Performance ofspeciality hair fibers blended wool fabrics

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Abstract

Performance enhancement is worth requirement of woolen apparel.The fabric performance divided in several criteria. These are aesthetic, durability, appearance and care properties. This property directly affects the quality of pure wool and blendedwool fabrics.The study was focused on performance of speciality hair fibers blending in wool/polyester fabrics.The several properties related to performance of wool fabrics are i.e. drapability, tensile strength, pilling and felt shrinkage.Drapability is related aesthetic and tensile strength is related to durability. Similarly pilling is related to performance retention property and felt shrinkage is care property of wool fabric.The results of drapability of wool and wool blended fabrics indicating that drape behaviour of WNP (Wool: Nylon: Pashmina) fabric is poor than other fabrics. While CW(Commercial wool) and WPA(Wool:Polyester:Angora) fabrics have better drapability than that of WPP(Wool:Polyester:Pashmina) and WNP(Australian merino wool:Nylon:Pashmina) fabrics.WPP has adequate drapability and suitable for women's wear garments. The tensile strength of WPA has higher as compare to CW, WNP and WPP.Blending of angora in wool/polyester increases the tensile strength as compare to blending of pashmina and Australian merino.Pilling tendency of CW and WNP fabrics is higher and ranked lowest followed by WPP and WPA fabrics. WPA has a lowest pill formation because of blending of angora in wool and polyester. The mean value of shrinkage after six washing cycles is found highest for CW fabric (9.49%) followed by WPP (4.86%), WPA (3.11%) and WNP (0.89%).It was concluded that blending of speciality hair fibers i.e. angora, pashmina and Australian merino positively give impact on performance of wool/synthetic blended fabric.

Index terms:Performance, Wool, Speciality hair fiber, Drapability, Tensilestrength, Felt shrinkage

Introduction

Performance related properties directly give impact on the quality of fabric material. The fabric performance divided in several criteria. Those are aesthetic, durability, appearance and care properties.Aesthetic properties are related to look and appearance of fabric material. Aestheticproperties impacts on end use application and market of fabric material. It is related to luster, drape, texture, hand. Drape is essentialproperty that decides the elegance of garment as it is allied to aesthetic and form of garments. It describes the way in which fabric falls itself in specific shape according to its properties.When part of it is supported by any surface and rest is supported.Drape is much important for selection of appropriate fabric for intended garment. Drape is defined as the ability of a fabric to hang limply in graceful folds. Cusick (1965) defined the drape of a fabric as a deformation of the fabric produced by gravity when only part of the fabric is directly supported.Drape appearance depends not only on the way the fabric hangs in folds, but also upon the visual effects of light, shade and fabric luster at the rounded folds of the fabric as well as on the visual effects of folding on color, design and surface decoration. In practice, drape is usually assessed visually, or subjectively, and its actual assessment greatly depends often upon changing factors, such as fashion, personal preference, human perception, etc. (Fan and Hunter, 2009).A durability property is the manner in which the product withstands use. That is, the length of times the product is considered suitable for the use for which it was purchased. Will the consumer be satisfied with how well it wears, how strong it is, and how long it remains attractive.Durability is present by tensile strength of fabric. How much fabric is strong during manufacturing and wear-ability.It is important to assess for knowing the strength of fabric and apparel development.The tensile strength is determined by a force at a constant rate of extension to a fabric sample held in place by one fixed and one moveable jaw. The force required for a break in the fabric is recorded. The elongation at break is also recorded by the strength tester.Appearance retention property is how the product maintains its original appearance during use and care. Pilling is an undesirable phenomenon that affects the hand and the appearance of garments.(Long and Wei , 2003). The pill formation on fabric surface follows four stages[1]: (i) fuzz forming, (ii) fuzz entanglement, (iii) pill forming, and (iv) pill wear-off.At last**,** care properties arerelated to end use performance of fabric material**.**Laundering is processes of washing cycles assess the shrinkage of fabric in warp and weft direction and valuable care property of fabric for end use. In the case of wool fabric, flat shrinkage was assessed the performance of fabric.

Methodology:

Raw material:

Three developed fabrics of JKwool/Polyester/Angora (WPA),JKwool/Polyester/Pashmina (WPP),Australian merino wool/Nylon/Pashmina(WNP)and one commercial fabric were taken for detail study as shown in table.The Commercial wool fabric was procured from M/s Bhutico Corporative Society.Bhuntar (HP) having similar fabric construction parameters.

Table: 1Identification of fabrics

S.No	Fabric	Code
1	JKWool/Polyester/Angora	WPA
2	JKWool/Polyester/Pashmina	WPP
3	Australian merino wool/Nylon/Pashmina	WNP
4	Commercial wool	CW

Methods:

Drape behaviour was measured on cusik drape meter. Drape coefficient is the area covered by the shadow of the draped specimen expressed as percentage of the area of the annular ring of fabric.For each fabric 2 specimens were prepared and size of specimen is 30cmin diameter Total 8 specimens were prepared for CW, WPA, WPP and WNP. Tensile properties and elongation at break were measured according to ASTM D5035. For tensile strength of CW, WPA, WPP and WNP fabrics, ten specimens were prepared with size of 150 mm ×150 mm i.e. five for warp and other five for weft direction for each fabric. Total 40 specimens were prepared.Tensile strength (gf) and elongation (%) is determined using universal tensile machine (Instron Model-4114). The gauge length was kept 100 mm and cross head speed was kept 100 mm/min.ICI pilling box was used for the evaluation using specimen size of 125 mm ×125 mm from both warpand weft directions.This test method covers the determination of the resistance of the formation of pill and other related surface changes on textile fabrics using the rotation cycle pill box.Felt shrinkage was measured according to dimensional stability to laundering IS: 648-1979 method.Launder-Ometer was used to assess felt shrinkage.12”x12”size samples were taken for the study.Dimension changes are determined by comparing the distance bench marked between length and width direction before and after a programming of six laundry cycle. The present study was evaluated performance through drape behavior, tensile strength, pilling resistance and felt shrinkage of blended wool and commercial wool fabrics.

Result and discussion:

Drapability:

Table: 2 Drape behavior of commercial wool and blended wool fabrics

S.No	Fabric ID	Co-efficient of drapability (%)

1	CW	44.4
2	WPA	44.1
3	WPP	48.4
4	WNP	52.8

Figure:1 Coefficient of drapability

The results of drapability of commercial wool and wool blended fabrics are depicted in figure1. From the figure, it is observed that drape coefficient of WNP fabric is higher (52.8%) than WPP (48.4%), CW (44.4%) and WPA (44.1%) fabrics indicating that drape behavior of WNP fabric is poor than other fabrics. While CW and WPA fabrics have better drapability than that of WPP and WNP fabrics. However, no significance difference is found in coefficient of drape of WPA and CWfabrics. The WPP fabric has moderate coefficient of drapability which is falling between WPA and WNP fabrics. Thus it concluded that WPP has adequate drapability and suitable for women's wear garments. The drape coefficient is highly increasedin the case of WNP fabric. It may be due to increase in picks per centimeter. The higher pick density gives lesser space for yarn movement in fabric and provides tighter and stiffer fabric. Drape coefficient of fabric was affected by wool blending (Kim and Na, 2013). Fabric thickness has significant influence on the draping quality (Lawal, Bawa and Nkeonye, 2012). Not only soft and thin but also the heavier and thicker fabric used for outwear can also have drape forming aesthetic folds.

2.Tensile strength:

The tensile strength and elongation at break of different fabrics are shown in table

Table: 3 Tensile strength of Commercial wool and blended wool fabrics

S.no	Fabric ID	Load at peak (Kg)	Elongation(%)
1	CW	25.2	28
2	WPA	33.4	35
3	WPP	20.0	28
4	WNP	23.0	42

Load at peak:

The table reveals that tenacity of WPA is highest (33.4kg) followed by CW (25.2kg), WNP (23.0kg) and WPP (20.0kg) fabrics. The fabric strength of CW,WPA, WPP and WNP is significant level($p<0.001$). The poor tensile strength of WPP yarn translates into poor strength of WPP fabric mainly due to the lower tenacity of pashmina fibre as compare to wool and angora fibre. In the case of WPP fabric, the tenacity of WPP fabric decreases after blending of pashmina and polyester in wool. A similar trend was also found in WNP fabric (23.0kg), after blending of pashmina and nylon in Australian merino wool. WPA fabric has found highest strength among all the fabrics while WPP and CW fabrics are weaker in strength. The fabric strength of WPA, WPP and WNP in also compare CW fabric using F test (2sample for variance) .Which inference that the fabric WPA,WPP and WNP have significant difference in tensile strength as compare to CW fabric.

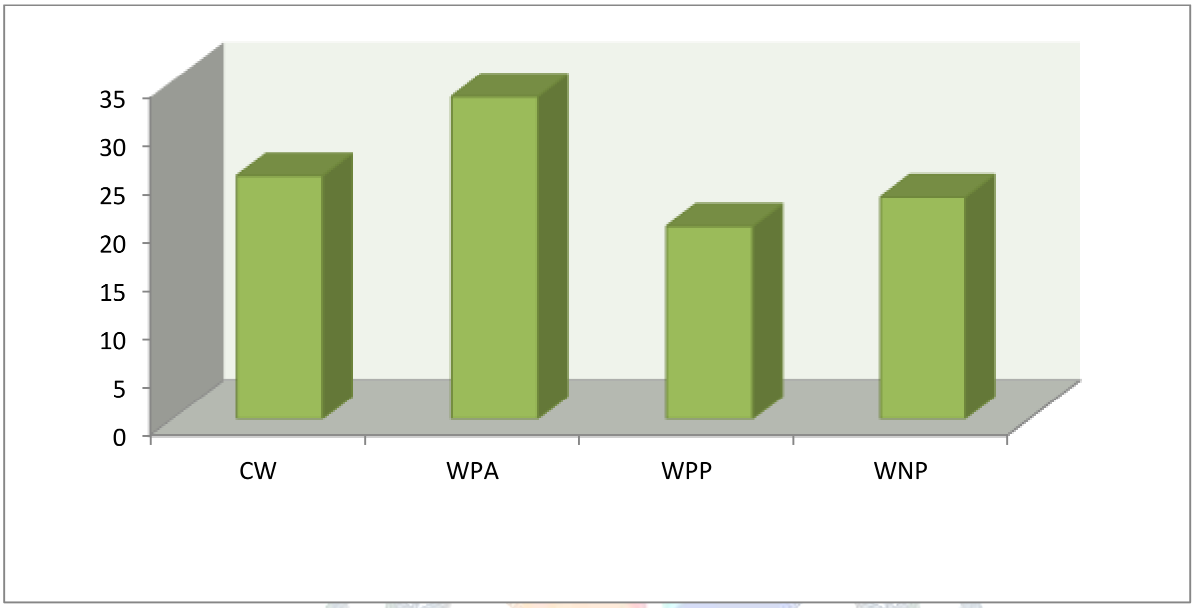

Figure:2Load at peak (Kg)

Elongation:

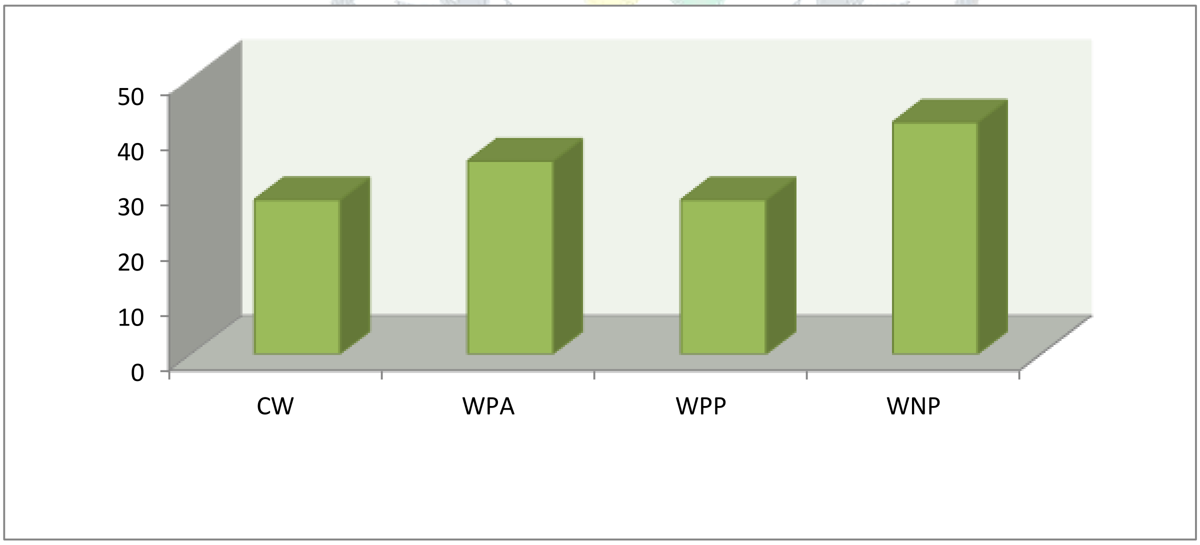

Figure: 3Elogation of fabrics (%)

The elongation at break of fabric represents extensibility of fabric which depends on elongation of fibre, yarn twist and fabric crimp.The elongation at break of different fabric shown in table 3 and figure 2**,** elongation of WNP fabric is more (42%) than WPA (35%), CW and WPP (28%) fabrics. The elongation at break of CW,WPA, WPP and WNP fabric is significantly different at 99 % confidence level ($p< 0.01$).Blending of nylon in pashmina and wool, the elongation at break increases by 42% in WNPblended fabric in comparison with pure commercial fabric.Which is significantly differ at 95% confidence level($p<0.05$). In the caseof WPA fabric,blending of angora with wool and polyester; elongation increases by 35%. However the difference is non-significant.Blending of pashmina and polyester in wool, the difference is found in elongation at break (28%) in WPP fabric, which is significant at 95% confidence level($p<0.05$).

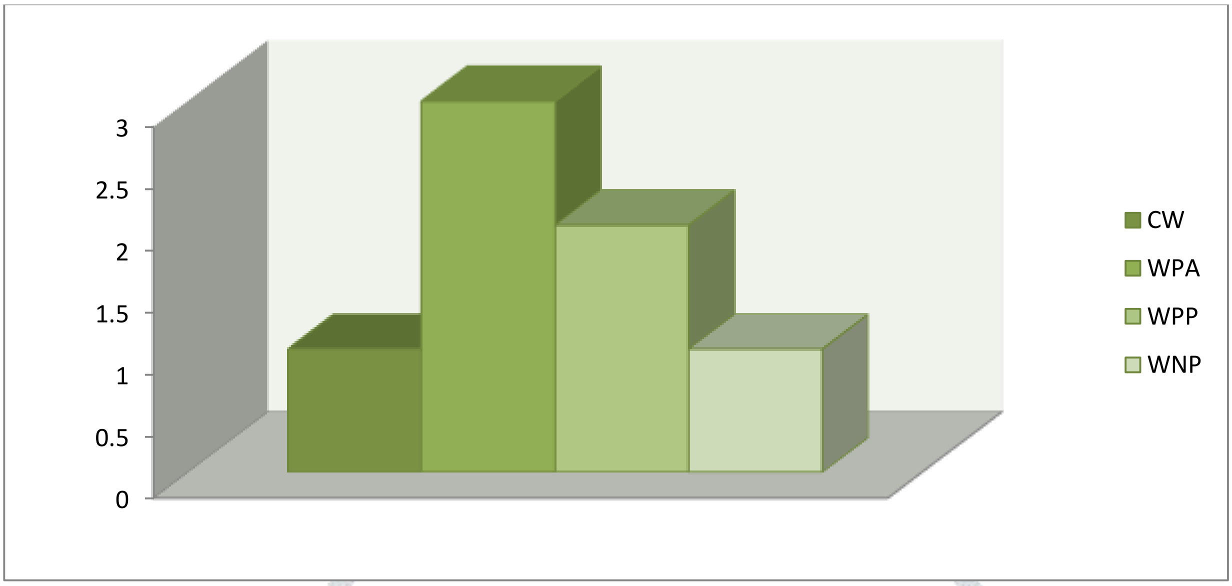

Figure: 4Pilling grades of fabrics

The figure 4 shows that pilling tendency of CW and WNP fabrics is higher and ranked lowest followed by WPP and WPA fabrics. WPA has a lowest pill formation because of blending of angora in wool and polyester. Angora is fine, smooth, soft and low friction properties, which results low pill formation. Similarly, WPP fabric is also shown low pill formation due to the blending of pashmina in wool and polyester. Pashmina is fine, soft and low friction character, which decreases the tendency of pill formation in WPP fabric. WNP fabric has high pill formation tendency, no significant difference is found in blending of pashmina in Australian merino wool and nylon may be due to dominate effect of nylon blending in wool fiber. Baird, Hatfield and Morris (2013) reported that 50/50wool and nylon blended fabric sometime pill more than 100% nylon fabric. They also reported that pilling is decreased by increasing yarn twist, ends and picks density and using doubled yarns in the place of comparable single yarns.

Pilling does not depend only on single reason, however, it is the result of many reasons such as fibre characteristics, yarn & fabric construction and finishing processes. In the case of polyester/wool blended fabrics, pilling tendency of the fabric increases with increase of the polyester content. Finer yarns have lower pilling than coarser. Thus, the blending of speciality hair fibre in wool/polyester and wool/nylon blend decreases the pill formation on fabric.

Felting shrinkage**:**

Felting shrinkage is shrinkage of fabric in the warp and weft direction and valuable care property of fabric for end use application. It depends on mainly type of wool,number of scales on the surface and scale height.Heat, moisture and mechanical action cause the wool fibre to shrink and the edge of the scales to interlock,preventing the fibre from returning to its original position. Felting shrinkage of the commercial wool fabric and blending of speciality hair fibers (angora and pashmina) and synthetics fiber (polyester and nylon) with wool fiber fabrics has been reported in table and figure

Table:4 felt shrinkage of all fabrics

S.no	Fabric ID	C1	C2	C3	C4	C5	C6
1	CW	8.80	9.75	11.02	11.33	8.80	7.21
2	WPA	1.00	1.99	1.99	2.65	2.33	2.67

3	WPP	2.32	6.56	6.28	8.25	5.00	3.67
4	WNP	-0.66	1.33	-0.67	1.66	0.33	0.67

The table 4 and figure 5 shows that CW fabric has highest felt shrinkage followed by WPP, WPA and WNP fabrics in six laundry cycle. After 4th cycle, CW fabric is stable in shrinkage behaviour. The felting shrinkage of CW fabric is found 7.5-11%. The shrinkage (%) is found to increase up to 11% after that is stabilized at 8% level. WPP fabric has shown felting shrinkage upto 8% at 4th cycle. It is found stabilized or reduce to 4%.WPA fabric has showed felting shrinkage ≤ 3%, which reveals that WPA fabric is more stable structure than other wool and wool blended fabrics. Moreover the WNP showed ≤ 2% felting shrinkage.

The mean value of shrinkage after six washing cycles is found highest for CW fabric(9.49%) followed by WPP(4.86%),WPA(3.11%) and WNP(0.89%).The difference in felting shrinkage of different fabric is found significant 99% confidence level($p<0.01$).It is further observed that the felting shrinkage(%) in WPA,WPP and WNP fabric is found significantly lower than commercial fabric at 99.9% confidence level($p<0.01$)

Ammayappan, Moses, Senthi, Raja and Jimmy (2011) confirm that wool fiber is easily susceptible to shrink during home laundering in comparison of other fibers. In all blended fabrics, proportion of wool fibre is higher (50%) as compare to other fibres. From above discussion it could be concluded that the blending of polyester and nylon with wool,pashmina and angora fiber significantly reduce the felting shrinkage and fabric could be made more dimensionally stable during washing. It is well established that blending of wool with synthetic fibre i.e. polyester and nylon reduces the rate of felting of woolen product.Wool/polyester blend woven product are often machine wash and easy care, however pure wool product get felt and shrink in the same washing cycle.The felt shrink effect depends on the proportion and type of synthetic fibre used in blend.This reduction in felt shrinkage is assume to involve the separation of wool fibre by the synthetic fibre, so that direct contact between wool fibre and the interaction of scales on the surface is restricted.Which cause reduction in shrinkage after blending of synthetic fibre in wool fibre(Kettewell, Boos and Jackson, 2014). Bruce, McGregor and Postle (2009) reported that cashmere wool blend with superfine merino wool affects fabric air permeability, resistance to pilling, relaxation shrinkage, hygral expansion and dimensional stability during laundering.

Conclusion:

It was concluded that fold geometrical characteristics depend not only on the structural and mechanical properties of fabric but also on the fibre type, blending and cloth construction. Blending of nylon increases the strength of WNP fabric, similarly blending of polyester andangora increases the tensile strength of WPA fabric.Tensile strength of wool highlyincreased after the blending of nylonas compare to polyester in blended fabrics, similarly blending of angora increases tensile strength as compare to pashmina. CW and WPP found adequate tensile strength.

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