) have the highest liquid moisture management capacity (OMMC is very good to good) and accumulative one-way transport index (AOTI is excellent to very good), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry[133]. DS_3 fabric sample also had relatively large spreading rates (SS_b is very good) and more than medium wetted radius (MWR_b is large) on the bottom surface, indicating that liquid can spread on the bottom surface and dry quickly.

Fabric having poor liquid moisture management properties with a very low wetted radius and spreading rates on the bottom surface, as well as negative accumulative one-way transport capacities (DS_8) indicate that the liquid (sweat) cannot diffuse easily from the next-to-skin surface to the opposite side and will accumulate on the top surface of the fabric[159].

Sample DS9 had the highest accumulative one-way transport index (AOTI =1095.08) and also a high moisture management capacity (OMMC=0.61). It means that the liquid sweat can be quickly transferred from next-to-the skin to the opposite side of the fabric to keep the skin dry and provide better thermal comfort[33]. Figure 4.24 and 4.25 show example of the typical fingerprint of moisture management properties of fabric sample – DS_3 and DS_8 respectively.

Water location versus time can be obtained as a colourful simulation which is given in figure 4.26 and figure 4.27 for DS_{19} and DS_{23} respectively. The water content of the bottom layer was significantly higher than that of the top layer as soon as the fabrics were wetted by liquid water, indicating that liquid water was transferred quickly to the bottom layer from the top layer. Figure 4.28 and 4.29 shows the typical liquid moisture content change versus test time on the fabrics top layer measured by the MMT for Satin dyed fabric DS_{19} and DS_{23} respectively woven with 20 Tex weft. Figure 4.30 shows the accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics woven with 20 Tex weft.

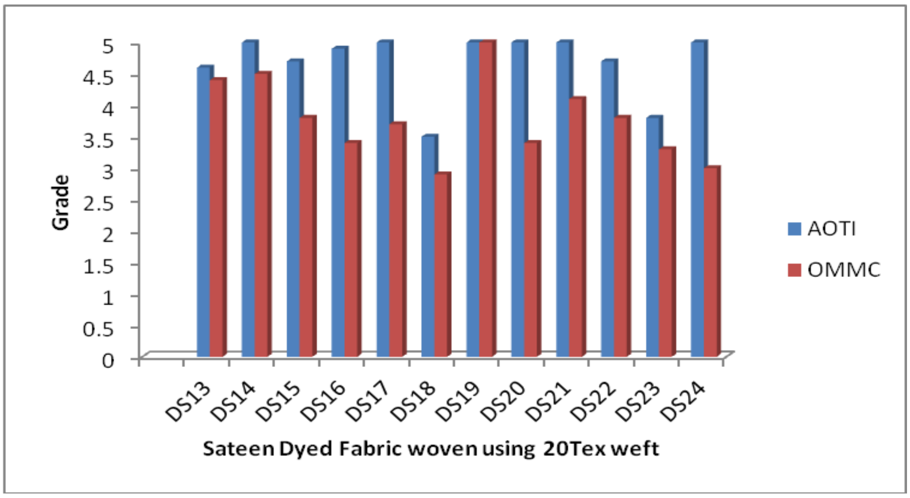

Figure 4.30: Accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics of 20 Tex weft

It can be noticed from table 4.59, AOTI values of all the samples except DS_{18}, and DS_{23} showed excellent AOTI because values are approximately above 400. In case of RFD samples (see table 4.61) RS_{14} showed excellent AOTI. OMMC values of DS_{13}, RS_{14}, DS_{14}, DS_{15}, DS_{17}, DS_{21}, and DS_{22}, showed good OMMC because values are approximately above 0.6. Also, for the fabric having the value higher than 0.8, the overall capability of the fabric is defined as excellent (DS_{19}), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry. DS_{19} fabric sample also had relatively large spreading rates (SS_b is very good) and more than medium wetted radius (MWR_b is very large) on the bottom surface, indicating that liquid can spread on the bottom surface and dry quickly.

Sample DS_{22} had the highest accumulative one-way transport index (AOTI =886) and also a high moisture management capacity (OMMC=0.64). It means that the liquid sweat can be quickly transferred from next-to-the skin to the opposite side of the fabric to keep the skin dry and provide better thermal comfort[33]. Figure 4.31 and 4.32 show example of the typical fingerprint of moisture management properties of fabric sample – DS_{19} and DS_{23} respectively.

Water location versus time can be obtained as a colourful simulation which is given in figure 4.33 and figure 4.34 for DS_{27} and DS_{35} respectively. Figure 4.35 and 4.36 shows the typical liquid moisture content change versus test time on the fabrics top layer measured by the MMT for Satin dyed fabric DS_{27} and DS_{35} respectively woven with 13 Tex weft. Figure 4.37 shows the accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics woven with 13 Tex weft.

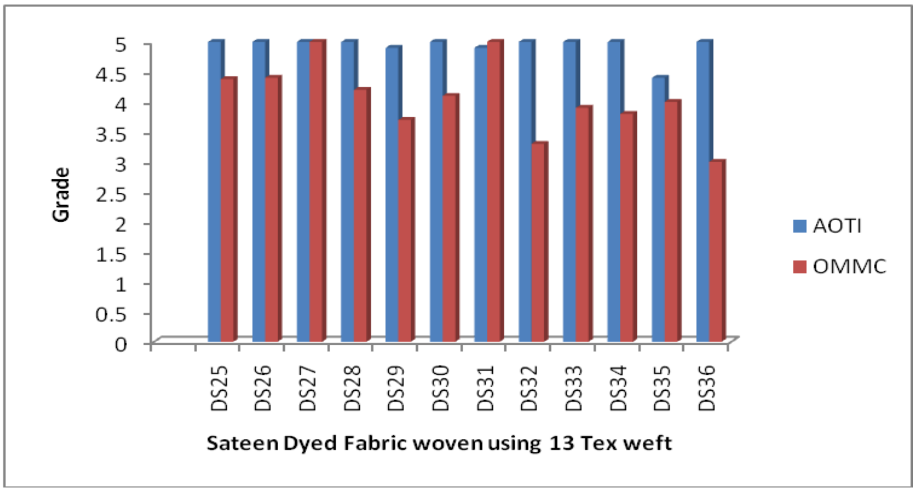

Figure 4.37: Accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics of 13 Tex weft

It can be noticed from table 4.61 and 4.63, AOTI values of all the samples (except DS_{35}) showed excellent AOTI because values are approximately above 400. In case of RFD samples RS_{33} showed excellent AOTI. OMMC values of all the samples except DS_{32} and DS_{36} showed very good OMMC because values are approximately above 0.6. In case of RFD samples RS_{33} showed showed very good OMMC. Also, for the fabric having the value higher than 0.8, the overall capability of the fabric is defined as excellent (DS_{27} and DS_{31}), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry.

Sample DS_{32} had the highest accumulative one-way transport index among all the investigated samples of Satin Dyed fabric (AOTI =1241) and also a good moisture management capacity (OMMC=0.56). It means that the liquid sweat can be quickly transferred from next-to-the skin to the opposite side of the fabric to keep the skin dry and provide better thermal comfort[33]. Figure 4.38 and 4.39 show example of the typical fingerprint of moisture management properties of fabric sample – DS_{27} and DS_{35} respectively.

Table 4.48 – 4.50 shows the fabric classification results of all Satin Dyed samples prepared. It can be seen that the main contributing factors to fabrics being slow-drying or quick drying are their water spreading area and the spreading speed on the outer fabric surface. A slow-drying fabric has a small spreading area and slow spreading speed on the outer fabric surface which a quick drying fabric has a large spreading area and fast spreading speed on the outer fabric surface. It is clear that with the same amount of liquid being dropped on the fabric's inner surface during the testing time, if the liquid is spreading in a large area on the inner fabric surface with high spreading speed and then quickly transported to the outer fabric surface, the liquid content on the inner fabric surface will be small and the liquid moisture will move more easily from the outer fabric surface into the environment, thus, the fabric will dry in comparatively less time (quick drying fabric)[19].

To address a mathematical relationship between the weft density, yarn tex, blend ratio and Overall Moisture Management Capacity of fabric Multiple Regression analyses were made between Overall Moisture Management Capacity and these parameters. Overall Moisture Management Capacity defined as dependent variable (Y), and weft density, yarn tex and blend ratio are defined as independent variables (X). Multiple linear regression analysis have been applied to the measured values and obtained the best fit equation using MINITAB17. To deduce whether the parameters were significant or not, p values were examined.

Table 4.51: Regression Analysis of Satin Dyed fabric: OMMC versus Weft density (PPI), Yarn Tex for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	1.183	0.158	7.50	0.000
PPI	-0.00392	0.00144	-2.72	0.011
Blend ratio				
2	0.0100	0.0515	0.19	0.847
3	0.0344	0.0515	0.67	0.508
4	-0.1656	0.0515	-3.22	0.003
Yarn Tex	-0.00899	0.00245	-3.67	0.001
S = 0.109188	R^2= 52.10%	R^2 (adjusted) = 44.11%	R^2 (predicted) = 32.14%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	0.38893	0.07779	6.53	0.000
PPI	1	0.08809	0.08809	7.39	0.011
Blend ratio	3	0.22525	0.07508	6.30	0.002
Yarn Tex	1	0.16071	0.16071	13.48	0.001
Residual Error	30	0.35763	0.01192		
Total	35	0.74656			

Table 4.52: Multiple Linear regression equation of Satin Dyed fabric: OMMC versus Weft density, Yarn Tex for each Blend ratio

Regression Equation

Blend ratio		
(Polyester/Viscose)	1	OMMC = 1.183 - 0.00392 PPI - 0.00899 Yarn Tex
(Polyester/Viscose)	2	OMMC = 1.193 - 0.00392 PPI - 0.00899 Yarn Tex
(Polyester/Viscose)	3	OMMC = 1.217 - 0.00392 PPI - 0.00899 Yarn Tex
(Polyester/Viscose/Lycra)	4	OMMC = 1.017 - 0.00392 PPI - 0.00899 Yarn Tex

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

The best regression equation for OMMC of Satin Dyed fabric for different blend ratio is given in Table 4.52. For the study, as the value of S is quite lower, the equation predicts the response much better. Together, blend ratio, yarn tex and picks per inch accounted for 52.10% of the variance in the OMMC (see table 4.51). R^2 (predicted) = 32.14%, which indicates that the model explains 32.14% of the variation in OMMC when used for prediction. The p-value for the blend ratio, yarn tex and picks per inch is less than/ equal to α-level 0.05, which means that the effect of blend ratio, yarn tex and picks per inch on OMMC is significant.

For the evaluation of the statistical importance of the air permeability, fabric weight and fabric thickness on the overall moisture management capacity of the woven fabrics, Pearson correlation was found. In order to decide the statistical significance of the variable on the related property, p value is also used. The higher the p-value, the less it can be believed that the observed relation between variables in the sample is a reliable indicator of the relation between the respective variables in the population. Pearson correlations between the air permeability and overall moisture management capacity for Satin Dyed fabrics are given in Table 4.53. Pearson correlations between the fabric weight and overall moisture management capacity for Satin Dyed fabrics are given in Table 4.54. Pearson correlations between the fabric thickness and overall moisture management capacity for Satin Dyed fabrics are given in Table 4.55.

Table 4.53: Pearson Correlation of OMMC and Air Permeability for Satin Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	0.692	0.013
20	0.528	0.078
13	0.663	0.019

Table 4.54: Pearson Correlation of OMMC and Fabric weight for Satin Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	-0.727	0.007
20	-0.654	0.021
13	-0.83	0.001

Table 4.55: Pearson Correlation of OMMC and Thickness for Satin Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	-0.644	0.024
20	-0.599	0.039
13	-0.693	0.012

The air permeability of a fabric can influence its comfort behaviour in several ways. One most important is, a material that is permeable to air is also, in general, likely to be permeable to water, in either the vapour or the liquid phase. Thus, the moisture-vapour permeability and the liquid –moisture transmission are normally closely related to air permeability. It can be observed that for all the weft counts used, correlations between fabric weight and fabric thickness and the Overall Moisture management capacity are inversely linearly related since the Pearson correlations are close to +1 and -1. Highest correlation was achieved for fabric weight in case of Satin Dyed fabrics.

4.3.2.Moisture management properties of Twill fabric samples woven using 37 Tex, 20 Tex and 13 Tex weft

Liquid moisture transport test results of ready for dyeing and dyed Twill samples of 37 Tex woven fabrics in value are given in Tables 4.56 and 4.58 respectively and the results converted into grades are given in Tables 4.57 and 4.59 respectively where grades range from 1 to 5 – poor to excellent. Liquid moisture transport test results of ready for dyeing and dyed Twill samples of 20 Tex woven fabrics in value are given in Tables 4.60 and 4.62 respectively and the results converted into grades are given in Tables 4.61 and 4.63 respectively. Liquid moisture transport test results of ready for dyeing and dyed Twill samples of 13 Tex woven fabrics in value are given in Tables 4.64 and 4.66 respectively and the results converted into grades are given in Tables 4.65 and 4.67 respectively.

Wetting time

As can be seen from Table 4.57, 4.59, and figure 4.40 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Twill fabrics woven using 37 Tex weft.

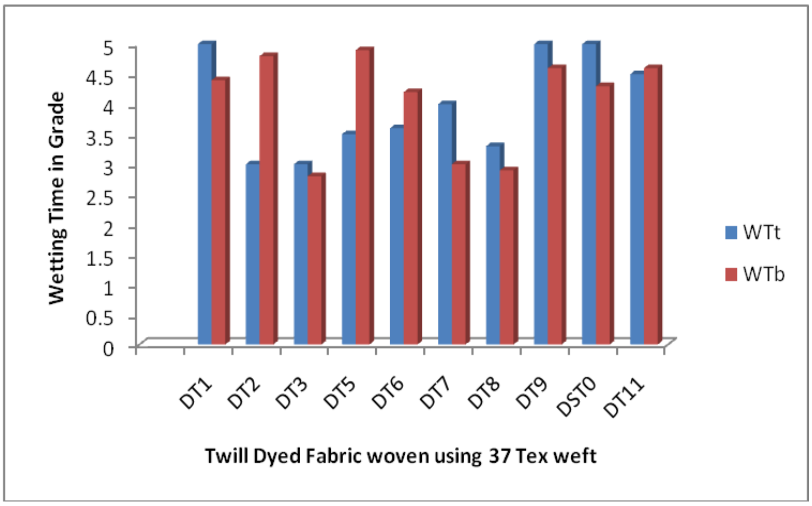

Figure 4.40: Top and bottom wetting time grade of Twill dyed fabrics woven using 37 Tex weft

Investigated Twill samples woven using 37 Tex weft demonstrated better results compared to corresponding Satin samples: fast to very fast wettability as the wetting time range from 2.74 to 3.83 seconds. DT_5 and DT_7 samples have very fast wetting time for both the surfaces due to the

Table 4.56: MMT results of ready for dyeing Twill Samples woven using 37 Tex weft

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RT_1	Mean	3.2001	3.407	54.0426	46.4433	20	20	4.0730	3.9011	65.5853	0.4710
	CV	0.0887	0.0743	0.0320	0.0130	0	0	0.0384	0.02423	0.2678	0.0410
RT_2	Mean	3.401	3.3387	41.4362	34.9022	20	20	3.7985	3.869	-14.706	0.3378
	CV	0.1872	0.2283	0.2177	0.2213	0	0	0.1391	0.1394	-0.5601	0.1718
RT_3	Mean	3.538	3.145	44.7417	39.7838	20	20	3.5278	3.7030	15.4114	0.3807
	CV	0.1175	0.1341	0.1070	0.1046	0	0	0.0604	0.07185	0.4587	0.0658
RT_5	Mean	2.9015	2.9953	53.5498	38.9322	20	20	4.1326	4.0409	172.2347	0.5758
	CV	0.0645	0.0846	0.0219	0.0235	0	0	0.0276	0.0278	0.1858	0.0570
RT_6	Mean	3.2014	3.1076	49.7735	43.1689	20	20	3.7893	3.7536	21.0456	0.4005
	CV	0.0434	0.0686	0.0232	0.0331	0	0	0.0221	0.0227	0.5113	0.0341
RT_7	Mean	2.9643	2.7457	48.9032	42.1342	20	20	3.8113	3.9436	10.5389	0.3886
	CV	0.4866	0.4688	0.4985	0.4972	0.4970	0.4971	0.4915	0.4694	0.5188	0.0357
RT_8	Mean	3.8377	4.181	63.2699	46.9924	15	15	2.9004	2.6427	-62.5273	0.2396
	CV	0.0879	0.0646	0.0327	0.0645	0	0	0.0495	0.0714	-0.1051	0.1000
RT_9	Mean	3.6312	2.8078	57.4465	22.7092	20	13	3.5441	3.2659	853.2957	0.5487
	CV	0.0667	0.2916	0.1010	0.9261	0	0.5160	0.0306	0.2221	0.9221	0.3274
RT_{10}	Mean	3.8938	3.8	46.0226	36.9934	18	17	3.2644	3.0931	-21.6452	0.2837
	CV	0.2883	0.2839	0.3385	0.2817	0.2485	0.3946	0.3224	0.4086	-0.5718	0.4110
RT_{11}	Mean	3.557	3.37	52.9240	44.9571	19	20	3.2200	3.4410	69.3017	0.4331
	CV	0.0493	0.0555	0.0181	0.0350	0.1177	0	0.0424	0.0178	0.3565	0.0500

Table 4.57: MMT results of ready for dyeing Twill Samples woven using 37 Tex weft

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RT_1	4.5	4.4	3.5	3.5	4	4	4.8	4.6	2.2	2.9
RT_2	4.5	4.7	3.2	2.8	4	4	4.3	4.7	1.7	2.3
RT_3	4.3	4.6	3.4	2.9	4	4	4	4.2	2	2.4
RT_5	5	4.6	3.5	3	4	4	5	4.8	3.4	3.4
RT_6	4.6	4.7	3.5	3.1	4	4	4.4	4.3	2	2.5
RT_7	4.7	4.8	3.5	3.0	4.0	4.0	4.3	4.3	2.0	4.7
RT_8	4	4	3.8	3.3	3	3	3.3	3.2	1	1.7
RT_9	4.2	4.6	3.6	2	4	2.6	4	3.7	3.8	3.3
RT_{10}	4.3	4.2	3.2	2.8	3.6	3.4	3.8	3.4	1.6	1.8
RT_{11}	4.1	4.3	3.5	3.2	3.8	4	3.7	4	2.3	2.6

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.58: MMT results of Dyed Twill Samples woven using 37 Tex weft

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DT_1	Mean	2.08	3.07	71.42	46.05	17.00	12.00	3.43	3.12	1484.45	0.75
	CV	0.15	0.40	0.08	0.43	0.16	0.37	0.16	0.52	0.08	0.09
DT_2	Mean	12.41	1.91	221.11	20.72	12.00	10.00	0.75	3.69	1178.61	0.72
	CV	0.24	0.53	0.56	0.51	0.37	0.00	0.28	0.37	0.16	0.09
DT_3	Mean	30.16	39.35	79.76	38.19	8.00	11.00	0.89	2.61	777.16	0.67
	CV	1.67	1.25	0.79	0.91	0.84	0.93	0.65	0.95	0.78	0.46
DT_5	Mean	7.73	2.36	76.34	27.45	16.00	10.00	1.84	2.67	988.61	0.69
	CV	0.51	0.27	0.30	0.25	0.34	0.00	0.62	0.19	0.35	0.07
DT_6	Mean	8.09	8.13	133.85	29.80	14.00	15.00	1.50	3.30	392.80	0.61
	CV	0.53	1.59	0.48	0.22	0.16	0.24	0.88	0.58	0.58	0.21
DT_7	Mean	4.43	44.90	77.57	37.15	10.00	10.00	1.63	1.94	568.34	0.67
	CV	0.52	1.45	0.19	0.87	0.50	1.00	0.56	1.00	0.55	0.30
DT_8	Mean	9.30	50.19	46.96	7.11	5.00	6.00	0.54	1.13	-239.65	0.06
	CV	0.22	1.27	0.26	0.98	0.00	0.91	0.20	0.96	-0.76	1.07
DT_9	Mean	1.93	4.06	72.70	58.31	15.00	14.00	3.24	2.87	901.63	0.79
	CV	0.22	1.05	0.06	0.23	0.00	0.16	0.21	0.24	0.09	0.05
DT_{10}	Mean	1.82	14.45	68.87	50.42	14.00	11.00	3.15	2.33	560.53	0.72
	CV	0.19	1.86	0.19	0.38	0.39	0.20	0.17	0.46	0.29	0.20
DT_{11}	Mean	3.82	2.96	66.99	39.05	15.00	15.00	2.04	2.15	218.77	0.48
	CV	0.71	0.39	0.24	0.29	0.00	0.00	0.33	0.27	0.48	0.33

Table 4.59: MMT results of Dyed Twill Samples woven using 37 Tex weft

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DT_1	5	4.4	4	3.2	3.4	2.4	4.1	3.3	5	4.4
DT_2	3	4.8	4.4	2	2.4	2	1.1	4	5	4.2
DT_3	3	2.8	3.6	2.6	1.8	2.6	1.5	3.2	4.6	3.9
DT_5	3.5	4.9	4.1	2.5	3.2	2	2.3	3.1	5	3.9
DT_6	3.6	4.2	4.5	2.4	2.8	3	1.8	3.6	4.2	3.6
DT_7	4.00	3.00	4.17	2.67	2.00	2.33	2.00	2.67	4.83	4.00
DT_8	3.3	2.9	3.1	1.3	1	1.6	1	1.8	1.2	1
DT_9	5	4.6	4	3.6	3	2.8	3.7	3.4	5	4.6
DS_{T0}	5	4.3	3.9	3.4	2.8	2.2	3.7	2.8	4.9	4.2
DT_{11}	4.5	4.6	3.8	2.9	3	3	2.5	2.8	3.6	3

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

Table 4.60: MMT results of ready for dyeing Twill Samples woven using 20 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RT_{13}	Mean	2.4522	2.7332	50.5203	43.1179	25	25	5.7315	5.5032	29.0985	0.4300
	CV	0.1818	0.0445	0.1251	0.1288	0	0	0.0617	0.0380	3.3473	0.2186
RT_{14}	Mean	3.014	3.0142	54.0782	45.4771	22	24	4.5282	4.6220	-32.0805	0.3685
	CV	0.0260	0.0461	0.0254	0.0219	0.1245	0.0932	0.0522	0.0423	-0.0741	0.0121
RT_{15}	Mean	3.0332	3.1638	47.0880	42.3956	21	21	4.3429	4.2454	-10.0322	0.3793
	CV	0.0805	0.1074	0.1706	0.1364	0.1065	0.1065	0.0875	0.1043	-0.7888	0.0544
RT_{16}	Mean	4.4322	4.752	53.1257	40.3333	16.25	16	4.0106	3.7895	-79.4582	0.8629
	CV	0.1671	0.1658	0.6627	0.6608	0.4615	0.5	0.1907	0.2351	-0.7020	1.2665
RT_{17}	Mean	3.295	2.827	52.1719	30.3687	20	19	3.5959	3.5148	685.9064	0.7154
	CV	0.0616	0.1805	0.0593	0.6180	0	0.1177	0.0494	0.1179	0.4787	0.1317
RT_{18}	Mean	3.0324	3.1448	56.1801	46.4563	22	21	4.3583	4.1995	-47.3857	0.3549
	CV	0.0352	0.04	0.0127	0.0267	0.1245	0.1065	0.0461	0.0449	-0.1136	0.0206
RT_{19}	Mean	3.6692	3.8186	47.3389	47.6200	20	20	3.5561	3.5468	1.5460	0.3740
	CV	0.1879	0.1878	0.1947	0.1887	0	0	0.1160	0.0905	7.8368	0.1078
RT_{20}	Mean	4.181	4.7427	86.4220	54.8894	20	20	3.4551	3.0467	-185.6860	0.2953
	CV	0.2393	0.2337	0.2148	0.2309	0	0	0.1994	0.2179	-0.3435	0.3027
RT_{21}	Mean	4.624	4.624	61.8725	16.7075	16	9	2.5481	2.2449	1286.6393	0.4843
	CV	0.2622	0.8452	0.1034	1.3733	0.2615	0.7244	0.3313	0.5834	0.5839	0.1555
RT_{22}	Mean	3.4818	3.5006	61.5162	48.3227	20	20	3.6024	3.5334	-50.5958	0.3203
	CV	0.0669	0.0554	0.0256	0.0154	0	0	0.0424	0.0486	-0.1647	0.0329
RT_{23}	Mean	3.8562	3.9686	56.8062	39.5159	20	20	3.1609	3.1558	203.5128	0.5433
	CV	0.1377	0.1340	0.0504	0.2150	0	0	0.1012	0.0876	0.8587	0.3449
RT_{24}	Mean	5.1106	5.8408	90.4131	47.1628	18	17	2.3538	2.2315	-278.4191	0.2059
	CV	0.1983	0.3798	0.1065	0.1908	0.1521	0.1611	0.2557	0.2392	-0.1060	0.3368

Table 4.61: MMT results of ready for dyeing Twill Samples woven using 20 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RT_{13}	5	5	3.4	3.1	5	5	5	5	2.2	3
RT_{14}	4.8	4.8	3.5	3.4	4.4	4.8	5	5	1.5	2.5
RT_{15}	4.9	4.7	3.3	3	4.2	4.2	4.9	4.8	1.8	2.4
RT_{16}	4.2	3.8	3.8	3.5	4.3	4	4.2	4.2	1	2
RT_{17}	4.6	4.8	3.5	2.5	4	3.8	4.1	4.1	4.6	4.3
RT_{18}	4.8	4.6	3.5	3.4	4.4	4.2	5	5	1.4	2.4
RT_{19}	4.3	4.1	3.3	3.3	4	4	4.1	4.1	1.9	2.4
RT_{20}	4	3.8	4.5	3.5	4	4	4	3.5	1	2
RT_{21}	3.9	4.4	3.7	1.5	3.2	1.8	3.1	2.8	4.3	3.2
RT_{22}	4.2	4.3	3.6	3.5	4	4	4.1	4	1.2	2
RT_{23}	4	4	3.5	3	4	4	3.6	3.5	3.3	3.2
RT_{24}	3.7	3.6	4.4	3.3	3.6	3.4	2.9	2.8	1	1.4

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.62: MMT results of Dyed Twill Samples woven using 20 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DT_{13}	Mean	10.76	13.04	180.19	19.38	11.67	10.00	1.13	1.37	1162.08	0.57
	CV	0.29	1.07	0.96	0.74	0.49	0.00	0.61	0.49	0.31	0.12
DT_{14}	Mean	10.54	3.52	206.23	17.32	14.00	15.00	0.93	2.96	958.13	0.67
	CV	0.23	0.67	0.82	0.51	0.30	0.33	0.22	0.47	0.14	0.12
DT_{15}	Mean	7.25	5.30	63.71	65.87	16.00	23.00	1.93	4.17	549.46	0.90
	CV	0.61	0.43	0.17	0.10	0.14	0.12	0.40	0.11	0.09	0.02
DT_{16}	Mean	9.70	4.62	244.27	11.85	5.00	10.00	0.54	1.41	485.88	0.40
	CV	0.31	0.20	0.65	0.99	0.00	0.00	0.23	0.16	0.84	0.62
DT_{17}	Mean	3.58	5.00	74.81	52.93	14.00	14.00	2.14	2.99	1325.30	0.78
	CV	0.37	0.59	0.13	0.24	0.16	0.16	0.18	0.25	0.10	0.09
DT_{18}	Mean	9.88	3.70	248.51	22.25	12.50	12.50	1.37	2.77	857.68	0.66
	CV	0.68	0.75	0.69	0.40	0.23	0.40	0.94	0.62	0.33	0.17
DT_{19}	Mean	1.82	3.89	60.41	53.65	17.00	18.00	3.28	2.60	449.24	0.75
	CV	0.07	0.18	0.12	0.09	0.16	0.15	0.12	0.21	0.12	0.08
DT_{20}	Mean	8.48	16.25	319.94	8.18	8.00	9.00	0.61	1.20	-103.11	0.29
	CV	0.05	1.16	0.39	0.43	0.34	0.25	0.07	0.63	-7.28	0.89
DT_{21}	Mean	1.95	2.47	74.35	52.76	17.00	12.00	3.27	2.49	685.86	0.74
	CV	0.16	0.14	0.24	0.07	0.16	0.23	0.09	0.10	0.08	0.03
DT_{22}	Mean	1.63	3.31	63.94	57.11	16.00	14.00	3.44	2.29	364.90	0.70
	CV	0.10	0.40	0.12	0.11	0.14	0.16	0.06	0.33	0.06	0.07
DT_{23}	Mean	6.04	29.58	112.70	21.74	13.75	12.50	1.59	1.86	473.75	0.59
	CV	0.62	1.82	0.67	0.69	0.46	0.52	0.50	0.63	0.35	0.22
DT_{24}	Mean	9.88	10.22	277.88	6.03	6.00	10.00	0.56	1.52	231.87	0.34
	CV	0.44	0.71	0.63	0.27	0.37	0.00	0.30	0.71	0.90	0.62

Table 4.63: MMT results of Dyed Twill Samples woven using 20 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DT_{13}	3.2	3.5	4.3	2.0	2.3	2.0	1.7	1.7	5.0	3.3
DT_{14}	3.2	4.4	4.5	1.7	2.8	3	1.3	3.4	5	3.8
DT_{15}	3.8	3.9	3.8	3.8	3.2	4.6	2.4	4.7	5	5
DT_{16}	3.3	3.8	5	1.3	1	2	1	1.9	3.9	2.6
DT_{17}	4.2	3.9	4.1	3.5	2.8	2.8	2.7	3.6	5	4.5
DT_{18}	3.5	4.4	4.8	2.1	2.5	2.5	1.8	3.0	5.0	3.9
DT_{19}	5	4.1	3.7	3.5	3.4	3.6	3.8	3	4.9	4.5
DT_{20}	3.3	3.3	5	1.1	1.6	1.8	1	1.7	3.1	2.1
DT_{21}	5	5	4.1	3.5	3.4	2.4	3.8	3	5	4.2
DT_{22}	5	4.4	3.8	3.6	3.2	2.8	3.9	2.8	4.3	3.9
DT_{23}	4.0	4.1	4.3	2.0	2.8	2.5	2.1	2.5	4.8	3.5
DT_{24}	3.2	3.3	5	1	1.2	2	1	2	3.3	2.2

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

Table 4.64: MMT results of ready for dyeing Twill Samples woven using 13 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
RT_{25}	Mean	2.3586	2.6772	54.971	44.6229	28	26	6.7827	6.1955	51.2037	0.4586
	CV	0.2563	0.0913	0.1158	0.0925	0.0978	0.0860	0.1379	0.0778	0.9849	0.0982
RT_{26}	Mean	2.9017	3.089	52.4523	43.1659	26.6667	25	5.7387	5.6070	-53.2161	0.3494
	CV	0.0855	0.1094	0.1672	0.1523	0.1083	0	0.1014	0.0606	-0.3733	0.0161
RT_{27}	Mean	2.8266	2.8638	54.1375	47.6290	25	25	5.6397	5.5352	-39.5127	0.3662
	CV	0.0545	0.0373	0.0113	0.0058	0	0	0.0299	0.0306	-0.0802	0.0079
RT_{28}	Mean	4.1186	4.4623	81.5242	54.1076	21.6667	21.6667	4.1525	3.7875	-136.4543	0.3314
	CV	0.2168	0.1949	0.0960	0.1172	0.1332	0.1332	0.2239	0.2463	-0.2110	0.1646
RT_{29}	Mean	2.9952	2.0592	60.2539	7.887	20	14	4.1429	3.7746	1080.10722	0.6863
	CV	0.0443	0.0455	0.0185	0.1195	0	0.5868	0.0230	0.4320	0.0526	0.1264
RT_{30}	Mean	3.1262	3.1072	59.7660	50.8269	24	23	4.5982	4.4079	-57.0656	0.36342
	CV	0.0341	0.0135	0.0133	0.0715	0.0932	0.1191	0.0182	0.0814	-0.0727	0.0278
RT_{31}	Mean	3.7064	3.8372	57.6298	50.0822	21	22	3.5229	3.5615	84.0656	0.4738
	CV	0.0139	0.0752	0.0496	0.2510	0.1065	0.1245	0.0762	0.0685	1.7071	0.2994
RT_{32}	Mean	4.886	5.1106	86.1462	53.0946	20	18	2.9543	2.6052	-246.4811	0.2535
	CV	0.3955	0.3411	0.1318	0.3348	0.1767	0.1521	0.2940	0.2828	-0.1815	0.4199
RT_{33}	Mean	3.3136	2.2464	57.2637	8.4540	17	7	3.0201	2.7694	1828.5687	0.5563
	CV	0.2973	0.1614	0.0932	0.2028	0.2631	0.3912	0.3132	0.3995	0.1038	0.5206
RT_{34}	Mean	3.627	3.791	58.3996	40.0716	22.5	22.5	-5.8586	4.1192	-91.5753	0.2944
	CV	0.4516	0.4546	0.1254	0.2137	0.1283	0.1283	-3.3035	0.3783	-0.4295	0.1952
RT_{35}	Mean	3.5946	3.145	58.1658	32.3053	22	22	3.4711	3.6423	192.4641	0.5515
	CV	0.0143	0.2274	0.0512	0.3037	0.1245	0.1245	0.0601	0.0814	0.6932	0.2512
RT_{36}	Mean	4.727	5.1718	88.2634	52.5807	17.5	16.25	2.4707	2.2152	-302.0650	0.2195
	CV	0.1916	0.1559	0.2234	0.1843	0.1650	0.1538	0.2564	0.2650	-0.1420	0.3009

Table 4.65: MMT results of ready for dyeing Twill Samples woven using 13 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
RT_{25}	5	5	3.4	3.4	5	5	5	5	2.2	2.7
RT_{26}	4.8	4.8	3.3	3.3	5	5	5	5	1.2	2.3
RT_{27}	4.9	5	3.5	3.5	5	5	5	5	1.5	2.5
RT_{28}	3.8	3.8	4.2	3.5	4.3	4.3	4.3	4.2	1	2.2
RT_{29}	4.8	5	3.5	1	4	2.8	5	3.9	5	4
RT_{30}	4.6	4.5	3.5	3.5	4.8	4.6	5	5	1	2.5
RT_{31}	4	4	3.5	3.4	4.2	4.4	4	4.1	2.5	2.8
RT_{32}	3.9	3.7	4.3	3.4	4	3.6	3.4	3.2	1	1.7
RT_{33}	4.3	5	3.5	1.1	3.4	1.4	3.5	3.3	5	3.8
RT_{34}	4.1	4.1	3.6	3	4.5	4.5	3.6	4.3	1	2
RT_{35}	4	4.5	3.5	2.5	4.4	4.4	4	4.1	3.2	3.2
RT_{36}	3.8	3.6	4.4	3.8	3.5	3.3	3	2.8	1	1.4

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity)

Table 4.66: MMT results of Dyed Twill Samples woven using 13 Tex weft in value

Fabric		WTt (sec)	WTb (sec)	ARt (%/sec)	ARb (%/sec)	MWRt (mm)	MWRb (mm)	SSt (mm/sec)	SSb (mm/sec)	AOTI (%)	OMMC
DT_{25}	Mean	3.78	2.32	80.26	59.11	18.00	18.00	3.04	4.15	1218.52	0.86
	CV	0.92	0.29	0.65	0.32	0.15	0.15	0.27	0.26	0.09	0.07
DT_{26}	Mean	7.30	8.37	106.58	40.87	15.00	17.00	1.46	3.00	574.27	0.69
	CV	0.74	1.31	0.50	0.39	0.24	0.26	0.62	0.47	0.65	0.16
DT_{27}	Mean	2.70	3.97	40.87	62.90	21.00	24.00	2.61	5.12	544.82	0.90
	CV	0.30	0.50	0.11	0.10	0.11	0.09	0.22	0.16	0.15	0.02
DT_{28}	Mean	9.30	24.34	332.13	6.18	5.00	10.00	0.54	0.84	475.95	0.39
	CV	0.19	1.20	0.34	0.46	0.00	0.35	0.16	1.24	0.77	0.49
DT_{29}	Mean	3.46	28.46	65.24	44.43	15.00	12.00	2.32	1.49	594.48	0.66
	CV	0.53	1.80	0.11	0.56	0.41	0.56	0.40	0.59	0.11	0.14
DT_{30}	Mean	4.79	27.97	182.74	48.13	14.00	16.00	2.17	2.83	556.80	0.71
	CV	0.78	1.84	0.98	0.57	0.39	0.56	0.62	0.72	0.34	0.33
DT_{31}	Mean	4.46	6.85	89.38	49.71	17.00	20.00	2.35	2.37	224.97	0.52
	CV	0.81	1.06	0.51	0.14	0.16	0.35	0.51	0.32	1.20	0.53
DT_{32}	Mean	11.27	6.72	491.74	8.66	8.00	11.00	0.47	1.45	5.11	0.21
	CV	0.13	0.50	0.27	0.20	0.34	0.20	0.12	0.75	56.22	0.87
DT_{33}	Mean	1.91	4.29	76.75	58.42	17.00	13.00	3.27	2.21	564.04	0.74
	CV	0.10	0.63	0.23	0.14	0.16	0.21	0.11	0.19	0.11	0.04
DT_{34}	Mean	1.78	2.79	74.52	53.92	16.00	14.00	3.33	2.38	356.20	0.69
	CV	0.19	0.23	0.03	0.12	0.14	0.30	0.19	0.22	0.06	0.08
DT_{35}	Mean	7.42	4.89	91.85	48.74	15.00	10.00	1.61	2.12	365.18	0.65
	CV	0.52	0.83	0.19	0.22	0.00	0.00	0.53	0.14	0.13	0.10
DT_{36}	Mean	10.04	7.14	384.58	9.23	8.75	10.00	0.55	1.46	-16.47	0.14
	CV	0.24	0.13	0.51	0.33	0.29	0.00	0.22	0.62	-8.37	1.14

Table 4.67: MMT results of Dyed Twill Samples woven using 13 Tex weft in grade

Fabric	WTt	WTb	ARt	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
DT_{25}	4.6	4.9	3.9	3.6	3.6	3.6	3.6	4.5	5	5
DT_{26}	3.9	4.1	4.4	3	3	3.4	1.8	3.3	4.7	4
DT_{27}	4.7	4.2	3.1	3.7	4.2	4.8	3.1	5	5	5
DT_{28}	3.3	3.1	5	1	1	2	1	1.5	4.1	2.5
DT_{29}	4.5	3.1	3.8	3	3	2.6	2.9	2.1	5	3.7
DT_{30}	4.2	3.4	4.3	3.1	2.8	3.4	2.7	3.2	4.7	4.2
DT_{31}	4.3	4	4.1	3.4	3.4	3.8	2.8	2.9	3.3	3.2
DT_{32}	3	3.5	5	1.1	1.6	2.2	1	1.9	2.3	1.6
DT_{33}	5	4.3	4.2	3.6	3.4	2.6	3.8	2.6	5	4.2
DT_{34}	5	4.8	4	3.6	3.2	2.8	3.8	2.9	4.3	3.9
DT_{35}	3.6	4.4	4.4	3.3	3.0	2.0	2.1	2.6	4.4	3.8
DT_{36}	3.3	3.5	5.0	1.4	1.8	2.0	1.0	1.9	1.8	1.5

(WTt: Wetting time on top surface; WTb: Wetting time on bottom surface; ARt: Top absorption rate; ARb: Bottom absorption rate; MWRt: Top maximum wetted radius; MWRb: Bottom maximum wetted radius; SSt: Top spreading speed; SSb: Bottom spreading speed; AOTI: Accumulative one-way transport index; OMMC: Overall moisture management capacity).

high attraction between the liquid and the fibre surface (known as the fibre surface energy: Viscose 200mJm^2; Polyester 43mJm^2).

It is interesting to observe the differential behavior of the top and bottom surfaces of the Twill dyed fabric woven using 37 Tex weft: a comparison of the wetting time of the top surface (WTt) and that of the bottom surface (WTb) shows that the for samples DT_1, DT_2, DT_8, WTt is smaller than the WTb, suggesting that it took longer for the liquid water to be transferred to the bottom layer. These phenomena could be due to the factor that the moisture diffusion into a fabric through air gaps between yarns and fibers is a fast process, while moisture diffusion into fibres is coupled with the heat-transfer process, which is much slower and is dependent on the ability of fibres to absorb moisture[145]. It is notable that fabric DT_7 has the smallest mean WTb, demonstrating that it has a better liquid transfer ability from the top to the bottom layer. It can be observed that WTb values for the blend ratio of Polyester/Viscose 60/40 are highest among all blends studied for 37 Tex weft yarn.

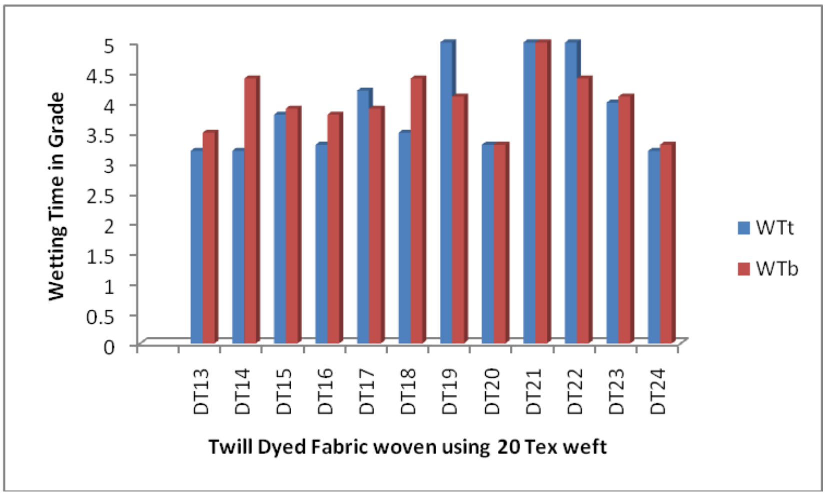

Figure 4.41: Top and bottom wetting time grade of Twill dyed fabrics woven using 20 Tex weft

As can be seen from Table 4.60, 4.62, and figure 4.41 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Twill fabrics woven using 20 Tex weft.

Investigated Twill samples woven using 20 Tex weft demonstrated: slow to very fast wettability as the wetting time range from 1.63 to 29.58 seconds. DT_{21} sample had very fast wetting time for both the surfaces due to the high attraction between the liquid and the fibre surface (known as the fibre surface energy: Viscose 200mJm^2; Polyester 43mJm^2).

It is interesting to observe the differential behavior of the top and bottom surfaces of the Twill dyed fabric woven using 20 Tex weft: a comparison of the wetting time of the top surface (WTt) and that of the bottom surface (WTb) shows that the for samples DT_{13}, DT_{17}, DT_{19}, DT_{20}, DT_{21}, DT_{22}, DT_{23} and DT_{24} WTt is smaller than the WTb, suggesting that it took longer for the liquid water to be transferred to the bottom layer[145]. It is notable that fabric DT_{21} has the smallest mean WTb, demonstrating that it has a better liquid transfer ability from the top to the bottom layer. It can be stated that finer the yarn, the lower the wetting time is. As the yarns get finer the thickness of the fabric decreases. When the results for 37Tex and 20 Tex fabrics from same blend proportion 75/25 compared, thinner fabrics shown faster WTb than thicker ones, when equal amount of water are applied. Since the number of fibres in finer yarns is less than coarse yarns, time of wetting decreases as well. So the fabric can be easily wetted by the liquid.

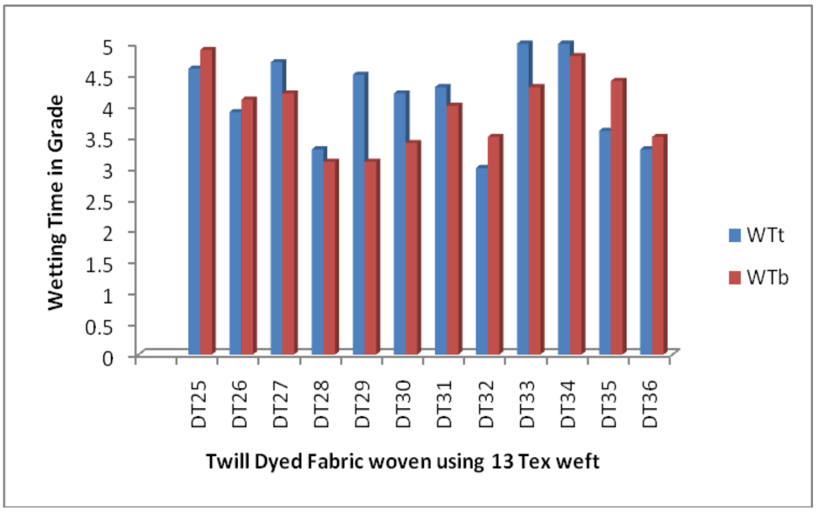

Figure 4.42: Top and bottom wetting time grade of Twill dyed fabrics woven using 13 Tex weft

As can be seen from Table 4.64, 4.66, and figure 4.42 the wetting time changes according to weft density and blend ratio on the top and bottom surfaces for both ready for dyeing and dyed Twill fabrics woven using 13Tex weft.

Investigated Twill samples woven using 13 Tex weft demonstrated: slow to very fast wettability similar to what observed in fabrics woven with 20 Tex weft as the wetting time range from 1.78 to 28.46 seconds. DT_{34} sample had very fast wetting time for both the surfaces due to the high attraction between the liquid and the fibre surface (known as the fibre surface energy: Viscose 200mJm^2; Polyester 43mJm^2).

However, it is interesting to observe the differential behavior of the top and bottom surfaces of the Twill dyed fabric woven using 13Tex weft: a comparison of the wetting time of the top surface (WTt) and that of the bottom surface (WTb) shows that the for samples DT_{26}, DT_{27}, DT_{28}, DT_{29}, DT_{31}, DT_{33}, and DT_{34} WTt is smaller than the WTb, suggesting that it took longer for the liquid water to be transferred to the bottom layer[146]. It is notable that fabric DT_{34} has the smallest mean WTb, demonstrating that it has a better liquid transfer ability from the top to the bottom layer.

Absorption rates

It can also be seen from Table 4.56, 4.58 and figure 4.43, that the absorption rate values change according to the weft density and blend ratio. As can be seen from Table 4.56 and 4.58, the bottom absorption rates of the Twill dyed fabrics woven using 37Tex weft are generally lower than top surfaces as observed in their counterparts of Satin fabrics.

As can be seen from Table 4.60 and 4.62, and figure 4.44 the bottom absorption rates of the Satin dyed fabrics woven using 20Tex weft are generally lower than top surfaces (except DT_{15}). Fabric DT_{20} have an extraordinarily higher absorption rate on top layer surface (ARt) which may be because of the liquid water accumulating on the top layer surface for a very short while, causing an obvious increase in the water content of the top surface (see figure 4.44).

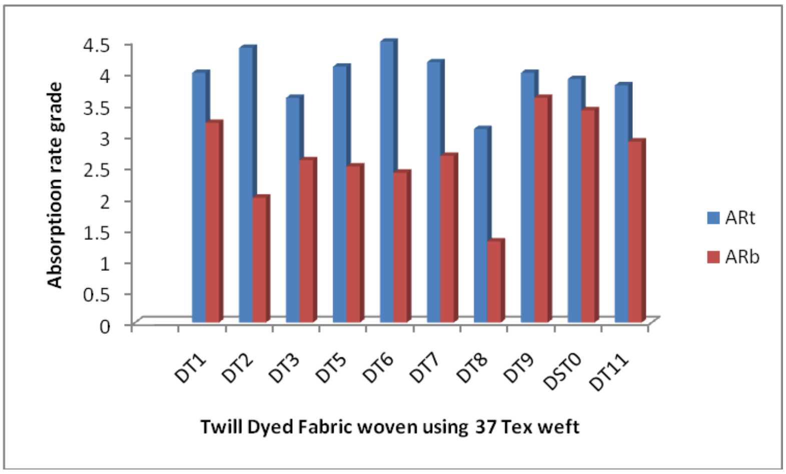

Figure 4.43: Top and bottom absorption rate grades of Twill dyed fabrics woven using 37 Tex

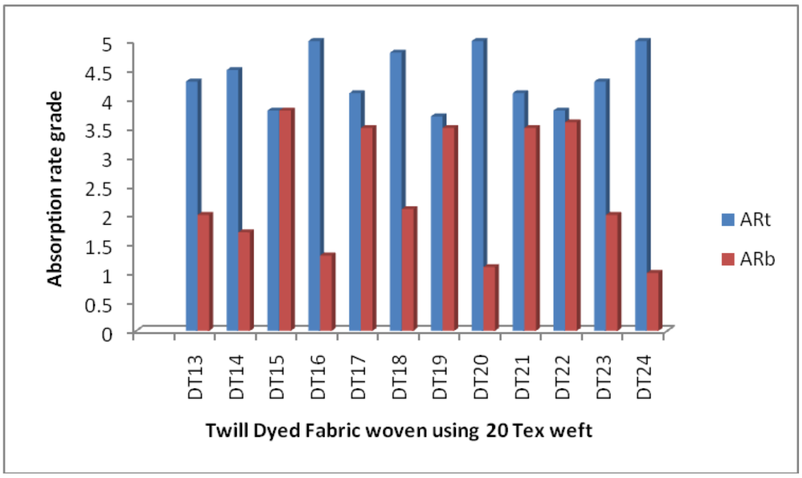

Figure 4.44: Top and bottom absorption rate grades of Twill dyed fabrics woven using 20 Tex

As can be seen from Table 4.64 and 4.66, and figure 4.45 the bottom absorption rates of the Satin dyed fabrics woven using 13Tex weft are generally lower than top surfaces (except DT_{27}). Fabric DT_2 , DT_{13}, DT_{14}, DT_{16}, DT_{18}, DT_{20}, DT_{24}, DT_{28}, DT_{32} and DT_{36} have an extraordinarily higher absorption rate on top layer surface (ARt) which may be because of the liquid water accumulating on the top layer surface for a very short while, causing an obvious increase in the water content of the top surface (see figure 4.43, 4.44 and 4.45).

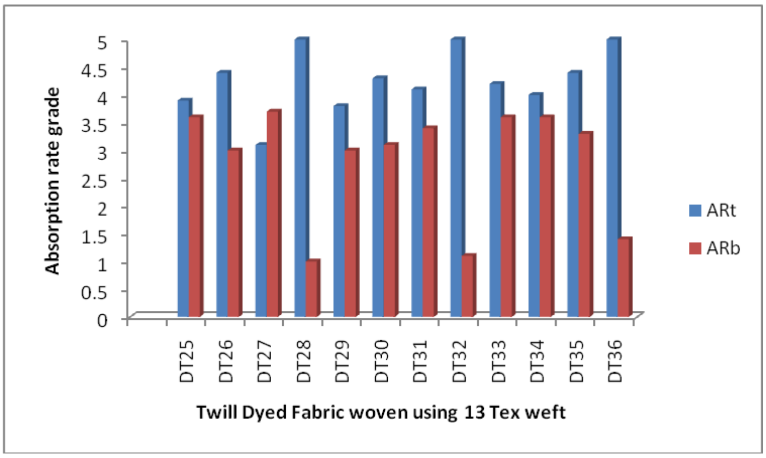

Figure 4.45: Top and bottom absorption rate grades of Twill dyed fabrics woven using 13 Tex

The absorption rate of the bottom surface of the DT_{27} higher than those of the top surface. This indicates that most of the liquid moisture gets distributed on the bottom surface of the fabric. Overall all the Twill samples shows absorption rate ranging from very slow to very fast as observed with Satin fabrics.

Spreading speed

Figure 4.46, 4.47 and 4.48 shows the top and bottom spreading speed grades of Twill dyed fabric woven with 37Tex, 20 Tex and 13 Tex weft, respectively.

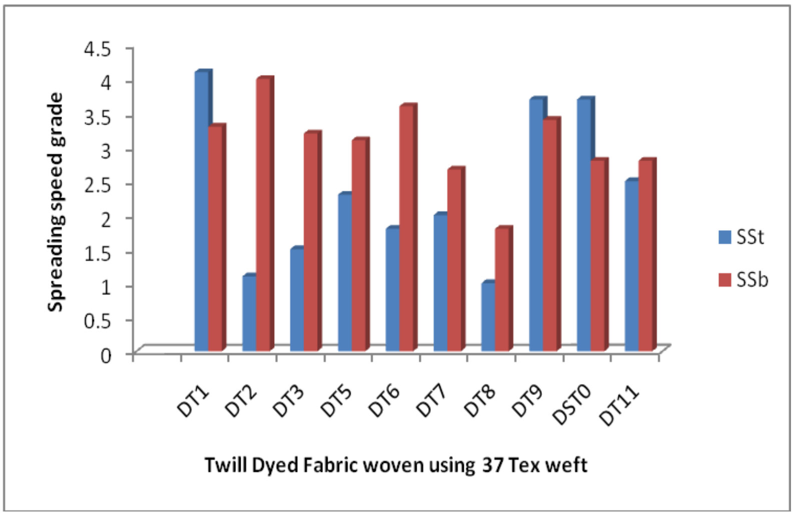

Figure 4.46: Top and bottom spreading speed grades of Twill dyed fabrics woven using 37 Tex weft

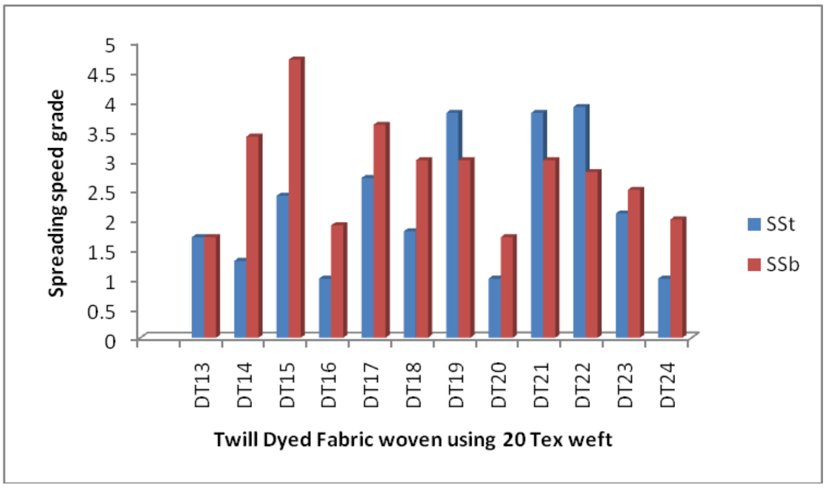

Figure 4.47: Top and bottom spreading speed grades of Twill dyed fabrics woven using 20Tex weft

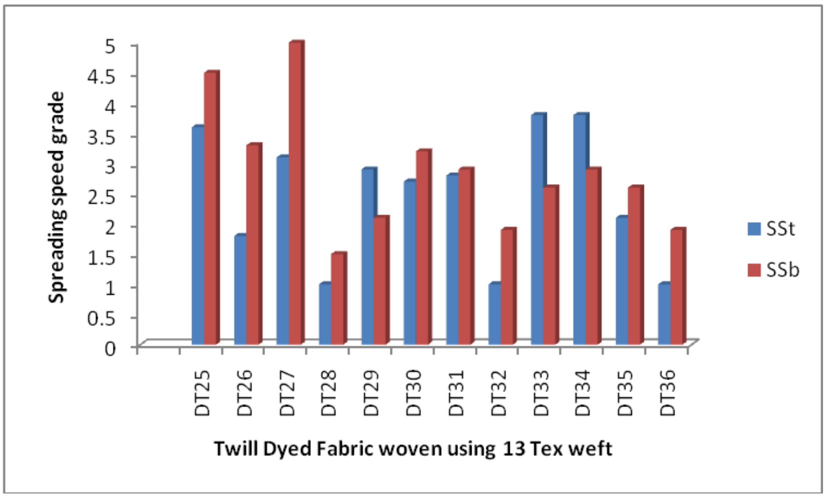

Figure 4.48: Top and bottom spreading speed grades of Twill dyed fabrics woven using 13Tex weft

Overall spreading speed for Polyester/Viscose 45/55 blend fabrics are better than 75/25 and 60/40 blended fabrics observed for all the three fineness of weft, which holds when the yarns are finer, the wetting time decreases as mentioned before, consequently spreading speed for the wetting of the fabric shorten. Fabric DT_{27} has medium to very fast spreading speed grade among others. Spreading speed on top and bottom decreases with the increase in the weft density.

Similar to Satin, Twill woven fabrics with blend ratio 75/20/5 also shows very slow spreading speeds on both top and bottom surfaces due to low proportion of Viscose fibre compared to other blends in all the three counts. Investigated Twill fabrics shown very slow to very fast spreading speed grades. As the spreading speed values are compared it can be clearly seen that, higher the yarn count, higher the spreading speed is.

Maximum wetted radius

Analyzing the data presented in figure 4.49, figure 4.50 and figure 4.51 it can be noticed that the DT_3 and DT_{27} have a large maximum wetted radius on the bottom surface, suggesting that this fabric had transferred and distributed more liquid water in the bottom layer than in the top layer; indicating that this fabric had a moisture management ability. It can also be noticed that the sample DT_{25}, and DT_{27} have a large maximum wetted radius on the top surface, indicating that liquid sweat can be easily transported with a large wetted area by capillary forces.

Figure 4.49: Top and bottom maximum wetted radius grades of Twill dyed fabrics of 37 Tex weft

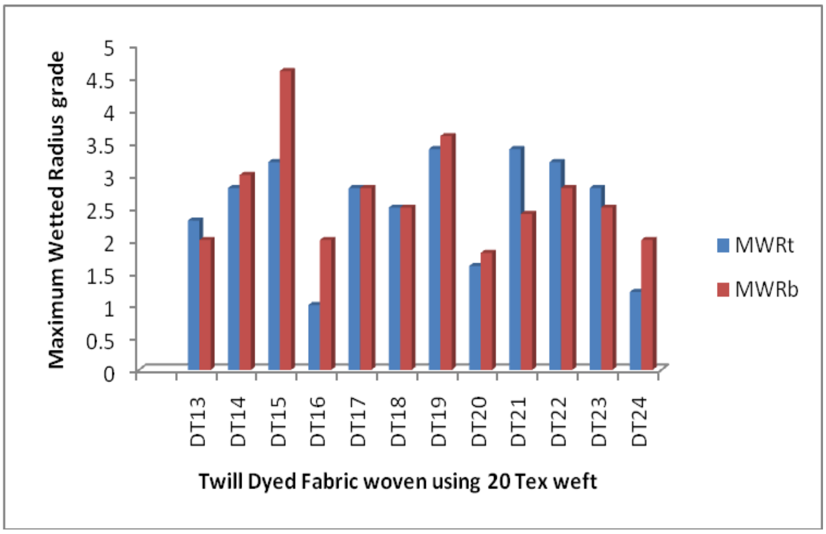

Figure 4.50: Top and bottom maximum wetted radius grades of Twill dyed fabrics of 20Tex weft

Since Fabric DT_8, DT_{16}, DT_{24}, and DT_{28} have the lowest top wetted radius values, which also indicate their good moisture transport property, they will give a dry feeling. Maximum wetted radius of top surface and spreading speed of top and bottom surface poor (DT_8): can be attributed to the inert nature of Polyester fibres due to their high crystalline molecular structure and lack of reactive groups. Accordingly, this prevents spreading of the liquid through-plane.

Analyzing the data presented in figure 4.51, it can be noticed that Twill samples woven with 13 Tex weft have the best maximum wetted radius on both the surfaces.

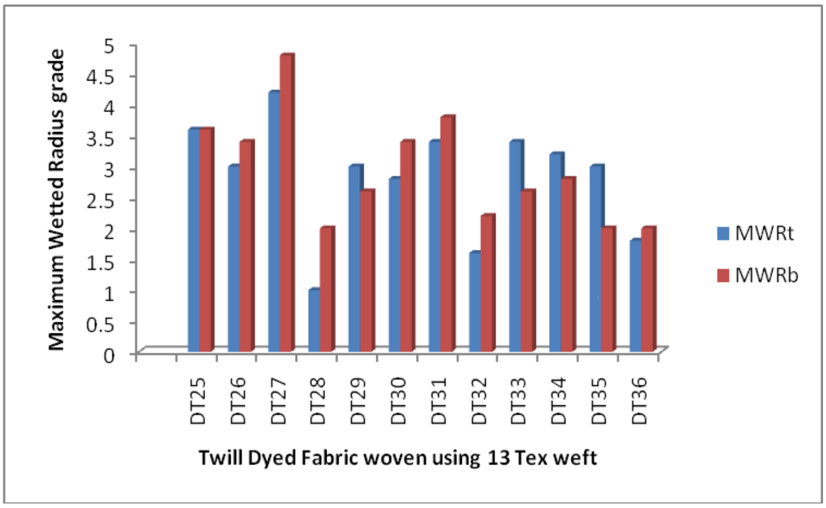

Figure 4.51: Top and bottom maximum wetted radius grades of Twill dyed fabrics of 13Tex weft

Accumulative one-way transport index grades and overall moisture management capacity

Water location versus time can be obtained as a colourful simulation which is given in figure 4.52 and figure 4.53 for DT_1 and DT_8 respectively. Figure 4.54 and 4.55 (see appendix) shows the typical liquid moisture content change versus test time on the fabrics top layer measured by the MMT for Satin dyed fabric DT_1 and DT_8 respectively woven with 37 Tex weft. Figure 4.56 shows the accumulative one-way transport index grades and overall moisture management capacity of the Satin dyed fabrics woven with 37 Tex weft.

Accumulative one-way transport index exhibits the liquid transport from top surface to bottom surface of fabric. If the AOTI value of one fabric is between 200 and 400 it means that the one-way transport is very good. Also for the fabric having the value higher than 400, one-way transport is defined as excellent. In light of this knowledge when table 4.56 and 4.58 examined AOTI values of all the samples except DT_6, DT_8 and DT_{11} showed excellent AOTI because values are approximately above 400. In case of RFD RT_5 showed good and RT_9 showed excellent AOTI.

When table 4.56 examined OMMC values of all samples except DT_8 and DT_{11} showed very good OMMC because values are approximately above 0.6. In case of RFD RT_5 and RT_9 showed good OMMC. Table 4.58 and figure 4.56 reveal that almost all fabrics (except DT_8) have the highest liquid moisture management capacity (OMMC is very good to good) and accumulative one-way transport index (AOTI is excellent to very good), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry.

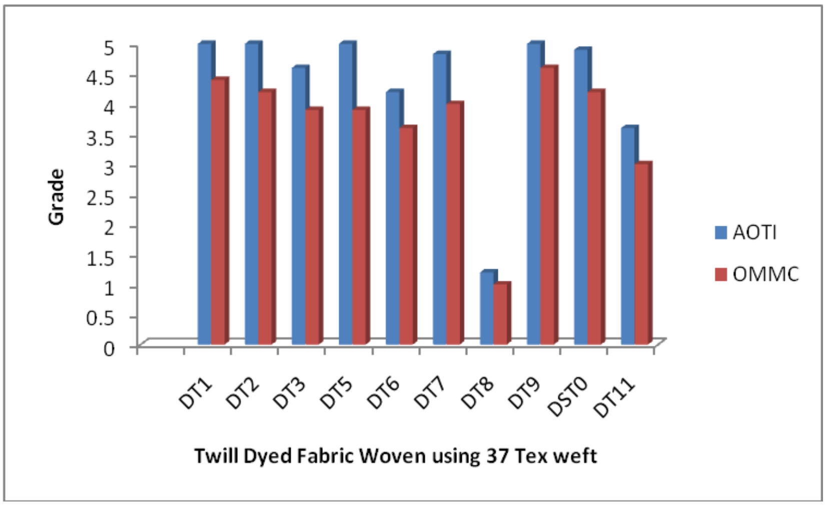

Figure 4.56: Accumulative one-way transport index grades and overall moisture management capacity of the Twill dyed fabrics of 37 Tex weft

Fabric having poor liquid moisture management properties with a very low wetted radius and spreading rates on the bottom surface, as well as negative accumulative one-way transport capacities (DT_8) indicate that the liquid (sweat) cannot diffuse easily from the next-to-skin surface to the opposite side and will accumulate on the top surface of the fabric[159].

Sample DT_1 had the highest accumulative one-way transport index (AOTI =1484) and also a high moisture management capacity (OMMC=0.75). It means that the liquid sweat can be quickly transferred from next-to-the skin to the opposite side of the fabric to keep the skin dry and provide better thermal comfort. Figure 4.57 and 4.58 (see appendix) show example of the typical fingerprint of moisture management properties of fabric sample – DT_1 and DT_8 respectively.

Figure 4.60 shows the accumulative one-way transport index grades and overall moisture management capacity of the Twill dyed fabrics woven with 20 Tex weft.

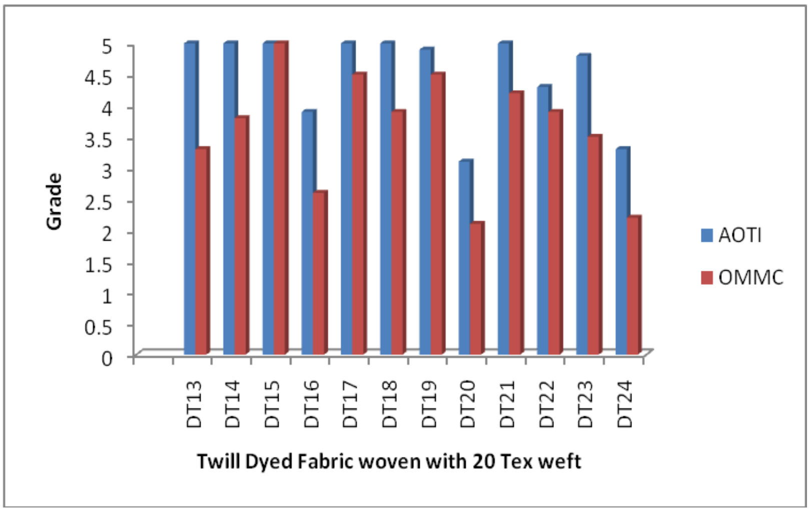

Figure 4.60: Accumulative one-way transport index grades and overall moisture management capacity of the Twill dyed fabrics of 20 Tex weft

It can be noticed from table 4.60 and 4.62, AOTI values of all the samples except DT_{20}, DT_{22} and DT_{24} showed excellent AOTI because values are approximately above 400. In case of RFD RT_{17} and RT_{21} showed excellent and RT_{23} showed good AOTI. OMMC values of DT_{14}, RT_{17}, DT_{17}, DT_{18}, DT_{19}, DT_{21}, and DT_{22}, showed very good OMMC because values are approximately above 0.6. Also, for the fabric having the value higher than 0.8, the overall capability of the fabric is defined as excellent (DT_{15}), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry.

Sample DT_{17} had the highest accumulative one-way transport index (AOTI =1325) and also a high moisture management capacity (OMMC=0.78).

Water location versus time can be obtained as a colourful simulation which is given in figure 4.61 and figure 4.62 (see appendix) for DT_{34} and DT_{36} respectively. Figure 4.63 and 4.64 (see appendix) shows the typical liquid moisture content change versus test time on the fabrics top layer measured by the MMT for Twill dyed fabric DT_{34} and DT_{36} respectively woven with 13 Tex weft. Figure 4.65 shows the accumulative one-way transport index grades and overall moisture management capacity of the Twill dyed fabrics woven with 13 Tex weft.

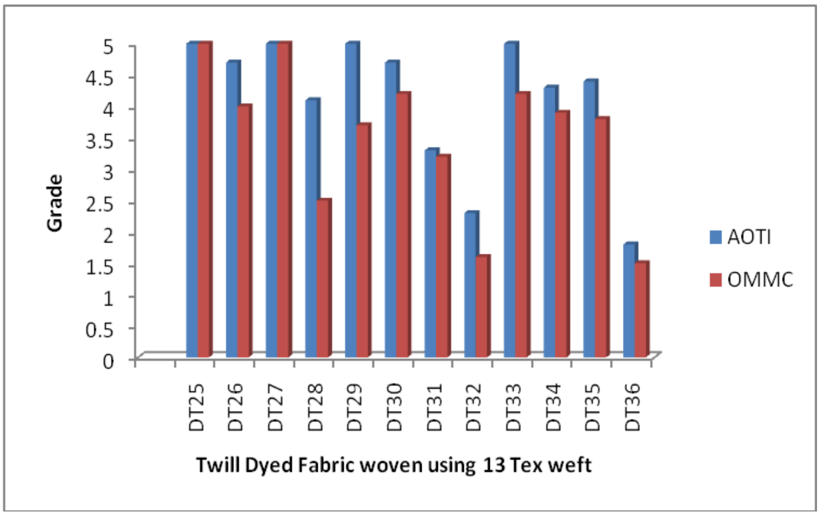

Figure 4.65: Accumulative one-way transport index grades and overall moisture management capacity of the Twill dyed fabrics of 13 Tex weft

It can be noticed from table 4.64 and 4.66, AOTI values of the samples DT_{25}, DT_{26}, DT_{27}, DT_{28}, RT_{29}, DT_{29}, DT_{30}, RT_{33} and DT_{33} showed excellent AOTI because values are approximately above 400. OMMC values of all the samples except DT_{28}, DT_{32} and DT_{36} showed very good OMMC because values are approximately above 0.6. Also, for the fabric having the value higher than 0.8, the overall capability of the fabric is defined as excellent (DT_{25} and DT_{27}), showing that liquid sweat can be easily and quickly transferred from next to skin to the outer surface to keep the skin dry.

Sample DT_{25} had the highest accumulative one-way transport index among all the investigated samples of Twill Dyed fabric (AOTI =1218) and also a good moisture management capacity (OMMC=0.86). Figure 4.66 and 4.67 (see appendix) show example of the typical fingerprint of moisture management properties of fabric sample – DT_{34} and DT_{36} respectively. Table 4.68– 4.70 (see appendix) shows the fabric classification results of all Twill samples prepared.

The best regression equation for OMMC of Twill Dyed fabric for different blend ratio is given in Table 4.72. As per regression analysis it was found that the equations obtained are good equations as the R^2 value is 76.72%. For the study, as the value of S is quite lower, the equation predicts the response much better. Together, blend ratio, yarn tex and picks per inch accounted for 76.72% of the variance in the UPF (see table 4.71). R^2 (predicted) = 65.75%, which indicates that the model explains 65.75% of the variation in UPF when used for prediction. The p-value for the blend ratio, yarn tex and picks per inch is less than α-level 0.05, which means that the effect of blend ratio and picks per inch on UPF is significant.

Table 4.71: Regression Analysis of Twill Dyed fabric: OMMC versus Weft density, PPI, Yarn Tex for each Blend ratio

Predictor	Coefficient	SE Coefficient	T	P
Constant	1.241	0.158	7.86	0.000
PPI	-0.00308	0.00144	-2.14	0.041
Blend ratio				
2	-0.0900	0.0509	-1.77	0.088
3	-0.0489	0.0509	-0.96	0.345
4	-0.4162	0.0549	-7.58	0.000
Yarn Tex	-0.01485	0.00253	-5.88	0.000
S = 0.107899	R^2= 76.72%	R^2 (adjusted) = 72.56%	R^2 (predicted) = 65.75%	

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	1.07408	0.21482	18.45	0.000
PPI	1	0.05334	0.05334	4.58	0.041
Blend ratio	3	0.77746	0.25915	22.26	0.000
Yarn Tex	1	0.40210	0.40210	34.54	0.000
Residual Error	28	0.32598	0.01164		
Total	33	1.40006			

Table 4.72: Multiple Linear Regression Equation of Twill Dyed fabric: OMMC versus Weft density, Yarn Tex for each Blend ratio

Regression Equation

Blend ratio

(Polyester/Viscose)	1	OMMC = 1.241 - 0.00308 PPI - 0.01485 Yarn Tex
(Polyester/Viscose)	2	OMMC = 1.151 - 0.00308 PPI - 0.01485 Yarn Tex
(Polyester/Viscose)	3	OMMC = 1.192 - 0.00308 PPI - 0.01485 Yarn Tex
(Polyester/Viscose/Lycra)	4	OMMC = 0.824 - 0.00308 PPI - 0.01485 Yarn Tex

Blend ratio: 1: 75/25; 2: 60/40; 3: 45/55; 4:70/25/5

Pearson correlations between the air permeability and overall moisture management capacity for Twill Dyed fabrics are given in Table 4.73. Pearson correlations between the fabric weight and overall moisture management capacity for Twill Dyed fabrics are given in Table 4.74. Pearson correlations between the fabric thickness and overall moisture management capacity for Twill Dyed fabrics are given in Table 4.75.

Table 4.73: Pearson Correlation of OMMC and Air Permeability for Twill Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	0.112	0.758
20	0.431	0.162
13	0.630	0.028

Table 4.74: Pearson Correlation of OMMC and Fabric weight for Twill Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	-0.445	0.191
20	-0.763	0.004
13	-0.841	0.001

Table 4.75: Pearson Correlation of OMMC and Thickness for Twill Dyed Fabrics

Yarn Tex	Pearson Correlation	p-value
37	-0.417	0.231
20	-0.845	0.001
13	-0.806	0.002

It can be observed that for Twill fabrics woven using 20 Tex and 13 Tex as weft, correlations between fabric weight and fabric thickness and the Overall Moisture management capacity are inversely related and highest since the Pearson correlations are close to +1 and -1.

It can be seen that the main contributing factors to fabrics being slow-drying or quick drying are their water spreading area and the spreading speed on the outer fabric surface. A slow-drying fabric has a small spreading area and slow spreading speed on the outer fabric surface while a quick drying fabric has a large spreading area and fast spreading speed on the outer fabric surface. It is clear that with the same amount of liquid being dropped on the fabric's inner surface during the testing time, if the liquid is spreading in a large area on the inner fabric surface with high spreading speed and then quickly transported to the outer fabric surface, the liquid content on the inner fabric surface will be small and the liquid moisture will move more easily from the outer fabric surface into the environment, thus, the fabric will dry in comparatively less time (quick drying fabric). When the moisture is absorbed at the skin surface but is not absorbed by the outer surface, then the body will feel wetted and uncomfortable due to the presence of unwanted wet feeling on skin[147].

A connection between the volume of water absorbed by a fabric and fabric thickness is generally accepted, but the relationship between fabric thickness and absorption is not particularly clear. Fabric absorption capacity has been reported to be influenced by many factors including fibre chemistry and morphology, fabric thickness and structure, yarn type, surface characteristics of fibre and fabric, size and shape of inter-yarn and inter-fibre spaces, and finishing treatments applied to fibre, yarn or fabric[160].