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Effect of Blend Percentage on Properties of Silk Acrylic Knitted Fabrics

Abstract

In this study effect of blend percentage on the properties of silk-acrylic blended knitted fabrics has been analysed. For this purpose, single jersey weft knitted fabrics were prepared from acrylic silk blended yarns such as 100% shrinkable acrylic A10, 80% shrinkable acrylic and 20% silk (A8S2), A6S4, A5S5, A6S4, A8S2 and 100% silk S10. Fabric properties in dry relaxed condition were analyzed. Effect of blend percentage on course/cm, wales/cm, stitch length, stitch density, loop shape factor, tightness factor, thickness and skewness of silk- acrylic blended single-jersey knitted fabrics has been studied. It has been found that course/cm first increases, then reaches maximum at 50/50 silk- acrylic blend and then decreases. Values of wales/cm and stitch length decrease and then increase. Stitch density increases and then decreases. Decrease in stitch length is due to increase in bulk of yarn. Tightness factor is inversely proportional to stitch length. Thickness also increases and reaches maximum at 50/50 level and then decreases. Skewness of silk- acrylic blended fabrics is lesser than equivalent cotton fabric. Angle of spirallity or skewness of silk rich blends is greater than acrylic fabrics.

Keywords: Single Jersey Knitted Fabric, Course/Cm, Wales/Cm, Silk-Acrylic Blend.

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

Introduction

A variety of natural and synthetic fibres are used to manufacture different kind of knitted fabrics. Selection of a fibre depends upon fibre properties and it's end-use. It also depends upon unique characteristics and features of each fibre. While natural fibres are known for good moisture absorption properties whereas synthetic fibres are known for easy care properties, dimensional stability and durability. No single fibre can provide required properties. Right selection of fibre is necessary for particular end-use. The blend percentage of different fibres also play important role in determining properties of knitted fabrics. The structure of knitted fabric also changes with the blend percentage. It is necessary to study change in the structural parameters with the change in blend percentage

Silk is a natural fibre and is having good tenacity. Since the yarn posseses low bulk, hence more number of threads are required for producing better cover. This problem can be reduced by blending acrylic fibre with silk. Several researches have been done for studying effect of fibre type, yarn variables like count, twist on the properties of knitted fabrics but change in dimensional properties of single jersey weft knitted fabrics with the change in blend percentage have not been reported. Blending of silk and acrylic is relatively new to the industry and not much work has been done in this field. In this study properties of silk acrylic single jersey weft knitted fabrics at different blend levels has been studied. For comparison purpose cotton fabric of same construction was also manufactured so that properties of different blends can be compared with very common and popular cotton knitted fabric.

In this study the change in structure of loop with the change in blend percentage has been studied. Essential parameters related to loop shape like course/cm, wales/cm, stitch length, stitch density, loop shape factor, tightness factor, thickness, skewness, weight, fabric bulk has been studied.

Review of Literature

Research in the field of knitted fabric can be divided into many fields like effect of different types of yarns, effect of blend percentage, prediction of models to explain properties of knitted fabrics, relaxation of knitted fabrics, moisture transport, handle properties and thermal properties of knitted fabrics.

Jebali N. et al [1] have studied effect of test conditions and structural parameters on surface roughness of weft knitted structures. This study has been aimed at investigating the effect of test conditions and structural parameters of knitted fabrics and then establishing the relationships among the sample characteristics, the test conditions and the surface roughness parameters using the analysis of variance. The experimental results demonstrate that the yarn count, fabric structure, extension, applied force of the sensor and their interaction influence fabric roughness. Liu Xinjin., Su Xuzhong [2] have studied properties of knitted fabric made from modified ring- spun yarn. A modified ring spinning system, wherein a kind of airflow twisting device is equipped for improving the twist propagation process of ring spinning system. Three different yarns were spun and properties of corresponding knitted fabric including the thickness, weight per square metre, distorted angle, bursting strength and air- permeability were determined. It is found that compared to knitted fabric made from conventional ring spinning system, the fabrics spun on modified spinning system show reduced thickness, weight per square metre and spirality angle, increased bursting strength and improved permeability.

Kurbak Arif [3] has studied geometrical models for weft- knitted spacer fabrics. In this study geometrical models for weft- knitted spacer fabrics are created. Models of two commonly used weft- knitted spacer fabrics are created and are drawn to scale using computer graphical programme. It is observed that similar shapes to the real fabrics are obtained by models. Choi K. F. [4] has proposed energy model of plain knitted fabric. One major feature of this model is that the yarn in the fabric can be naturally curved with non- linear mechanical properties. The new model is able to describe the dimensional and low stress mechanical properties of a plain knit.

Candan C. [5] has studied performance of Open-end and ring spun yarns in weft knitted fabrics. In this paper the dimensional and some physical properties of a series of plain jersey and lacoste fabrics made from both cotton ring and open-end spun yarns are investigated. The results show that structural differences in the yarn play a large part in determining the dimensions and behavior of these two fabric types. As far abrasion resistance is concerned, ring spun knits perform slightly better than open end spun knits. Chen Q. H. et al [6] have studied effects of yarn and knitting parameters on the spirality of of plain knitted wool fabrics. This study investigates the relationship between the spirality of plain wool knits and various variables. Loop length and fibre diameter also show significant effects. In general increasing twist factor, loop length, and fibre diameter increases the angle of spirality. Sharma I. C. et al [7] have studied feasibility of single jersey fabric from open end spun blended yarn. The dimensional and mechanical properties of plain knitted fabrics from open end and ring spun acrylic viscose blended yarns are investigated. The fabric area shrinkage, thickness and areal density of open end spun yarns are greater but the bursting strength is less in comparison to ring spun yarn.

Jhanji Yamini et al [8] have studied comfort properties of plain knitted fabrics with varying fibre type. This study investigated the effect of fibre type and yarn linear density on the thermal properties such as thermal resistance, thermal conductivity and thermal absorbptivity alongwith air- permeability and moisture vapour transmission rate of single jersey plated fabrics. Ramachandran T. [9] has studied thermal behavior of ring and compact spun yarn single jersey, rib and interlock knitted fabric. The effect of thermal behavior, such as thermal insulation, thermal conductivity and thermal diffusion of single jersey rib and interlock knitted fabrics made out of ring and compact spun yarns has been studied. Sharma I. C. et al [10] have studied dimensional and physical characteristics of single jersey fabrics. An account is given of the dimensional changes of plain weft knitted fabrics made from 12^s, 16^s and 22^s grasicrimp yarn, brought about by various processes of relaxation. Hasani H. [11] has studied effect of processing stages on mechanical and surface properties of cotton knitted fabrics. The influence of different processing stages on the low stress mechanical and surface properties of cotton knitted fabrics has been studied.

In the previous study, Kumar R. [12], it was found that after steaming the increase in yarn diameter is maximum for acrylic- silk 50/50 blend. Lot of references are available for knitted fabrics but effect of blend percentage on the properties of knitted fabrics are few.

Aim of the Study

The aim of the study is,

1. To produce silk acrylic blended single jersey weft knitted fabrics at different blend levels.
2. To find out the effect of blend ratio on the geometrical properties of silk acrylic blended single jersey weft knitted fabrics.
3. To study effect of blend percentage on course and wales of knitted fabrics.
4. To study effect of blend ratio on the knitting constants of silk acrylic blended single jersey weft knitted fabrics.

Materials and Methods

Acrylic-silk yarns in different blend proportions such as 100% shrinkable acrylic A10, 80% shrinkable acrylic and 20% silk (A8S2), A6S4, A5S5, A6S4, A8S2 and 100% silk S10. were prepared of 30^s N_e and Twist multiplier 2.7 (T.p.i 14.8). For comparison of acrylic-silk blended yarns with equivalent cotton yarn, 100% cotton yarn of 30^s N_e and Twist multiplier 2.7 (T.p.i 14.8) was also prepared. All silk-acrylic blended fabrics, 100% silk and cotton fabrics were knitted on single jersey, 24 feeder circular knitting machine having 12 inches diameter, total numbers of needles 886 and 24 gauge. All 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

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conditions of 65% $\pm$ 2% RH and 27^{0}C $\pm$ 2^{0}C and then tested for the following properties according to the standard test methods.

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 constant 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.

Result and Discussion

Table 1 Properties of Acrylic-Silk Blended Dry Relaxed Knitted Fabrics

	Acrylic	A8S2	A6S4	A5S5	A4S6	A2S8	Silk	Cotton
Yarn linear density (tex)	19.9	19.9	19.5	19.5	19.9	19.5	20.3	20.2
	(3.1)	(2.5)	(3.7)	(2.7)	(2.1)	(2.6)	(3.8)	(3.6)
Course/cm	18.6	18.8	19.8	20.1	18.8	18.1	17.4	17.6
	(1.4)	(1.2)	(1.3)	(1.4)	(1.2)	(1.2)	(1.3)	(0.9)
Wales/cm	13.5	13.4	13.1	13.1	13.4	13.5	13.9	13.9
	(1.2)	(0.9)	(1.1)	(1.2)	(1.2)	(1.3)	(0.9)	(1.2)
Stitch density/cm^2	251.1	251.9	259.4	263.3	251.9	244.4	241.9	244.6
Stitch length (mm)	2.79	2.78	2.73	2.71	2.88	2.97	3.09	3.03
	(2.9)	(2.1)	(3.1)	(2.4)	(3.4)	(2.7)	(2.1)	(3.6)
Kc	5.19	5.23	5.41	5.45	5.41	5.38	5.38	5.33
Kw	3.77	3.73	3.58	3.55	3.86	4.01	4.30	4.21
Ks	19.5	19.5	19.3	19.3	20.9	21.6	23.1	22.5
Loop shape factor	1.38	1.40	1.51	1.53	1.40	1.34	1.25	1.27
Tightness factor	16.0	16.0	16.2	16.3	15.5	14.9	14.6	14.8
Thickness (mm)	0.57	0.6	0.63	0.64	0.58	0.52	0.45	0.5
	(1.5)	(1.7)	(1.4)	(1.3)	(1.3)	(1.6)	(1.8)	(1.9)
Skewness (%)	1	1.4	1.5	2	2.6	2.8	3	16.5
Weight (gm/m^2)	155.3	160.9	165.2	165.9	152.2	143.5	140.5	142.6
Fabric bulk (cc/g)	3.67	3.73	3.81	3.86	3.81	3.62	3.20	3.51

(Figures in parenthesis represent CV %)

The count of yarn was same for all the blends 30^s N_e or 20 tex. It may be observed that as the silk percentage in the blend silk- acrylic changes, the course/cm increases and then decreases after 50% silk level. Fig.2 indicates that as the percentage of silk increases wales/cm first decrease and then increase slightly.

Fig 1.- Effect of Blend % on Course/ cm

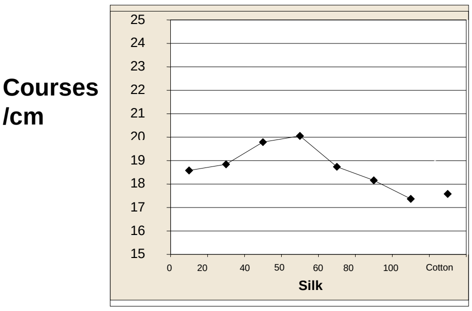
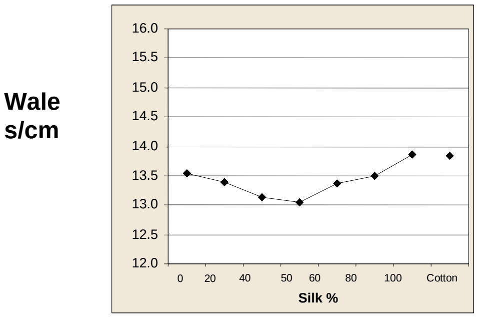
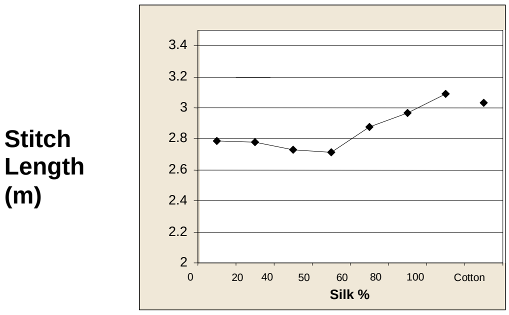


Fig.2 Effect of Blend % on Wales/cm



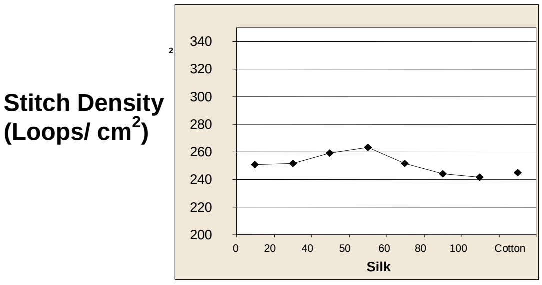
In Fig.3 change in stitch length is shown with change in blend percentage. Stitch length also decreases first and then increases. This trend is observed due to the change in bulk of the yarn with change in blend percentage. It has been observed already in the previous study that the bulk of the yarn first increases, reaches maximum value at 50/50 and then decreases. Due to bulky nature of the yarn, it is difficult to follow the looped path, hence the height of the loop has reduced, resulting in slightly more courses/cm and lesser wales/cm. Due to development of the bulk in the yarn, the value of the stitch length first reduces and then increases as shown in Fig. 3.

Fig3.Effect of Blend % on Stitch length



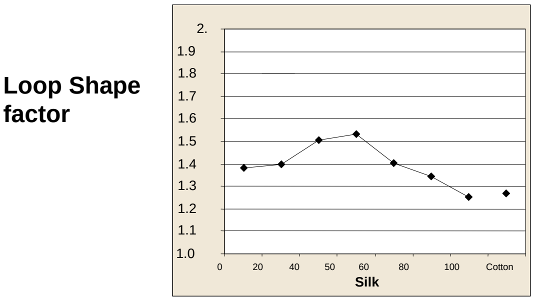
Stitch density is product of course/cm and wales/cm. Stitch density has changed according to the change in the values of the courses/cm and wales/cm as displayed in Fig.4.

Fig. 4 Effect of Blend % on Stitch Density



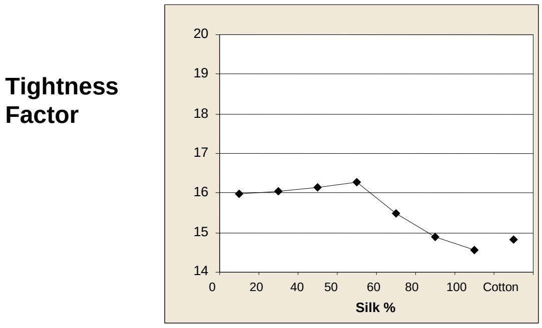
Stitch density first increases and then decreases. The values of knitting constants Kc, Kw and Ks have also changed according to change in values of courses/cm, wales/cm and loop length as shown in Table 1.

Fig. 5 Effect of Blend % on Loop Shape Factor



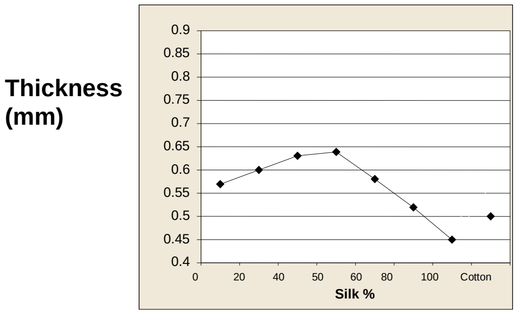
Loop shape factor is a ratio of course/cm and wales/cm. Due to change in the values of courses/cm and wales/cm, loop shape factor first increases and then decreases with changing percentage of silk in the blend, as shown in Fig. 5.

Fig.6- Effect of Blend % on Tightness factor



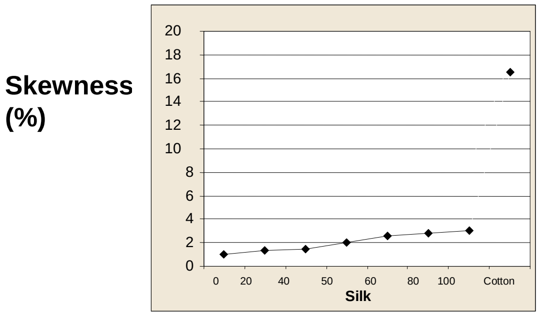
The tightness factor of the fabric is inversely proportional to stitch length. Due to reduction in the values of stitch length, the tightness factor first increases to maximum value at silk/acrylic 50/50 and then reduces gradually with increasing proportion of silk (Fig. 6).

Fig.7-Effect of Blend % on Thickness



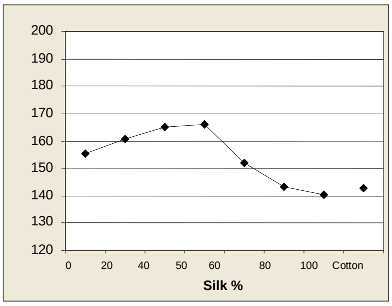
Diametre of the yarn also changes with the change in blend percentage. Thickness of fabric is largely dependent on the yarn diameter. The change in the values of the thickness of the fabric is due to change in the values of yarn diameter and bulk as shown in Fig. 7. Thickness of the fabric is maximum at silk acrylic 50/50 (A5S5) due to maximum value of yarn diameter of A5S5 yarn.

Fig.8-Effect of Blend % on Skewness



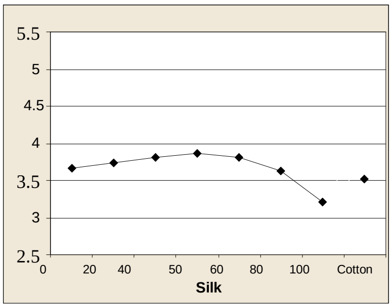
Skewness in the fabric depends mainly on snarling tendency of the yarn. 100% acrylic fabric displays minimum value of skewness in the fabric (Fig.8). Snarling tendency was also minimum for acrylic yarn as already observed earlier in the previous study. This is due to good steam setting properties of acrylic fibre.

Fig.9-Effect of Blend % on Weight



Weight/m^2 of fabric is shown in Fig. 9. It depends upon stitch density, loop length and tex of the yarn. As tex of yarn is same for all yarns, and loop length show a little variation, hence weight/m^2 of the knitted fabric varies according to the variation of the stitch density of the fabric studied.

Fig.10- Effect of Blend % on Fabric Bulk



Bulk of silk-acrylic blended fabrics first increases slightly and then decreases as shown in Fig. 10. This trend is a combined effect of changes in the values of the weight and thickness of the fabrics as fabric bulk is a ratio of the values of thickness and weight of the fabric.

Conclusion

The results of the study are as follows,

1. Course/cm first increases, reaches maximum at 50/50 level and then decreases.
2. Wales/cm first decreases and then increases with change in blend percentage.
3. Due to change in the bulk of the yarn, stitch length first decreases and then increases with change in blend % of acrylic-silk blended yarns.
4. Thickness tightness factor of knitted fabric was found maximum at silk/ acrylic 50/50 level.
5. Skewness of silk- acrylic blended fabric is lesser than equivalent cotton fabric.

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