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Properties of Bulk Silk Knitted Fabrics

Abstract

The present study aims to investigate the effect of blend percentage on the properties of bulk silk knitted fabrics. Bulk in the silk yarn was produced by blending shrinkable acrylic fibre with varying blend percentage. 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. Bursting strength, abrasion resistance, air- permeability, moisture regain and thermal resistance of the fabrics were analysed in dry relaxed condition. Effect of blend percentage on silk- acrylic single- jersey knitted fabrics has been studied. Bursting strength of silk- acrylic blended single jersey weft knitted fabrics increase with increase in silk percentage in the blend. Abrasion resistance of all silk- acrylic blended fabrics is greater than equivalent cotton fabric. Abrasion resistance also increases with increase in silk fibre percentage in the blend. Air- permeability of silk- acrylic blended single jersey weft knitted fabrics decreases with increase in silk percentage, reaches minimum level at 50/50 blend percentage and then increases with increases in silk percentage. This is due to maximum bulk level of silk- acrylic yarn at 50/50 level. Moisture regain of the fabrics increases with increase in silk percentage in the blend. Thermal resistance was maximum at 50/ 50 silk acrylic level due to maximum bulk of yarn at 50/50 blend percentage.

Keywords: Single Jersey Knitted Fabric, Silk- Acrylic Blend, Abrasion Resistance, Air- Permeability

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Introduction

Knitted fabrics are becoming very popular these days due to their shape fitting property, easy care but the consumer also requires essential properties like wear comfort and durability. The main characteristics of knitted fabrics are bursting strength, abrasion resistance, air- permeability, moisture regain and thermal resistance. These properties are responsible for wear comfort as well as durability. Durability of the fabric depends upon abrasion resistance and bursting strength of the knitted fabric. Wear comfort depends upon moisture regain, air- permeability, and thermal resistance. Wear comfort and durability both depends upon selection of fibres also. A variety of natural and synthetic fibres combinations are used for production of knitted fabrics.

There is need of right type of fibre used for the knitted fabric so that desired functional properties are achieved. Silk is a natural fibre having natural lusture and good strength. Since the yarn possesses low bulk, hence there is need to improve bulk of silk yarn. The bulk of yarn can be improved by preparation of blend of shrinkable acrylic fibre and silk. A high bulk silk yarn can not only give a new texture with better cover but also warmth. The fabric would also be light. These kinds of fabrics would have outstanding characteristics of acrylic fibre like excellent resistance to atmospheric conditions, dimensional stability, heat settable, easy care properties as well as elegant lusture, moisture absorption of silk.

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. With the change in blend, the change in abrasion resistance, bursting strength, air- permeability, moisture regain and thermal resistance of silk- acrylic blended single jersey weft knitted fabrics 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.

Review of Literature

Kurbak Arif [1] 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. Lloyd N Ndlovu et al [2] have studied physical properties of plain single jersey- knitted fabrics made from blended and core- spun polysulfonide/ cotton yarns. Plain single jersey structured fabrics were knitted from 100% polysulfonmide (PSA) yarn, and from PSA85/Cotton15 and PSA70/Cotton30 blended and core- spun yarns. PSA and cotton were blended and core- spun to improve the processability and mechanical properties of PSA. Jhanji Yamini et al [3] 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 absorptivity alongwith air- permeability and moisture vapour transmission rate of single jersey plated fabrics. Singh G. et al [4] have studied dimensional parameters of single jersey cotton knitted fabrics. The problem of shrinkage by knitting single jersey cotton fabrics has been investigated. Linear density, twist factor, machine gauge and stitch length are dominating factors and influence the shrinkage. Zurek W. et al [5] have studied physical properties of weft knitted fabrics. In this paper geometrical dimensions of weft knitted fabrics made of polyester and polyamide yarns (twisted and textured) and their effect on the tensile properties of these fabrics are discussed. The air-permeability of textured fabrics is half that of twisted yarns. Knapton J.J.F. [6] has studied the dimensional properties of knitted wool fabrics. This paper concludes that nature of knitted loop is dependent on the yarn's physical properties, mechanical processing, and knitting variables. Gong R.H. [7] has studied quality measurement of knitted apparel fabrics. The possibility is investigated of objectively measuring and controlling the quality of knitted garment during finishing. Results of an industry based study in the quality and hand of knitted garment are reported. The association of the hand of knitted garment alongwith requirement for objective testing technique is discussed. Mukhopadhyay A. and Kaushik R.C.D. [8] have studied bulk characteristics of air- textured yarn knitted fabrics. In this study the thickness and specific volume of knitted fabric have been analyzed in relation to yarn type, stitch length and relaxation treatment. Choi M. S. [9] has studied effect of changes in knit structure and density on the mechanical and hand properties of weft knitted fabrics for outerwear. This study focuses on mechanical properties of weft knits for outerwear as a function of knit structure, density and the relationship between hand, structure and density. Ramachandran T. [10] has studied thermal behavior of ring and compact spun yarn single jersey, rib and interlock knitted fabrics. 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.

In the previous study, Kumar R. [11], 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 bulk silk weft knitted single jersey silk- acrylic blended knitted fabrics at different blend levels.
2. To find out the effect of blend ratio on bursting strength of bulk fabrics.
3. To study effect of blend percentage on abrasion resistance of bulk silk fabrics.
4. To study effect of blend ratio on air-permeability, moisture regain and thermal resistance of bulk silk fabrics.

Material and Methods

Acrylic-silk yarns in different blend proportions 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 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 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.

Result and Discussion

Table 1 shows properties of acrylic- silk blended fabrics at different blend ratios. Acrylic represents 100% shrinkable acrylic fabric and A8S2 represents 80% shrinkable acrylic and 20% silk blended fabric. Similarly Silk represents 100% silk fabric and Cotton represents 100% cotton fabric.

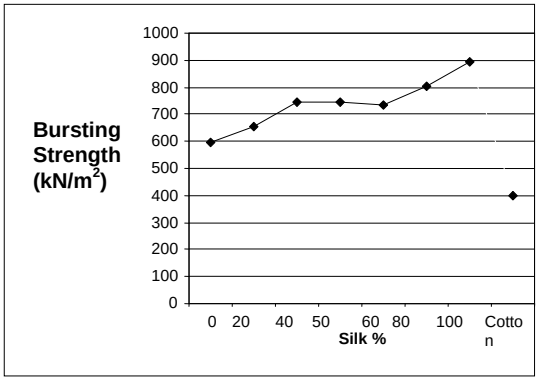
Table 1 Properties of Acrylic-Silk Blended Knitted Fabrics

	Acrylic	A8S2	A6S4	A5S5	A4S6	A2S8	Silk	Cotton
Bursting strength (KN/sq. m)	596.0	655.6	745.1	744.9	735.1	804.7	894.1	397.3
	(13.1)	(12.1)	(13.4)	(13.9)	(12.4)	(13.1)	(10.6)	(14.1)
Abrasion resistance (cycles)	670	694	722	750	746	784	802	510
	(26.5)	(28.1)	(24.1)	(30.4)	(28.9)	(30.1)	(30.1)	(32.9)
Air permeability (cubic m/sq. m/min.)	160.0	156.1	153.1	150.0	162.1	178.1	191.7	166.7
	(20.4)	(18.1)	(20.4)	(17.4)	(20.5)	(20.1)	(17.6)	(18.1)
Moisture Regain (%)	0.03	1.0	1.5	3.2	3.9	5.0	6.3	5.1
	(14.7)	(13.1)	(12.1)	(13.7)	(12.9)	(11.8)	(15.4)	(14.1)
Pilling Tendency*	2	2	2	2	2	3	3	4
Thermal Resistance (clo)	2.12	2.16	2.19	2.24	2.20	1.85	1.25	1.80
	(9.8)	(9.4)	(10.4)	(7.9)	(8.0)	(7.9)	(10.2)	(9.4)

(Figures in parenthesis represent CV %)
*1 – Very severe pilling,
2 – Severe pilling,
3 – Moderate pilling,
4 – Slight pilling,
5 – No pilling

Fig. 1 indicates that bursting strength of the fabric increases with the addition of the silk in the blend.

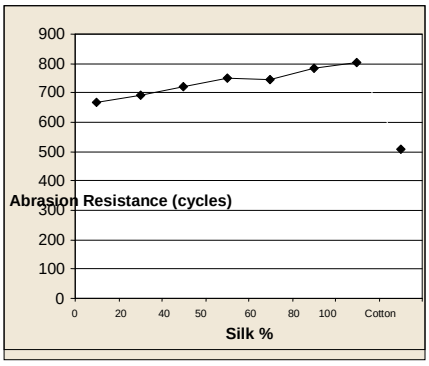
Fig.1- Effect of Blend % on Bursting Strength



This trend accords with the tenacity of these yarns. During bursting of the fabric, tenacity in combination with elongation of the yarn plays an important role. Silk yarn has maximum tenacity, hence it exhibits maximum bursting strength.

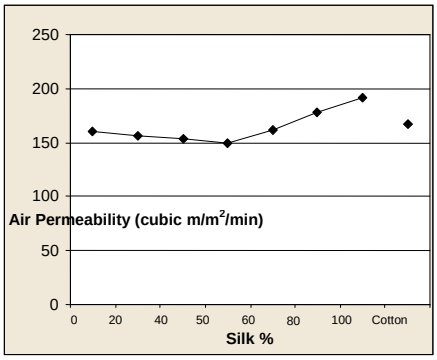
The abrasion resistance of the silk-acrylic knitted fabric shows an increasing trend with increasing proportion of silk in the fabric (Fig. 2).

Fig.2- Effect of Blend % on Abrasion Resistance



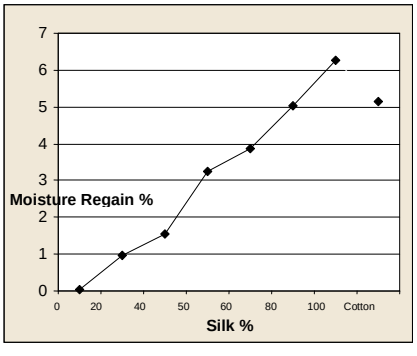
Acrylic rich blends have lesser abrasion resistance than silk rich blends. Such a trend occurs because of loose and bulky structure of acrylic fibres in the blended yarn which can cause quick rupture of sheath fibres in a bulky yarn in comparison to compact structure of all silk blended yarns during abrasion cycles.

Fig.3- Effect of Blend % on Air-permeability



It is observed from Fig. 3 that air permeability of silk/acrylic knitted fabrics shows a downward trend first and then increases slightly. We have already observed that with the increase in silk content in the blend, the yarn diameter increases, attains maximum value at 50/50 silk-acrylic level and then decreases. It results in higher cover factor and reduced air-permeability of the fabric at 50/50 silk-acrylic level.
Moisture regain is lower for fabrics having higher acrylic content (Fig.4)

Fig.4- Effect of Blend % on Moisture Regain



This is due to hydrophobic nature of the acrylic fibre. Consistent increase in values of moisture regain is observed with increasing silk content. From Table 1 severe pilling propensity is observed in case of acrylic rich fabrics.

Fig.5- Effect of Blend % on Thermal resistance

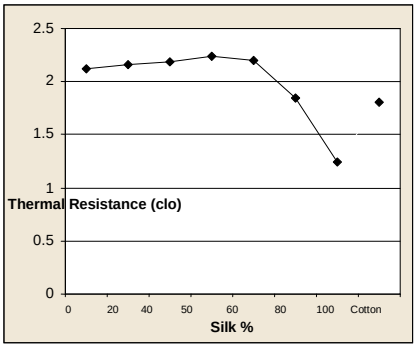


Fig.5 shows that thermal resistance of knitted fabrics first increases and then decreases with increase in silk proportion in the blend. The maximum value corresponds to acrylic-silk 50/50 (A5S5). This trend accords with the values of the yarn bulk. Fabric made from the yarn A5S5 having maximum bulk is exhibiting maximum thermal resistance

Conclusion

The results of the study are as follows:

1. Bursting strength of all silk- acrylic blended single jersey knitted fabric is greater than equivalent cotton fabric. Bursting strength also increases with the increase in silk percentage.
2. Abrasion resistance of silk- acrylic blended single jersey knitted fabric increases slightly with the increase in silk percentage in the blend.
3. Air-permeability of silk- acrylic blended single jersey knitted fabrics is minimum at 50/50 silk- acrylic blend level. This is due to maximum bulk of yarn at 50/50 level.
4. Moisture regain of silk- acrylic blended single jersey knitted fabric increases with increase in silk percentage in the blend.
5. Thermal resistance is maximum at 50/50 silk- acrylic blend ratio due to lesser air-permeability.

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References

1. *Kurbak A., (February 2016) Geometrical models for weft knitted spacer fabrics, Textile Research Journal, Vol 87, No 4, p 409-423.*
2. *Ndlovu Lloyd N., Siddiqui Q., Omollo E., (August 2014) Physical properties of plain single jersey-knitted fabrics made from blended and core- spun polysulfonmide/ cotton yarns, Textile Research Journal, Vol 85, No 3, p 262-271.*
3. *Jhanji Y., Gupta D., Kothari V. K., (March 2015), Comfort properties of plated knitted fabrics with varying fibre type, Indian Journal of Fibre and Textile Research, Vol 40, No. 1, p 11-18.*
4. *Singh G., Roy K.,Varshney R., Goyal A., (June 2011), Dimensional parameters of single jersey cotton knitted fabrics, Indian Journal of Fibre and Textile Research, Vol 36, No. 2, p 111-116.*
5. *Zurek W., Cislo R., Bialek U., (April 1986) Physical properties of Weft Knitted Fabrics, Textile Research Journal, Vol 56, No 4, p 241-248.*
6. *Knapton J.J.F., Ahrens F. J., Ingenthron W.W., (October 1968) The Dimensional Properties of Knitted Wool Fabric, Textile Research Journal, Vol 38, No 10, p 999-1012.*
7. *Gong R. H., (September 1995), Quality Measurement of Knitted Apparel Fabrics, Textile Research Journal, Vol 65, No 9, p 544-549.*
8. *Mukhopadhyay A., Kaushik R. C. D., (March 2003), Bulk Characteristics of air- jet textured yarn knitted fabrics, Indian Journal of Fibre and Textile Research, Vol 28, No. 1, p 36-40.*
9. *Choi Mee-Sung., Ashdown Susan P., (December 2000) Effect of Changes in Knit Structure and Density on the Mechanical and Hand properties of Weft-Knitted Fabrics for Outerwear, Textile Research Journal, Vol 70, No 12, p 1033-1045.*
10. *Ramachandran T., Manonmani G., Vigneswaran C., (September 2010), Thermal behavior of ring and compact spun yarn single jersey, rib and interlock knitted fabrics, Indian Journal of Fibre and Textile Research, Vol 35, No. 3, p 250-257.*
11. *Kumar R., Tak S.P., (July 2016), Study and Evaluation of Effect of Steaming on Bulk Silk Yarns, Asian Resonance, Vol 5, No.3, p 75-78.*