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Comparison of Properties of Polyester/ Viscose & Cotton Knitted Fabrics

Rajiv Kumar
Associate Professor,
Deptt.of Textile Technology,
M.L.V. Textile & Engineering College,
Bhilwara, Rajasthan, India.

Abstract

Due to limited availability and higher cost of cotton fibre, polyester/ viscose knitted fabrics are increasingly used these days. The aim of the paper is to compare the properties of 65/35 Polyester-Viscose single jersey knitted fabric with that of 100% Cotton single jersey knitted fabric having same particulars. It was found that bursting strength of P/V knitted fabric is greater than cotton fabric, due to higher elongation at break values of P/V yarn. Abrasion resistance of P/V fabric was also greater than that of cotton fabric. The air permeability of cotton fabric is slightly less than P/V fabric due to bigger diameter and higher value of hairiness in case of cotton yarn. Moisture regain of cotton fabric is higher than P/V fabric. The thermal resistance of cotton fabric is found to be greater than P/V fabric due to higher values of hairiness and yarn diameter in case of cotton yarn. The courses/cm of cotton fabric is slightly greater than P/V fabric whereas wales/cm of both the fabrics is almost same. The stitch length of cotton knitted fabric is slightly less than P/V fabric of equivalent construction. This is due to greater flexural rigidity of P/V yarn than cotton yarn. A yarn having more flexural rigidity or stiffer yarn is supposed to follow a longer path, resulting in higher value of loop length. It will also lead to slight increase in the height of the loop. It implies that slightly less number of courses may be accommodated in the same unit space. The stitch density of cotton fabric is higher than P/V fabric, which is due to higher value of courses/cm in case of cotton fabric. The slightly higher value of tightness factor for cotton fabric is due to lower value of stitch length for this fabric. Thickness of cotton fabric is greater than P/V fabric. It is a combined effect of greater value of yarn diameter and hairiness for cotton yarn. The skewness in P/V fabric is more than cotton fabric. The snarling tendency of the P/V yarn is major cause of skewness of knitted fabric.

Keywords: Polyester Viscose Knitted Fabric, Cotton Knitted Fabric, Course per Cm, Wales per Cm.

Introduction

Natural fibres are always preferred for apparel purpose due to good moisture regain and comfort. Most common apparel fabrics are either woven or knitted. Knitted fabrics have many advantages. As compared to woven fabrics, knitted fabrics are more comfortable and retain their appearance for a longer time. Knitted fabrics are more flexible and adapts as per our body movement. Cotton knitted fabric is very popular and very common and widely used for various applications like under-garments, leisurewear and sportswear. Cotton knitted fabric is used for both innerwear and outerwear. But it has some drawbacks like poor abrasion resistance, wrinkle resistance and durability. The cotton fibre is grown in agricultural fields, hence it is available in limited quantity. With the advent of manmade fibres, a new horizon appeared in engineering textile fabrics, owing to their superior properties. The drawbacks of cotton knitted fabric can be overcome by using manmade fibre like polyester. Polyester is quite tough, durable, crease resistant and cheap also, but it is hydrophobic fibre and hence it is not considered comfortable for apparel purpose.

Most of the drawbacks of polyester are overcome if viscose is blended with polyester. Moisture regain of viscose is even greater than cotton fibre. Hence these days, polyester- viscose blended fabrics have become very popular in textile industry due to affordable price, good mechanical properties, functional properties, aesthetics and economics. Polyester viscose blend offers positive attributes of polyester and viscose

both. Polyester is responsible for greater resilience, shape and form retention, dimensional stability and durability. Viscose is responsible for absorbency, aesthetic feel, gracefulness and loftiness of the fabric. Thus combination of polyester and viscose plays an important role in achieving desirable properties.

Hence in the present study, the properties of polyester/ viscose single jersey knitted fabric have been examined and compared with 100% cotton single jersey knitted fabric. For this purpose it is necessary to study some properties like abrasion resistance, bursting strength, air- permeability, moisture regain and thermal resistance. At the same time course/cm, wales/cm, stitch length, stitch density, shape of the loop, tightness factor, thickness and weight of the polyester/ viscose and cotton knitted fabric has also been compared. Hence this work compares the properties of polyester-viscose single jersey knitted fabric with that of 100% cotton single jersey knitted fabric having same particulars.

Review of Literature

Research work in the field of polyester, viscose and cotton can be divided into many groups like yarn, woven fabrics and knitted fabrics. Hossain I. et al [1] have predicted the color properties of viscose knitted fabrics using soft computing approaches. They have tried to predict the colour strength of viscose knitted fabrics by using fuzzy logic model based on dye concentration, salt concentration and alkali concentration as input variables. The performance of fuzzy logic is compared with that of artificial neural network model. It was found that both artificial neural network and fuzzy logic models have ability and accuracy to predict the fabric colour strength effectively in non- linear domain. However ANN prediction model shows higher prediction accuracy than that of fuzzy model. Wu Wen [2] has studied functional finishing of viscose knitted fabrics via graphene coating. Functional finishing of viscose knitted fabrics was realized through layer by layer assembly with grapheme oxide and reduction treatment of hydrazine hydrate. These multifunctional fabrics have potential application in conductive devices, water treatment systems and smart textiles. Sular Vildan [3] has studied roughness and frictional properties of cotton and polyester woven fabrics. The roughness and frictional properties of cotton and polyester fabrics and relationship between these properties have been investigated and compared. For all the test fabrics, it was noted that an increase in weft setting causes decrease in fabric roughness values for every weave type and this tendency is in accordance with the fabric friction results. Relationship between frictional and roughness values show high correlations for both cotton and polyester fabrics. Tyagi G.K. et al [4] have studied comfort aspects of finished polyester-cotton and polyester- viscose ring and MJS yarn fabrics. The influence of different experimental conditions on the thermal comfort behavior of polyester- viscose and polyester-cotton ring and MJS yarn fabrics has been studied. The finished fabrics provide enhanced thermal insulation, more absorbency and lesser air and water transport than the corresponding grey fabrics regardless of yarn type.

Cincik E.[5] has analysed air-permeability of polyester- viscose blended needle- punched nonwovens. In this study an analysis on the air- permeability of the polyester- viscose blended needle punched nonwovens has been carried out. It was concluded that blend ratio of polyester- viscose fibres in web, fabric mass per unit area and needle density have major effects on the air-permeability of the nonwovens. Nayak R.K. et al [6] has studied comfort properties of suiting fabrics. The effects of polyester content, pick density and weave on the thermal comfort and tactile properties of polyester/ viscose blended yarn fabrics have been studied by measuring the low stress mechanical properties on Kawabata evaluation system. Tyagi G.K. [7] has studied effect of fibre cross- sectional shape on handle characteristics of polyester- viscose and polyester- cotton ring and MJS yarn fabrics. The relationships between handle characteristics of polyester-visose and polyester- cotton ring and MJS yarn fabrics and yarn bulk and yarn rigidity have been studied using FAST evaluation system. MJS yarn fabrics are relatively thicker, more rigid and provide a lower shear rigidity and enhanced formability. A polyester- cotton fabric has been found preferable to a polyester- viscose fabric in respect of fabric handle.

Bhargav G.S. [8] has studied effect of blend composition and fabric sett on some characteristics of Polyester- Viscose fabrics. In this study effect of blend composition and fabric sett on breaking strength, breaking extension, fabric assistance, flexural rigidity and air permeability of polyester- viscose blend fabrics has been studied. It was observed that reduction in the polyester component in the blend results in a weaker, less extensible and more flexible, permeable fabric with lower value of fabric assistance. Increase in fabric sett results in a strong, more extensible, less flexible and less permeable fabric with higher value of fabric assistance. Tyagi G.K. [9] has studied Hand related properties of polyester-viscose and polyester- cotton ring and MJS yarn fabrics, effect of fibre profile and finishing treatment. The hand related properties of polyester- viscose and polyester- cotton ring and polyester- viscose MJS yarn fabrics have been studied using FAST evaluation system. It was found that polyester- cotton fabrics are more rigid, less extensible and provide higher shear rigidity and enhanced formability even for similar fibre profiles. Mukhopadhyay A. [10] has evaluated comfort properties of polyester-viscose suiting fabrics. The comfort properties of polyester- viscose blended fabrics of two different structures plain and twill, have been

studied. It was observed that with the change in polyester content, total hand value of twill woven fabric shows different trend than that of plain woven fabric.

Aim of the Study

The aim of the study is:

1. To prepare 65/35 Polyester-Viscose blended knitted fabric and 100% Cotton single jersey knitted fabric with same yarn and fabric particulars.
2. To compare bursting strength and abrasion resistance of 65/35 Polyester-Viscose blended knitted fabric with that of 100% Cotton single jersey knitted fabric.
3. To compare air permeability and moisture regain of 65/35 Polyester-Viscose blended knitted fabric with that of 100% Cotton single jersey knitted fabric.
4. To compare geometrical properties like course/cm, wales/cm, stitch length, stitch density, shape of the loop, tightness factor, thickness and weight of the polyester/ viscose and cotton knitted fabric.

Material and Methods

To manufacture P/V yarn and cotton yarns for knitting purpose, rovings of 65/35 polyester-viscose blend and 100% cotton were procured from a nearby industry. The fibres were taken out from the respective rovings, identified on microscope and then tested on Vibroskop and Vibrodyn. The results are shown in Table 1. Two types of yarns of 30^S Ne (19.68 Tex) were spun having twist multiplier 2.7, from the rovings of 65/35 P/V and cotton. A low twist multiplier was used, as the yarn was intended for knitting purpose and to compare both the yarns and fabrics under similar conditions. While yarn manufacture at ring frame, the roller settings were fixed according to the fibre length.

Two types of fabrics, 65/35 Polyester-Viscose blended fabric and 100% Cotton single jersey knitted fabric were knitted on single jersey, 24 feeder circular knitting machine having 12 inches diameter, total numbers of needles 886 and 24 gauge. Both the fabric samples were knitted at the same time one by one with same cam setting.

The dry relaxed fabric samples were conditioned in the standard atmospheric test conditions of 65% $\pm$ 2% RH and 27^0C $\pm$ 2^0C and then tested for the following properties according to the standard test methods.

Bursting strength of the fabric was measured on Prolific bursting strength tester. Flat abrasion resistance of the fabric was measured on Prolific abrasion tester. Abrasion resistance is expressed as average number of cycles required to produce a hole in a knitted fabric. Zero number emery paper was used as an abradant. Air permeability of the fabric was measured on Prolific air permeability tester. Moisture regain of the fabric was determined according to ASTM standards. Thermal resistance of the fabric was measured on Sasmira thermal conductivity apparatus. In this case time taken by the hot plate to cool down from 50^0C to 49^0C was noted down for each sample and clo value was found. The guard box temperature was maintained a 50^0C. The pilling tendency was tested using Heal's pilling boxes.

Course and wale density of the fabrics was measured with thread counting glass. Stitch length of the knitted fabric was measured according to British Standards. The stitch density was obtained by multiplying wales/cm and course/cm. The knitting constants were calculated from the following equations

K_C = Course/cm × Stitch length

K_w = Wales/cm × Stitch length

$K_s = K_c \times K_w$

Loop shape factor, tightness factor and fabric bulk were calculated by following formulas

Loop shape factor = K_C / K_w

Tightness factor = $\frac{\sqrt{T}}{l}$ where T is tex of yarn and l is loop length.

Fabric bulk (cc/g) = Thickness (cm)/ Weight of fabric (g/cm^2)

Thickness of the fabric was measured on Prolific thickness tester at a foot pressure of 20 gf/cm^2. Skewness of the fabric was measured according to ASTM standards.

Table 1 Comparison of Fibre Properties

	Polyester	**Viscose**	**Cotton**
Tenacity (g/den)	6.14	2.21	2.22
	(8.15)	(21.95)	(12.44)
Elongation (%)	25.88	16.27	10.01
	(14.10)	(11.50)	(15.41)
Staple length (mm/2.5% span length)	51	51	25.41
	(28.20)	(20.42)	(25.42)
Fineness (den/micronaire)	1.41	1.61	4.0
	(5.54)	(10.13)	(20.42)

Figure in parenthesis represents CV%.

Results & Discussion

The properties of single jersey cotton and P/V knitted fabric are shown in Table 2.

Table 2 Fabric Properties

	Knitted Fabrics	
	Cotton	**Polyester/ Viscose**
Bursting strength (KN/sq. m)	448.17	733.98
	(15.8)	(18.72)
Abrasion resistance (cycles)	510	1055
	(25.42)	(26.42)
Air permeability (cubic m/sq. m/min.)	173.37	183.47
	(14.67)	(16.2)
Moisture Regain (%)	5.37	2.8
	(16.42)	(12.45)
Pilling Tendency	1	3
Thermal Resistance (clo)	1.9	1.3
	(12.14)	(16.14)

Figure in parenthesis represents CV%

From Table 2, it is clear that bursting strength of P/V knitted fabric is greater than cotton fabric of equivalent construction. The extensibility of

the yarns and structure of the fabric are the important factors which affects bursting strength of fabric. Higher bursting strength of P/V fabric may be attributed to higher elongation at break values of P/V yarn as the structure of both fabrics are same. It is observed from Table 2 that abrasion resistance of P/V fabric is much greater than that of cotton fabric. The same trend was also observed in yarn abrasion resistance. This trend may be ascribed to the higher tenacity and elongation percentage at break values and hence higher toughness index of P/V yarn. The air permeability of cotton fabric is slightly less than P/V fabric. This may be due to bigger diameter and higher value of hairiness in case of cotton yarn. Cotton fabric exhibits higher value of moisture regain as compared to P/V fabric. This trend accords with the blend proportion of the yarns studied. Results of pilling test revealed that fabric knitted from P/V yarn has more pilling propensity. This may be due to presence of higher tenacity polyester fibre in P/V yarn. The thermal resistance of cotton fabric is found to be greater than P/V fabric. This trend may be explained on the basis of higher values of hairiness and yarn diameter in case of cotton yarn.

Geometrical Properties of Knitted Fabrics

The physical properties of dry relaxed cotton and P/V fabrics are shown in Table 3. It is clear from this Table that courses/cm of cotton fabric are slightly greater than P/V fabric whereas wales/cm of both the fabrics are almost same. The higher value of courses/cm for cotton may be explained on the basis of stitch length of the fabric. The stitch length of cotton knitted fabric is slightly less than P/V fabric of equivalent construction. We have already observed that flexural rigidity of P/V yarn is slightly greater than cotton yarn. A yarn having more flexural rigidity or stiffer yarn is supposed to follow a longer path and resulting in higher value of loop length. It will also lead to slight increase in the height of the loop. It implies that slightly less number of courses be accommodated in the same unit space.

The stitch density of cotton fabric is higher than P/V fabric, which is due to higher value of courses/cm in case of cotton fabric. The knitting constants K_C , K_W and K_S are also shown in Table 3. The value of loop shape factor (ratio of K_C and K_W) which depends upon shape of the loop, is higher in case of cotton fabric. This is again due to higher value of courses/cm in cotton fabric. The slightly higher value of tightness factor for cotton fabric is due to lower value of stitch length for this fabric.

It is clear from Table 3 that thickness of cotton fabric is greater than P/V fabric. It may be a combined effect of greater value of yarn diameter and hairiness for cotton yarn. The skewness in P/V fabric is more than cotton fabric. The snarling tendency in the yarn is major cause of skewness of knitted fabric. The value of skewness are reflecting similar trend as that of snarling tendency in the yarn. The weight/m^2 of the fabrics which is a combined effect of stitch density, stitch length and tex of yarn, is also shown in Table 3. Fabric bulk (ratio of thickness and areal density of fabric) of cotton fabric is slightly greater than P/V fabric.

Table 3 Properties of Cotton and Polyester/ Viscose Knitted Fabrics

	Knitted Fabrics	
	Cotton	**Polyester/ Viscose**
Yarn linear density (tex)	20.16	19.58
	(3.6)	(3.12)
Course/cm	17.58	16.59
	(0.99)	(0.85)
Wales/cm	13.85	13.76
	(1.21)	(1.12)
Stitch density/cm^2	243.48	228.32
Stitch length (cm)	0.3027	0.3132
	(3.62)	(2.81)
Kc	5.3212	5.1980
Kw	4.1922	4.3100
Ks	22.307	22.403
Loop shape factor	1.2693	1.2060
Tightness factor	14.833	14.125
Thickness (cm)	0.0505	0.0434
	(1.92)	(1.48)
Skewness (%)	17.5	19.0
Weight(gm/m^2)	132.66	123.62
Fabric bulk * 10^4	3.53	3.5107

Figure in parenthesis represents CV%.

Conclusion

The results of the study are as follows:

1. It was found that bursting strength and abrasion resistance of 65/35 blended Polyester/ Viscose knitted fabric is greater than 100 % cotton knitted fabric of equivalent construction. Higher bursting strength of P/V fabric may be attributed to higher elongation at break values of P/V yarn as the structure of both fabrics are same.
2. The air permeability of cotton fabric is slightly less than P/V fabric. This may be due to bigger diameter and higher value of hairiness in case of cotton yarn. Cotton fabric exhibits higher value of moisture regain as compared to P/V fabric.
3. The stitch length of cotton knitted fabric is slightly less than P/V fabric of equivalent construction. This is due to fact that flexural rigidity of P/V yarn is slightly greater than cotton yarn. A yarn having more flexural rigidity is stiffer and is supposed to follow a longer path and resulting in higher value of loop length.
4. Courses/cm of cotton fabric is slightly greater than P/V fabric whereas wales/cm of both the fabrics are almost same.
5. Thickness of cotton fabric is greater than P/V fabric. It may be a combined effect of greater value of yarn diameter and hairiness for cotton yarn.

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References

Bhargava G.S., Yadav R.K., (December 1983), Effect of blend composition and fabric sett on some characteristics of Polyester-viscose fabrics, Indian Journal of Textile Research, Vol 8, No. 4, p 115-120.

Cincik E., Koc Erdem., (September 2012), An analysis on air- permeability of polyester-viscose blended needle punched nonwovens , Textile Research Journal, Vol 82, No 5, p 430-442.

Hossain Ismail., Choudhury I.A., Mamat A.B., Hossain A., (January 2017), Predicting the colour properties of viscose knitted fabrics using soft computing approaches, The Journal of Textile Institute, Vol 108, No. 10, p 1689-1699.

Mukhopadhyay A., Sharma I.C., Sharma M., (March 2002), Evaluation of comfort properties of polyester- viscose suiting fabrics, Indian Journal of Fibre and Textile Research, Vol 27, No. 2, p 72-76.

Nayak R.K., Punj S.K., Chatterjee K.N., Behera B.K., (June 2009), Comfort properties of suiting fabrics, Indian Journal of Fibre and Textile Research, Vol 34, No. 2, p 122-128.

Sular V., Oner E., Okur A., (December 2013), Roughness and frictional properties of cotton and polyester woven fabrics, Indian Journal of Fibre and Textile Research, Vol 38, No. 4, p 349-356.

Tyagi G.K., Krishna G., Bhattacharya S., Kumar P., (June 2009), Comfort aspects of finished polyester- cotton and polyester- viscose ring and MJS yarn fabrics, Indian Journal of Fibre and Textile Research, Vol 34, No. 2, p 137-143.

Tyagi G.K., Bhattacharya S., Kumar P., (June 2008), Hand related properties of polyester- viscose and polyester- cotton ring and MJS yarn fabrics- Effects of fibre profile and finishing treatment , Indian Journal of Fibre and Textile Research, Vol 33, No. 2, p 126-131.

Tyagi G.K., Madhusoodanan P., (December 2006), Effect of fibre cross- sectional shape on handle characteristics of polyester- viscose and polyester- cotton ring and MJS yarn fabrics, Indian Journal of Fibre and Textile Research, Vol 31, No. 4, p 496-500.

Wu W., Zhang H., Ma H., Cao J., Jiang L., Chen G., (March 2017), Functional Finishing of Viscose Knitted Fabrics via Graphene Coating, Journal of Engineered Fibres and Fabrics, Vol 12, No. 3, p 1-6.