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Innovation The Research Concept

Suitability of Polyester/ Viscose & Cotton Yarns for Knitting

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Abstract

These days cotton yarn is extensively used for knitted fabrics. Cotton is a natural fibre and available in limited quantity, hence textile industry uses manmade fibres like viscose, polyester and their blends for knitted fabrics. Polyester/ viscose 65/35 blended yarn is very commonly used in producing woven fabrics and knitted fabrics. A yarn should possess some qualities if it is meant for knitting. Hence it is necessary to compare properties of polyester/ viscose 65/35 and cotton yarn for knitting purpose. In this study suitability of polyester/ viscose 65/35 and cotton yarn for knitting has been examined. For this purpose tenacity, elongation, evenness, imperfections, hairiness, flexural rigidity, yarn metal friction, loop breaking load, knot breaking load and snarling tendency of polyester/ viscose 65/35 and cotton yarn has been examined. Tenacity, elongation and fibre strength realization of polyester/ viscose 65/35 yarn is greater than cotton yarn. Cotton yarn has more imperfections, unevenness and hairiness values. Flexural rigidity of P/V yarn is slightly greater than cotton yarn. Abrasion resistance of P/V yarn is much greater than cotton yarn. Yarn metal friction of polyester/ viscose 65/35 yarn is slightly lesser than cotton yarn. Snarling tendency of polyester/ viscose 65/35 yarn is greater than cotton yarn. Loop breaking load and knot breaking load of polyester/ viscose 65/35 yarn is greater than cotton yarn. All these properties indicate that good quality knitted fabrics may be manufactured from polyester/ viscose 65/35 yarn.

Keywords: Polyester- Viscose Blend, Cotton Yarn, Loop Strength, Knot Strength Suitability of Yarn for Knitting.

Introduction

These days knitted fabrics are very popular. Knitted fabrics have many advantages. As compared to woven fabrics, knitted fabrics are more comfortable and retain their appearance for a longer time. It adapts easily to body movements and has good recovery from wrinkles. There are more open spaces between yarns due to looped structure of knitted fabric and hence air permeability is greater than woven fabric.

Knit fabrics provide outstanding comfort qualities and have long been preferred as fabrics in many kinds of clothing. This fact, combined with new technological advancements that have increased the variety of knits available, has expanded their use to approximately 50% of the apparel fabrics. In addition to comfort due to stretch imparted by looped yarn structure, knits also provide light weight, warmth, wrinkle resistance and ease of care. Among the qualities that make one fabric preferable or selected over another is handle or the sensations associated with touching.

A combination of a high order of extensibility with a relatively low modulus and good recovery properties may be regarded as the distinguishing characteristics of knitted fabrics. Knitted fabrics are widely used for outerwear as well as for under-garments, leisurewear and sportswear. The easy-care and high extensibility of garments which, irrespective of the body-movements, allow the garment to fit the body without excess strain. The extensibility of a knitted structure is of the order of 10 times that of a woven fabric made from same material and is caused by the inherent loop structure of which the fabric is constructed.

In knitting sector, cotton garments are most commonly used. But it has some drawbacks like poor abrasion resistance, wrinkle resistance and durability. 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. Hence in the present study, the feasibility of producing single jersey knitted fabric has been examined. For this purpose it is necessary to study suitability of polyester/ viscose yarn for knitting purpose. Cotton yarn is very commonly used for knitted fabrics. Hence this work compares the properties of polyester-viscose yarn with that of 100% cotton yarn having same yarn particulars.

Review of Literature

Research work in the field of polyester, viscose and cotton can be divided into many groups like yarn, woven fabrics, knitted fabrics and fabrics containing spandex.

Canoglu S.[1] has studied hairiness values of the Polyester / Viscose ring- spun yarn blends. The aim of the study was to investigate the hairiness of ring- spun polyester/ viscose blends which are commonly used in the textile industry by three different test methods. The pilling values of these samples were also determined. As a result within the produced yarns, the worse hairiness was obtained on the viscose yarns and the worse pilling values are existed on the knitted fabrics which are formed from these spun yarns. Sardag S. [2] has has studied effects of heat setting on the properties of Polyester/ Viscose blended yarns. Bobbins consisting of 67% polester and 37% viscose were subjected to heat setting in order to investigate the effects of heat setting conditions on the properties of twisted yarns. Both heat set and unset yarns were dyed. The tensile strength properties of yarns were measured before heat setting, after heat setting and after dyeing. As a result heat setting and dyeing processes were found effective in the tenacity and elasticity of the yarns. Kaushik R.C.D. et al [3] have studied influence of draw- off nozzle type on characteristics of Polyester-Viscose rotor spun yarns. The effect of yarn twist, yarn composition and draw off nozzles on the properties of polyester- viscose rotor spun yarns has been studied. It is observed that surface characteristics of the draw- off nozzle have greater influence on the polyester fibre yarns. Notched draw- off nozzle produces stronger, more extensible and more even yarns. Tyagi G.K. [4] has studied variation on polyester-viscose and polyester- cotton ring and rotor yarn characteristics as a consequence of fibre cross-section. The influence of twist factor and rotor speed on the properties of polyester ring and rotor yarns spun from polyester fibres of circular and trilobal cross- sections has been studied. Fibre profile plays a key role in determining the mechanical and surface properties of the all polyester, polyester- viscose and polyester-cotton yarns, as evidenced by the fact that both ring and rotor spun yarns with trilobal polyester fibre have lower tenacity, higher breaking extension, more twist liveliness, lower work of rupture and higher flexural rigidity. Mahish S.S. [5] has studied effect of process parameters and blend percentage on physical properties of polyester/ viscose blended air- jet textured yarns. The effect of air pressure, overfeed and varying blend percentage on the properties of the polyester- viscose blended air- jet textured yarn has been studied. It is observed that at lower air-pressure and overfeed levels, the increasing texturing speed reduces physical bulk, and at higher texturing speed the increasing overfeed increases physical bulk. Tyagi G.K. [6] has studied physical characteristics of polyester- viscose and polyester- cotton yarns spun on ring and rotor spinning system. It was found that rotor spun yarn are slightly weaker, more extensible, more regular and have fewer imperfections and higher yarn quality index than their ring- spun counterparts. However polyester majority yarns require higher twist factors than polyester minority yarns in spinning on a rotor frame.

Lou C.W. [7] has produced Polyester core-spun yarn with spandex using a Multi- section drawing frame and a Ring spinning frame. In the present study a polyester core- spun yarn containing spandex fibres was made using a self-designed, multi- section drawing frame and a ring spinning frame. The mechanical properties of the core- spun elastic yarns were examined in various processing conditions. The results show that when the main drawing ratio of the spandex fibres was either 2.2 or 2.7, the maximum breaking tenacity and elongation of the core-spun elastic yarns exceeded those in any of the main drawing ratio conditions. Babaarslan Osman[8] has developed method of producing a Polester/ Viscose core- spun yarn containing Spandex using a modified ring spinning frame. In this study, method of producing a polyester/ viscose covered Lycra core- spun on a modified short staple ring spinning frame is discussed. The experiment and test results show that core positioning has a direct effect on the structure, properties and performance of these core- spun yarns.

Subramaniam V. [9] has studied effect of fibre length, fineness and twist on the bending behavior of polyester and viscose staple rotor spun yarns. It was found for the polyester staple rotor spun yarns, use of shorter and coarser fibres leads to a higher magnitude of bending hysteresis, yarn bending rigidity and bending recovery. For the viscose staple rotor spun yarns, use of longer staple fibres leads to increased bending hysteresis and yarn bending rigidity. Basu A.[10] has studied quality characteristics of polyester/ viscose and polyester/ cotton two ply yarns. The inter-relationship between the characteristics of single and double yarns made of polyester- viscose and polyester- cotton has been studied. The major yarn characteristics such as unevenness, imperfections, single yarn strength, elongation at break and yarn hairiness of double yarns were found to be related to the respective properties of single yarn. Tyagi G.K. et al [11] have studied contribution of fibre profile to performance

characteristics of polyester- viscose and polyester- cotton ring and MJS yarns. In this study the influence of fibre cross- sectional shape and production speed on the performance potential of polyester- viscose and polyester-cotton ring and MJS yarn has been studied. For all experimental combinations, the MJS yarn possess better structure integrity, better compressional resilience, less hairiness and lower abrasion resistance than ring- spun yarns.

Aim of the Study

The aim of the study is

1. To evaluate and compare the properties of polyester/ viscose 65/35 and 100 % cotton yarn.
2. To compare knitting specific properties like yarn metal friction, loop breaking load, knot breaking load and snarling tendency of polyester/ viscose 65/35 and cotton yarn.
3. To compare flexural rigidity and abrasion resistance of polyester/ viscose 65/35 and 100 % cotton yarn so as estimate durability.
4. To check suitability of polyester/ viscose 65/35 yarn for knitting.

Material and Methods

To manufacture P/V yarn 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.

All the fibres and yarns test sample were conditioned in a standard atmospheric conditions of 65% RH $\pm$ 2% and 27^0C $\pm 2^0$C temperature. Fibre fineness and tenacity where assessed on Vibroskop and Vibrodyn according to ASTM D3822-95(a). Yarn tensile properties were tested on Instron tensile tester 4465 according to ASTM D2256. The fibre strength realisation percentage is a ratio of actual yarn strength and fibre strength expressed as a percentage. In the case of binary blends where the two components have different elongation at break and proportions, it is the ratio of actual and expected yarn strength.

Yarn evenness, imperfections and hairiness were tested on Keisokki evenness tester 80 and Zweigle G 566 hairiness tester according to ASTM D1425-96 and ASTM D5647-95 respectively. Yarn abrasion resistance (Flex) was tested on Custom Scientific Instruments according to ASTM D1379-64. Loop strength and knot strength of yarns were evaluated on Instron tensile tester 4465 according to BS 1932 Part-II. Yarn metal friction was measured on the Shirley yarn friction recorder winder according to ASTM D3108.

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 comparison of 30^S P/V and 30^S cotton yarn having same twist is shown in Table 2. It is evident from Table 2 that yarn tenacity of P/V yarn is much greater than equivalent cotton yarn. This may be attributed to the high tenacity of polyester fibre, longer fibre length and absence of short fibres. Yarn strength realization was calculated by dividing yarn strength and fibre strength. In case of P/V blend, it was calculated from the stress-strain curves of polyester and viscose. The fibre strength realization of P/V yarn is greater than cotton yarn due to the reasons explained above for yarn tenacity. The elongation at break values of P/V yarn is also greater than cotton yarn. As the construction and twist of both the yarns is same, this may be due to higher elongation at break values of polyester and viscose fibres as compared to cotton. The modulus of P/V yarn is observed to be higher than cotton yarn.

A higher value of U% is observed in case of cotton yarn due to presence of short fibres in it. Total numbers of imperfections are also higher in cotton yarn. This may be due to length variation in case of cotton fibres. The hairiness of cotton yarn is also greater due to presence of short fibres, which could not have been incorporated in the body of yarn during twisting.

Flexural rigidity of P/V yarn is observed to be slightly greater than cotton yarn. The abrasion resistance of P/V yarn is much greater than cotton yarn. The toughness index has maximum influence on abrasion resistance of yarn and it depends upon strength as well as extensibility of the yarn. The greater values of tenacity and elongation percentage at break values may be the cause of excellent abrasion resistance of P/V yarn as compared to cotton yarn.

The diameter of P/V yarn is slightly less than cotton yarn. The comparison of both yarns reveals that P/V yarn is superior in appearance and grading of yarn appearance board according to the standard followed.

Table 2 Yarn Properties

	P/V	Cotton
Yarn linear density(Tex)	20.42	20.16
	(3.25)	(3.6)
Tenacity(g/tex)	24.27	11.23
	(9.02)	(7.84)
Fibre strength realisation(%)	61.63	56.2
Strain % at break	11.01	5.26
	(7.89)	(8.12)
Modulus(gm/tex)	545.2	395.5
	(42.12)	(30.52)
Unevenness(U%)	10.82	16.32
Imperfections/250 meters		
Thin place (-50%)	3	92
Thick place (+50%)	5	106
Neps (200%)	19	216
Total imperfections	27	414
Hairiness value S3 (Hairs>3mm)	2237	2872
Flexural rigidity * 10^3 ($gm*cm^2$)	3.8298	3.7133
	(9.48)	(10.42)
Abrasion resistance (cycles)	856	110
	(25.32)	(28.12)
Yarn diameter	.01716	.020528
	(9.74)	(16.16)
Yarn appearance grade	B	C

Figure in parenthesis represents CV%.

The properties related to knitting are shown in Fig. 3.

Table 3 Yarn Properties for Knitting

Yarn Property	P/V	Cotton
Yarn metal friction	0.38	0.4
	(3.42)	(2.82)
Loop breaking load(Kg)	0.845	0.4349
	(12.84)	(6.39)
Loop breaking extension (%)	9.59	9.33
	(10.32)	(3.79)
Loop strength ratio	0.8589	0.9802
Knot breaking load(Kg)	0.4	0.1884
	(15.32)	(9.09)
Knot breaking extension (%)	10.47	9.06
	(12.32)	(8.8)
Knot strength ratio	1.2297	0.851
Snarling tendency(cm)	7.5	6.1
	(12.45)	(20.24)

Figure in parenthesis represents CV%

The loop breaking load of P/V yarn is observed to be greater whereas loop strength ratio is lesser than cotton yarn. This may be due to higher tenacity of P/V yarn. The loop breaking extension of both the yarns is almost same. The knot breaking load and knot strength ratio of P/V yarn are much greater than cotton yarn whereas knot breaking extension of P/V yarn is slightly greater than cotton yarn. It is clear from all the above mentioned observations that P/V yarn is suitable for knitting operation. The values of loop tests and knot tests are superior to cotton yarn except loop strength ratio.

Even after steaming the snarling tendency of P/V yarn is slightly greater than cotton yarn.

Conclusion

The results of the study are as follows

1. It was found that tenacity, elongation, of polyester/ viscose 65/35 yarn is greater than cotton yarn.
2. Unevenness, total number of imperfections, hairiness of cotton yarn was found higher than polyester/ viscose 65/35 yarn
3. Yarn metal friction of polyester/ viscose 65/35 yarn is slightly lesser than cotton yarn. Snarling tendency of polyester/ viscose 65/35 yarn is greater than cotton yarn. Loop breaking load and knot breaking load of polyester/ viscose 65/35 yarn is greater than cotton yarn.
4. All these properties indicate that polyester/ viscose 65/35 yarn is likely to perform well in knitting operation.

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