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A Study on Comparative Hand Behaviour of Fabrics Produced from Different Natural and Man-made Fibers

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Abstract

Selection of fibrous materials for different end uses is quite scientific for making comfortable, sensible and fashionable clothes. Fabrics produced from different fibers for common end uses having areal density in a particular slit are not investigated precisely yet. In this paper, different natural and man-made fibers are tried in pure and different blends to study the comparative hand behaviour of corresponding fabrics. Among all considered fibers, wool is found to be superior in winter application from hand point of view. Wool blends with different fibers are exhibited a typical hand behaviour depending upon different properties of blended fibers. Likewise silk offers highest hand value for summer application. However, polyester is a poor fiber from fabric hand point of view in its virgin form. It is therefore suggested that normal polyester fiber needs some modification so as to offer satisfactory hand behaviour. This paper provides fundamental database of various fiber properties and their effect in designing better hand fabrics.

Keywords: Primary Hand; Total Hand Value (THV); Tensile Energy; Compression Energy; Fullness; Thermal Comfort; Air Permeability

Introduction

The world is enriched by different natural and synthetic fibers which have its signature properties; like wool, a natural elastic fiber, silk, first micro denier natural fiber, linen a fiber of freshness, cool touch and magnificent brilliance and acrylic the fiber extensively using as replacement of wool etc. The fashion towards comfortable and elegant fabrics made the way to design the fabric by a more scientific approach. The situation becomes more interesting when different textile fibers are blended to extract some unusual comfort and aesthetic properties. Residual elongation and initial modulus of fibers are two prime criteria to decide the blending possibilities of two different staple fibers [1]. Fibers have a wide range of cross sectional shape like wool is having circular to oval while silk is having trifocal cross section. Fiber cross sectional shape plays important role to decide the yarn packing density that ultimately decides the low stress mechanical behavior of corresponding fabrics [2]. The availability of definitive fabric specifications based on the measurement of fabric mechanical surface and other physical properties provide a clearly defined goal for the development of new clothing products [3-6].

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To produce the high quality fabric, scientific control of each manufacturing process beginning from fiber manufacturing should be scrupulously assessed. Judicious selection of fabric constructional parameters using scientific principle of design engineering is essential for producing higher quality fabric. Selection of fibers for different end user applications is equally crucial for making comfortable and fashionable clothing [7-13]. In this contest, role of fiber characteristics on fabric low stress mechanical properties and handle is studied in detail.

Material and Methods

Materials

All possible major apparel grade fibers in pure and blended form are considered for this study (Table 1).

Wool and wool blend yarns were prepared by opting standard worsted yarn manufacturing system. Similarly other yarns were prepared on appropriate industrial yarn spinning systems. The fabric samples were woven on the high speed Rapier shuttle less looms to keep the fabric areal density 115-140 g.m^{-2}. The usual prescribed chemical processing were given to different type of fabrics in controlled laboratory conditions.

Evaluation of Fiber and Fabric Properties

The tensile behavior of fibers and yarns was measured on Tensile Tester, Instron 4302 as per ASTM D 3822-01 and ASTM D 2256-02 respectively. The fiber and yarn bending rigidities were tested on pure bending rigidity tester "Kawabata Evaluation System KES FB2". Fiber diameter was measured on Leica Optical Microscope in absence of compensator. The yarn hairiness was tested on the Zweigle hairiness tester. Air permeability was measured by the Textest FX 3300 air permeability tester.

The Permetest instrument was used to evaluate the relative moisture vapour transmission as per ISO 11092 singh et al. [6] which consists a heated porous membrane to imitate sweating skin. With an air current to remove the micro-climate that is generated on the top of membrane.

$$\text{Relative water vapour permeability}(P_{wv}) = \frac{\text{Heat loss with fabric on measuring head}}{\text{Heat loss from bare measuring head}} = \frac{q_1}{q_0} = \frac{u_1}{u_0}$$

where u_1 is the output voltage when fabric is placed on the measuring head, u_0 is the output voltage from bare measuring head.

Evaluation of Fabric Low Stress Mechanical Properties

Low stress mechanical properties such as tensile, shear, bending, compression, surface roughness and friction were measured on Kawabata fabric evaluation system (KES-FB) using standard procedures as prescribed by Kawabata et al. [13].

Results and Discussions

Fiber Properties

Mechanical properties of various fibers are shown in (Table 3). The results show that wool is most extensible fiber with lowest modulus while linen is the least extensible fiber among all the fibers

Table 1: Details of Fabric Samples using different Type of Fibres and its blends.

Sample Code	Blend	Warp count (Ne)	Weft count (Ne)	Ends per cm	Picks per cm	Weave	Areal density g/m²
F1	100% wool	1/40	1/40	28	24	Plain	150
F2	100% mul.silk	1/20	1/20	24	19	2/1 twill	180
F3	Wool: mul. silk (70:30)	1/48	1/48	33	25	2/1 twill	150
F4	Wool: linen (70:30)	2/48	2/48	27	21	2/1 twill	220
F5	Wool: cotton(65:35)	1/20	1/20	25	21	2/1 twill	190
F6	Wool: PET (50:50)	2/38	2/38	22	19	2/1 twill	175
F7	Wool: nylon (80:20)	2/22	2/22	15	14	2/1 twill	303
F8	Wool: acrylic (80:20)	2/52	2/52	24	20	2/1 twill	150
F9	100% PET (staple)	2/40	2/40	22	18	2/1 twill	140
F10	100%PET (filament-twisted: twisted)	1/40	1/40	52	30	Plain	120
F11	100%PET (filament- intermingled: intermingled)	1/66	1/66	47	30	Plain	118
F12	100% Cotton	1/20	1/20	32	24	Plain	190
F13	100% bamboo	1/20	1/20	33	20	Plain	195
F14	100% viscose	1/20	1/20	31	21	Plain	170
F15	Cotton: bamboo (60:40)	1/20	1/20	31	20	Plain	177

Table 2: Fabric low stress mechanical attributes from KES.

Test	Low –stress properties	Notation	Unit
Tensile test	Extensibility	EM	None
	Linearity	LT	None
	Tensile energy	WT	gf cm/cm²
	Tensile resilience	RT	%
Shear test	Shear stiffness	G	gf cm/degree
	Hysteresis at 0.5º shear angle	2HG	gf/cm
	Hysteresis at 5º shear angle	2HG5	gf/cm
Bending test	Bending rigidity	B	gf cm²/cm
	Hysteresis of bending moment	2HB	gf cm/cm
Compression	Linearity of compression	LC	None
Test	Thickness curve		
	Compressional energy	WC	gf cm/cm²
	Compressional resilience	RC	%
Surface	Coefficient of friction	MIU	None
Characteristics	Mean deviation of MIU	MMD	None
	Geometrical roughness	SMD	μm
Fabric	Weight/unit area	W	mg/cm²
Construction	Fabric thickness	T	mm

Table 3: Fibre Properties.

Fibre Type	Avg. Dia (μm)	Avg. Fibre denier	Avg. Bending Rigidity/tex² (cN.cm²/tex²)x 10⁻³	Average Initial Modulus (cN/Tex)	Average Extensibility %	Average Tenacity (cN/Tex)
PET (Staple)	12.8	1.4	0.19	855.3	10.7	50.93
PET (Filament)	06.7	0.8	0.06	729.2	13.4	40.78
Wool	19.8	2.7	0.20	497.7	29.7	14.49
Silk	12.2	1.6	0.65	774.9	20.6	39.69
Linen	21.9	3.5	1.05	1812.5	2.5	55.08
Cotton	13.5	1.5	0.65	799.4	7.3	48.78
PET(for blend with Wool)	18.6	2.0	0.42	921.2	8.7	57.15
Nylon	15.6	2.0	0.88	1012.1	6.9	61.83
Acrylic	16.5	2.0	0.50	885.1	7.6	68.58
Bamboo	16.0	1.5	0.45	780.8	23.9	17.92
Viscose	15.8	1.5	0.48	785.6	24.5	19.50

under investigation. It clearly indicates that the blend of wool with linen is very critical and linen fiber may lead to break when stretched between two pair of rollers in case of wool blended yarns but superiority of both the the fibers were major driving forces to opt this blend for study.

Fiber Properties and Yarn Properties

Fiber properties are not directly translated to yarn properties. Yarn spinning system, twist level, packing coefficient and fiber migration behaviour etc are major factors that influence the yarn properties which are made by identical fibers. The relation between fiber and yarn properties is complex, although some trends are easy to explain. Yarn extensibility comprehensively depends on the extensibility of constituent fibers. Higher residual extensibility of fiber and yarn is necessary to produce a superior quality fabric. Mathangadeeraa et. al. [14] has reported that higher breaking elongation cotton fiber produces a fabric of superior quality. The explanation of higher extensibility of wool and low extensibility of linen blended yarns is clearly evident (Table 4). Low extensibility of linen is well anticipated of highly crystalline structure of linen fibers with healthy lignin content while low crystalline content and helical structure of wool fiber exhibited a higher extensibility. Wool and Silk blended yarns revealed a lower extensibility while wool and silk both fibers have high degree of extensibility individually. The reason for this is obvious; the similar range of extensibility offers a strong adhesion between wool and silk which probably restricts the relative movement between adjacent wool and silk fibers. Wool / cotton blend yarn exhibited a high extensibility and that may attribute to a wide difference in staple length of both constituent fibers. The wide difference in staple length is behaving like a continuity defect and probably due to a lower cohesive force between cotton and wool fibers in yarn form. Bamboo and viscose, both regenerated cellulosic fibers exhibited the extensibility close to natural fibers like silk and wool. As the low extensibility cotton fiber was mixed with bamboo, the yarn extensibility dropped significantly as shown in (Table 4).

Yarn Hairiness

A yarn spun from fine fibers is less hairy as compared to one that is spun from coarser fibers. It is because of the centrifugal force acting on fiber during ring spinning, which is directly proportional to fiber linear density. The fiber migration theory during ring spinning holds good in deciding the hairiness of yarns. Fiber bending rigidity is also one of the important deciding factors to yarn hairiness. Fibers with higher bending rigidity are more difficult to be consolidated into the yarn form and more prone to protrude out as hair from yarn assembly which is obvious from very high hairiness value in wool/linen yarn (Table 4).

Bending Rigidity

Fiber bending rigidity and cohesiveness of constituent fibers inside the yarn are important deciding factors of yarn bending rigidity which is obvious from Table 3 &4. Australian Wool Innovation Ltd. has revealed in a study that the fiber cohesiveness in the yarn assembly develops by their crimp and twisting phenomenon. Higher bending rigidity of linen fiber is responsible for a higher bending rigidity in yarn; however, a significantly higher bending rigidity in case of wool/mulberry silk yarn is because of a high degree of cohesiveness between these two kinds of fibers. This high cohesiveness is due to the considerable stickiness between superfine silk and highly crimped wool fibers.

Low Stress Mechanical Properties

Tensile behaviour: The extensibility (EM) gives the tensile extensibility under strip biaxial extension. EM has a good correlation with fabric handle (Table 5). The higher the extensibility better is the fabric quality from the point of view of handle. A high EM value also signifies greater wearing comfort. The product of extensibility and stress at low stress level is tensile energy (WT) which is a representation of toughness of the material (Table 2). Low tensile energy causes low extension at low stress level. The fabric made with 100% wool fiber has high tensile energy means easy to extend. The tensile energy of wool and wool blend fabrics is quite higher than PET fabric and this may be attributed to the low modulus and high crimp level with natural elasticity. It is expected at low stress level that only de-crimping of individual fibers in yarns and de-crimping of yarn in fabrics are performed. The tensile energy of 100% cotton (F12) fabric is close to PET fabrics due to its low extensibility and higher crystallinity (Cotton crystallinity as about 67% with very high molecular weight). The bamboo and viscose fibers have comparatively low molecular weight and low crystalline fibers than cotton. Bamboo and Viscose based fabric samples (F13 and F14) show comparatively higher tensile energy than cotton and PET fabrics (F9 and F12). The 100% staple PET fiber based fabrics have lowest tensile energy in present all three samples (F9, F10 and F11). The bending rigidity of PET fiber was very less (Table 3) comparatively and giving close packing in yarn form. This may be attributed to the fiber fineness and diametric uniformity of PET fibers which offer a very close packing in yarn form. The tensile energy (WT) has exhibited a good compatibility with total hand value (winter) of fabrics (Figure 1).

Bending rigidity: The bending rigidity (B) is a measure of ease with which fiber/fabric/yarn bends. The bending stiffness of fabric

Table 4: Yarn Properties.

Blend	Max. Tensile Strength cN/Tex	Extensibility %	Bending rigidity .c/cN.cm²/yarn $\times 10^{-3}$	Hairiness (No. of hairs >3mm/km)
Wool	5.88	13.89	0.23	3229
Silk	9.20	11.10	0.22	NA
Wool/Mul.Silk	8.73	07.58	0.84	2770
Wool/Tussar silk	9.10	06.09	0.21	4740
Wool/Linen	5.08	09.71	0.60	7321
Wool/Cotton	3.49	15.59	1.10	2219
Wool/PET	14.14	08.58	0.27	2457
Wool/ nylon	11.25	09.35	0.24	2345
Wool/acrylic	8.54	6.12	0.30	2986
PET(staple two ply yarn)	24.28	09.16	2.35	1965
PET (Twisted filament yarn)	27.82	11.32	9.51	NA
PET (intermingled filament yarn)	28.25	15.61	11.19	NA
Cotton	15.71	04.21	03.79	2528
Bamboo	12.01	11.94	00.47	1225
Viscose	13.78	11.68	00.71	844
Cotton/Bamboo	13.95	05.75	01.09	1441

Table 5: Some Low Stress Mechanical Properties of Fabric.

Fabric Code	Bending rigidity cN.cm²/cm	Tensile energy cN.cm/cm²	Low stress extensibility %	Shear rigidity G cN/cm.degree	Compression energy cN.cm/cm²
F1	0.053	09.21	07.27	0.541	0.197
F2	0.042	08.27	11.29	0.362	0.129
F3	0.040	09.39	07.11	0.297	0.199
F4	0.054	13.59	08.22	0.482	0.211
F5	0.038	09.18	15.99	0.369	0.269
F6	0.072	10.31	06.76	0.622	0.229
F7	0.090	12.99	06.21	0.749	0.468
F8	0.080	10.44	06.01	0.670	0.278
F9	0.098	00.14	00.53	0.913	0.074
F10	0.074	00.16	00.75	0.810	0.011
F11	0.046	00.21	01.05	0.956	0.019
F12	0.118	00.35	01.53	2.694	0.337
F13	0.039	00.89	04.20	0.404	0.281
F14	0.033	01.18	05.38	0.226	0.304
F15	0.076	00.49	01.94	1.421	0.248

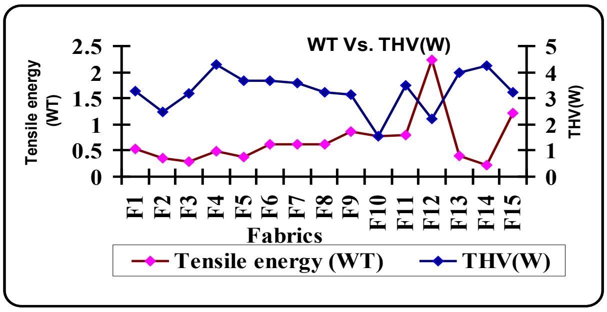

Figure 1: Tensile Energy of fabrics Vs. Total hand value (Winter).

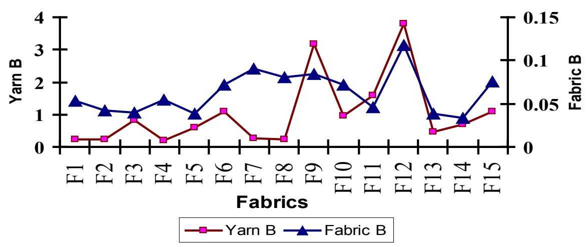

Figure 2: Yarn and fabric bending rigidity.

depends on the bending rigidity of constituent fiber and yarns from which the fabric is manufactured. The fabric construction and nature of chemical treatment given to the fabric are also important factors to influence the bending rigidity of the fabric. The results are shown in (Tables 3-5) and Figure 2.

Fiber bending rigidity and cohesiveness are important driving forces of yarn bending rigidity that propagates as an important characteristic to finalize the fabric bending rigidity. The fine polyester fiber has very negligible bending rigidity is governing the yarn bending rigidity because soft fibers are able to held together strongly and giving a higher packing index to eventuate the higher yarn bending rigidity. PET yarns in all three forms such as staple yarn, twisted filament yarn and intermingled zero twist yarn are posing higher bending rigidity among the all eleven samples and nearly similar trend is observed for their corresponding fabric bending rigidity (Figure 2). The PET fabric made from staple yarns exhibits higher bending rigidity as compared to filament fabrics which may be attribute to the lower GSM of PET10 and PET11 than PET9 fabric samples.

Extensibility: Fibers have residual extensibility in same range adds higher cohesion and restricts the relative motion of constituent fibers in the yarn. The air permeability of wool and wool/silk blended fabrics also supporting this concept as observing from (Tables 4-6). The air permeability of fabric samples F1 and F2 (pure wool and silk fabrics) is moderate. The cause of this justification of this trend is clearly evident that although extensibility of both constituent fibers are comparable but statistically different consequently constituent

Table 6: Transmission behaviour of Fabric Samples.

Sample code	Relative water vapour permeability %	Air Permeability cm³/cm²/s
F1	35.54	43.15
F2	45.22	22.67
F3	41.46	30.34
F4	21.53	09.44
F5	37.48	45.78
F6	13.42	42.33
F7	16.76	27.96
F8	26.99	38.09
F9	15.42	75.66
F10	17.42	134.14
F11	14.44	05.26
F12	56.14	05.61
F13	59.87	19.42
F14	59.70	25.64
F15	59.65	15.72

fibers are following different path at moderate stress level which is exerted during air exertion. Same explanation for air permeability and yarn is applicable in case of wool/cotton, wool/acrylic and wool/nylon fabrics.

Polyester fabrics F9, F10 and F11 are exhibited very low extensibility at low stress level. The yarn modulus may be deciding factor in yarn extensibility. In PET yarns the initial modulus values are quite higher than other yarns and same trend is maintained at fabric stage. It is evident from Tables 4 & 5 that blending of natural fibers with PET in which extensibility is not in same span, having lower modulus which was absent in case of 100% PET yarn where all constituent fibers or filaments have similar extensibility.

Shear behaviour: The shear rigidity of a fabric depends on the mobility of cross threads at the intersection point, which again depends on weave, yarn diameter and the surface characteristics of both fiber and yarn. From the point of view of handle, the lower the shear rigidity, the better the fabric handle would be. The shear rigidity of woolen fabrics is higher then its blends as shown in Table 5. The reason is quite evident that specific surface structure of wool fiber gets locked with each other by post weaving operations giving a papery feel. Wool /silk blended fabrics have shown lowest shear rigidity presumably due to the quite different surface structure of both wool and silk fibers which allow a relative movement between fiber to fiber and yarn to yarn at low stress level. Similar reason can be attributed to justify the highest shear rigidity for PET fabrics having pure polyester yarn in both warp and weft direction. The 100% cotton fabric's shear rigidity (G) is 2.224 cN/cm. degree which reduces to 1.221 cN/cm. degree after blending 40% bamboo fiber. The shear stiffness of F13 and F14 fabrics are 0.404 and 0.226 cN/cm. degree which is significantly lower than cotton fabric. Here it can be safely stated that after blending two fibers having different surface geometry, shear rigidity drops down which is helpful to manufacture a fabric of better hand value.

As the shear rigidity of wool and wool blended fabrics increases, THV (winter) decreases. This trend is observed for most of the wool and wool blended fabrics but the results I case of PET and cellulose based fabrics are quite complex as reflected in Figure 3.

Fabric compressibility: The compressibility of woven fabrics is mainly decided by packing density of constituent yarns and yarn spacing in the fabric. During fabric compression, firstly, the protruding fibers get compressed in fabric surface, subsequently yarns get compressed by movement of constituent fibers and finally fiber itself gets compressed and its corss-sectional shape gets changed [15]. Compressibility offers a feeling of bulkiness and spongy property in the fabric. Compressibility has some intimacy with fabric thickness; the higher the thickness, the higher the compressibility and it relates with primary hand value (Fukurami or fullness) of the fabric.

The woolen fabrics show a moderate compressibility in terms of compression energy (WC) at low stress level. This may be attributed to the scaly structure of wool fiber that restricts very high fiber to fiber surface contact in woolen yarns and yarn to yarn in fabric form which is further enhanced in case of blends of dissimilar fibers with wool in terms of surface geometry, extensibility and modulus. The polyester fabrics are very hard which is clearly observed by very low compression energy and this may be attributed to highly fiber to fiber and yarn to yarn surface contact reducing the free space for any relative movement between fibers and yarns and making the fabric more papery. Bueno et al [16] reported that the blending of plus shape polyester fiber with cotton improves the softness and wick ability of the yarn. The fabric F7 made from wool: nylon (80:20) has offered highest compression energy (WC) and this may be attributed to the elastic nature of both wool and nylon fibers at low stress level. The fabric samples F12-F15 have exhibited a better WC which is again due to comparatively higher extensibility and low modulus of these fibers (Table 5).

Total Hand Values (THVs): The THVs of fabric samples are estimated with the help of various primary hand values using the Kawabata-Niwa equations by KES system. This is necessary to mention here that all samples under this study have shown comparatively low hand value because of improper finishing conditions set in laboratory miniature processing equipment. The results depicts that most of the fabrics exhibited higher THV for winter applications as compare to summer in wool and wool blended fabrics. This is mainly due the presence of wool fiber and its unique properties like crimp, scaly surface and highly elastic nature. Although, few of the fabrics exhibited suitability for summer applications when blended with cotton. It is obvious from (Figure 3) that 100% woolen fabrics are most suitable for winter applications due to uniqueness of wool fiber. Synthetic blends with wool have a higher bulk and related fullness essential for winter applications because of artificially introduced crimp in synthetic fibers. The wool: linen blended sample revealed a maximum winter THV (i.e. 4.34) this may be attributed to high bulk and compressibility of fabric which is essential for better winter THV. The property of linen blended yarns can be attributed to the fact that linen is much coarser fiber in comparison to wool or silk. Due to fiber migration in ring spinning, linen come on sheath and generate more hairy yarn (7321 hairs/km) which gives bulkiness, sponginess and eventually higher compressibility leading to higher winter THV. Wool: mulberry silk and wool/cotton blends also give good handle when a proportion of wool is taken in the composition. The wool: cotton blended fabric is showing higher winter THV than 100% cotton fabric F12 as shown in Fig.3. This can be justified on the basis of wool fiber characteristics which is more elastic, less crystalline, and having higher staple length than cotton. Moreover, presence of cotton fiber further improved the hand value.

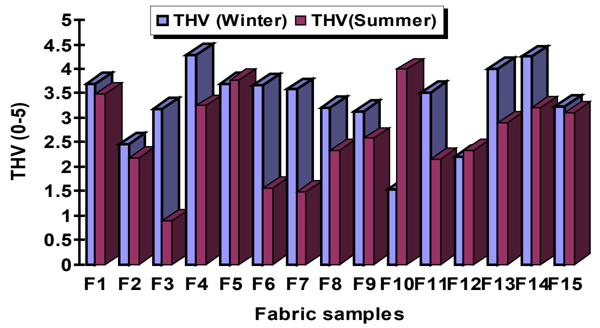

Figure 3: Total hand values of different fabrics.

The blend of wool with PET revealed a better THV due to the fact that the PET fibers are more consistent in uniformity to give better blending intimacy with wool fiber. When a comparison is made between PET fabrics F9, F10, and F11, the twisted filament yarn fabric (F10) presented the most suitable summer THV. This may be attributed to crispy feel of twisted filament yarn which is a desired hand characteristic in summer THV estimation. Wool/Cotton blend also exhibit a good THV (summer) because of the cotton component in the blend. Pure woolen fabric also posed a fine THV however in general, it may be inferred that worsted and woolen fabrics are not appropriate for summer application but there is a group emerging in society who prefer to wear wool blend for summer wear.

Air Permeability

Air permeability is described as the rate of air flow passing perpendicular through a known area under a prescribed air pressure differential between the two surfaces of a material. The initial warm/

cool feeling of the garment during wearing is measured by the resistance of fabric to the flow of air. The higher the air flow value, the greater the intensity of the warm/cool feeling will be. The results show that (Table 6) wool and wool blend fabrics provide reasonably good air permeability but the air permeability of 100 % PET fabrics made by intermingled yarns (F11) and 100% cotton fabric (F12) is exceptionally low i.e. 5.26 $cm^3/cm^2/s$ and 5.51 $cm^3/cm^2/s$ respectively. Researchers have reported that multifilament yarns cannot be modeled as cylinder which supports that nodes and entangled structure in intermingled multifilament fabrics have a crucial role in air transmission behaviour [17,18]. The very low air permeability of F11 may be attributed to the intermingled structure which offer very fine loops in the yarn made by constituent filaments while the low air permeability of cotton fabric F12 may be due to the higher hairiness of cotton yarns (Table 5) which actually forms a very fine mesh like structure in the inter-yarn stices. The fabric F10 consist highly twisted PET filament yarns shows highest air permeability to ascribe it to them with minimum yarn to yarn contact area due to twisted structure and more free space due to lower fabric cover while fabric thickness and GSM are almost same with F11 to transmit air more freely.

Moisture vapour transmission rate (MVTR)

An ideal fabric should allow transmitting water vapour from skin surface to pass through its pores, irrespective of the fiber material's natural absorbency. The water vapour should escape at a faster rate than it is released by skin so that the wearer feels dry, non-sticky and comfortable. 100% wool fabric (F1) shows a moderate MVTR but as blended with silk it enhances to 45.22% presumably due to formation of fine capillaries and providing more surface area for adsorption and diffusion of moisture in presence of fine silk fiber (Table 6). Wool: linen blended fabric shows a lower MVTR and this may result to coarser capillary size due to the presence of coarser linen fiber with wool. Linen by its inherent nature is highly crystalline and comparatively less water adsorption regions are available on this fiber. Blending of wool with cotton also offers a good MVTR because of relatively better hygroscopicity of cotton. As wool blended with hydrophobic PET fiber, MVTR drops significantly from 38.54 to 13.42% but as PET is replaced by nylon a slight rise in MVTR is registered. This may be attributed to higher moisture regain of nylon than PET. PET fiber requires some structural modification to improve MVTR. Cellulosic fabrics made from cotton, viscose and bamboo fibers show higher MVTR.

Conclusion

This study revealed that the fiber properties are most important basis for handle behaviour of fabrics. Type of fiber in terms of its signature characteristics, are transferred from fiber to fabric but influence is not always directly related with low stress mechanical properties. In some fiber like polyester, lower fiber bending rigidity produced yarn of higher bending rigidity which eventually showed higher fabric bending rigidity. Linen being a stiffer fiber than PET, blended with wool provides better THV than pure PET fabric. The presence of cotton fiber affects the THV mainly due to its short fiber length, convoluting surface, and crimp which produce a softer yarn and softer fabric. Silk (mulberry) fiber has also proved a useful fiber to be blended with wool to develop unconventional high quality worsted fabrics. To achieve a better THV, care should be initiated right from the fiber stage. Polyester fiber needs structural modification to give higher THV and other comfort characteristics.

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