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Suitability of Bulk Silk Yarns for Knitting

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Abstract

The suitability of acrylic-silk blended yarns for knitting has been evaluated. Yarns prepared with different proportions of acrylic-silk were evaluated and compared with equivalent cotton yarn having same yarn count and twist. Yarn metal friction, loop breaking load, loop breaking extension, loop strength ratio, knot breaking load, knot breaking extension, knot strength ratio of all the acrylic-silk blended yarns were evaluated. The properties of all the yarns were evaluated after steaming. Yarn metal friction of acrylic-silk blended yarns is slightly lesser than cotton yarn whereas loop breaking load, loop breaking extension, loop strength ratio, knot breaking load, knot breaking elongation and knot strength ratio are higher than cotton yarn. All acrylic-silk blended yarns have been found suitable for knitting.

Keywords: Yarn Metal Friction, Acrylic -Silk Blend Loop Strength, Knot Strength,

Introduction

India is the second largest silk producing country in the world after China. India is the only country in the world producing all the four varieties of silk (Mulberry, Tasar, Eri and Muga).The production contribution of mulberry silk is the maximum 90.7% among other varieties of silk (Tasar 3.9%, Eri 4.9%, and Muga 0.5%). Aproximately 95% of the silk produced goes into weaving industry. These days knitted fabrics are becoming more popular due to their shape fitting property.The market for knitted fabrics has been unquestionably deep rooted because of comfort qualities and stretch imparted by looped yarn structure. There has been apprehension among Indian knitwear manufacturer about the use of silk for knitting. Manufacturers have not taken initiatives into silk knits due to lack of evidence of the suitability of silk and silk blends to knitting. Thus there exists a need to explore the possibility of producing silk knitted fabrics.

The textile industry is well aware of potential of knitting sector. Over the recent years, use of knitted fabric has increased. Knitted fabrics are made from natural as well as manmade fibres. The properties of yarn depend upon properties of constituent fibre and process parameters. For successful knitting and to produce good quality knits, it is worthwhile to predict the behavior of these yarns prior to knitting and usage. For producing an acceptable quality of the fabric, yarn will have to meet some pre-specified quality standards. The properties of yarn for knitting differ from those required for weaving. Some special characteristics of yarn are to be checked, if it is meant for knitting. During knitting, loop formation takes place. The yarn passes around the needles, the friction between yarn and needles also plays important role. Before preparing a knitted fabric, it is necessary to check some yarn properties so that it can be ensured that whether this yarn is suitable for knitting or not.However not much work has been reported on knitting potential of acrylic-silk blends. For this purpose we will have to check yarn metal friction, loop breaking load, loop breaking extension, loop strength ratio, knot breaking load, knot breaking extension, knot strength ratio of the yarns. Generally yarns having loop and knot strength ratio greater than 70% are expected to perform well during knitting.

Review of Literature

It is necessary to study yarn properties so as to make a good quality knitted fabric. Many researchers have studied in this field. Liu Xinjin and Su Xuzhong[1] have studied properties of knitted fabric made from modified ring-spun yarn. They have prepared knitted fabric from two types of yarns, conventional ring spinning system and modified ring spinning system. They have found that knitted fabrics made from modified spinning system show reduced thickness, weight per square metre and spirality angle but increased bursting strength and improved

permeability. Ozdil Nilgun et al[2] have studied effect of yarn properties on thermal comfort of fabrics. In this research, thermal properties of rib fabrics knitted by using various yarns of different properties were investigated with details. Knapton J.F.[3] have studied knitting performance of wool yarns and studied effects of yarn metal friction, loop length and cover factor on knitting performance. Tyagi G.K. et al[4] have studied knitting potential of acrylic-cotton open end rotor spun yarn. The knot strength ratio and loop strength ratio have been used as important factor in evaluating the knittability. The knittability of the yarns have been judged with the help of knot strength ratio and loop strength ratio. The properties of yarns for knitting differ from those required for weaving [5-6]. Some special characteristics of yarn are to be checked, if it is meant for knitting [7].

Aim of the study

The aim of the study is

1. To find out yarn metal friction, loop breaking load, loop breaking extension, loop strength ratio, knot breaking load, knot breaking extension and knot strength ratio of acrylic-silk blended yarns.
2. To find out suitability of acrylic-silk blended yarns for knitting.
3. To see effect of blend on the suitability of the yarns for knitting.

Materials and Methods

Acrylic-silk yarns were spun in different proportions such as 100% shrinkable acrylic A10, 80% shrinkable acrylic 20% silk (A8S2), A6S4, A5S5, A4S6, A2S8 and 100% silk S10. The yarns were prepared by passing the material through card, drawframe, simplex and ringframe. All these yarns are to be prepared for knitted fabric, hence the as spun count and twist levels were decided in such a way that after steaming and shrinkage, same count 30^s and 14.8 TPI (TM 2.7) may be achieved for all the yarns. In this way, acrylic-silk blended yarns were produced with different values of count and twist so that after steaming and shrinkage, same count 30^s and 14.8 TPI (TM 2.7) may be achieved for all the yarns. After producing yarns on ring frame the other operations followed in sequence were Winding and clearing on cone, Hank Winding to form hank, Steaming, Hank Rewinding to produce cone, Winding and clearing cones for knitting.

The ring frame bobbins were wound to cones on a winding machine having electronic yarn clearer. Then hanks were prepared on hank winding machine. Hanks of about 20 g were prepared which were properly crossed and laced in at two or three points so as to avoid entanglements during and after steaming. The lacing was kept completely loose so as not to hinder the bulking process during shrinking. Then the hanks were hung in the autoclave. Any direct contact of the yarn with hot metal surface was avoided because it might cause formation of non-bulked areas in the yarns. Steaming of the hanks was done for 20 minutes at a temperature of 100^0C and pressure of 1.0 Kg/cm^2. After steaming the hanks were rewound on to cones on hank rewinding machine.It was followed by one more winding operation equipped with electronic yarn clearer. The second rewinding operation was incorporated to smooth the tension variations in the yarn package and to ensure a uniform unwinding during knitting.

Evaluation of Knitting Relevant Yarn Properties

Yarn Metal Friction

Very low coefficient of yarn metal friction may have slippage of yarn around needles whereas a higher value is likely to cause cutting action on needles. Hence it is necessary to check yarn metal friction before knitting.The coefficient of friction of yarn against stainless steel was measured on the Shirley Yarn Friction Recorder Winder at a speed of 54 m/min [8].

Loop and Knot Strength

Loop strength and knot strength of yarns indicates the brittleness of the yarn [9]. If a textile yarn is looped or knotted, it's tensile strength may reduce. Tensile stress acts parallel to yarn axis. However this is not true in case of knitting. The yarn is bent over an angle while passing round tension rods, needles or through needle holes, the stress is no longer of purely tensile character. Rupture of loops can occur at lower value than normal tenacity of yarns. Hence it is necessary to check loop strength of yarns. In addition to loop stress, the yarn must also be able to withstand stresses produced upon tying of knots. Material which possesses low strength knots is bound to be troublesome in knitting.

Loop breaking load and loop breaking extension was measured on Instron Tensile Tester 4465 at a guage length 7 inches and a rate of traverse of 12 inches/min according to British Standards [9]. Loop strength ratio is a ratio of mean loop breaking load and twice mean yarn breaking load (measured under same conditions)

For measuring knot breaking load and knot breaking extension of yarns, 60-70 cm of yarn was withdrawn from sample. A single overhand knot was tied as per British Standards [10], at approximately middle of the specimen taking care not to lose any twist and the specimen was mounted on Instron Tensile Tester 4465. The grips were set to give a specimen length of 500 mm and time to break 20$\pm$3 sec. Then knot breaking load and breaking extension was recorded. Knot strength ratio is a ratio of mean knot breaking load and mean yarn breaking load (measured under identical conditions).

Result and Discussion

Yarn Properties for Knitting

From the Table 1 it is clear that yarn metal friction of 100% acrylic yarn is lesser than cotton yarn but it increases with increasing percentage of silk in the blend. These values have also been plotted in Fig.1.

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Table 1
Properties of Acrylic-Silk Blended Yarns for Knitting

	Acrylic	A8S2	A6S4	A5S5	A4S6	A2S8	Silk	Cotton
Yarn metal friction	0.30	0.32	0.35	0.36	0.37	0.39	0.41	0.39
	(3.1)	(2.9)	(2.1)	(2.1)	(2.9)	(3.1)	(3.1)	(2.1)
Loop breaking load (g)	521.7	604.2	704.2	764.8	791.2	897.8	1048	435.8
	(9.8)	(7.8)	(10.4)	(9.8)	(10.4)	(12.4)	(8.9)	(10.7)
Loop breaking extension (%)	24.2	22.4	20.1	18.5	16.2	13.6	10.8	4.6
	(14.6)	(15.1)	(11.1)	(12.7)	(12.8)	(16.7)	(10.4)	(12.4)
Loop strength ratio	0.96	0.95	0.98	0.99	0.97	0.98	0.96	0.95
Knot breaking load(g)	267.5	301.7	331.8	361.2	405.6	445.4	495.6	184.2
	(14.1)	(19.1)	(15.6)	(20.4)	(18.7)	(14.1)	(14.8)	(13.6)
Knot breaking extension (%)	25.6	25.0	20.3	18.5	15.5	11.3	10.7	5.4
	(12.4)	(16.8)	(13.1)	(18.1)	(16.4)	(14.1)	(11.4)	(12.5)
Knot strength ratio	0.99	0.98	0.96	0.95	0.96	0.95	0.95	0.48

(Figures in Parenthesis Represent CV %)

Fig. 2 Reveals that Loop-Breaking Load of all Acrylic-Silk Blends is Greater than Cotton Yarn and it Increases with Increasing Silk Content.

Fig. 1
Yarn Metal Friction of Acrylic-Silk Yarns

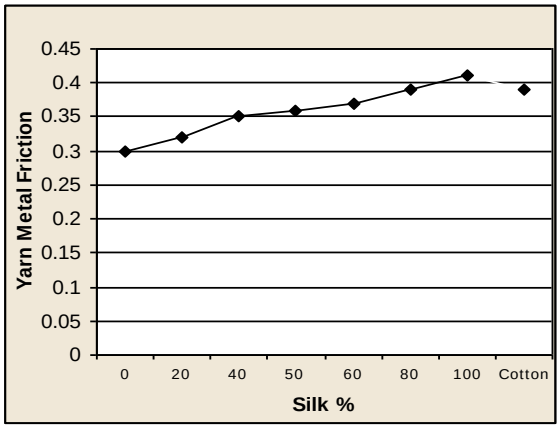
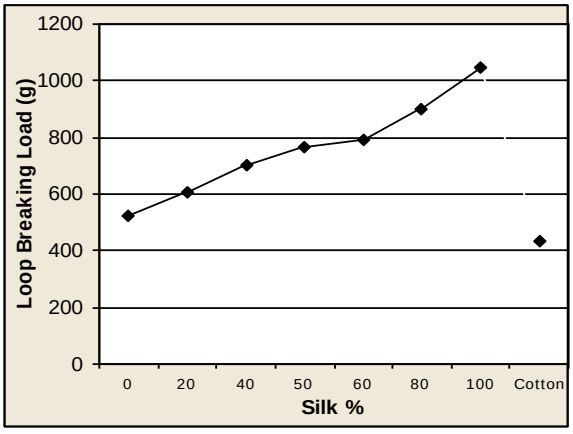


Fig. 2
Loop Breaking Load of Acrylic-Silk Yarns



It may be seen from Fig. 3 that loop-breaking extension of acrylic rich blends is considerably higher than silk rich blends. Such an increase is caused by higher elongation % at break values of acrylic fibre. Fig. 4 shows that loop strength ratio of all the yarns studied is greater than 95%.

Fig. 3
Loop Breaking Extension of Acrylic-Silk Yarns

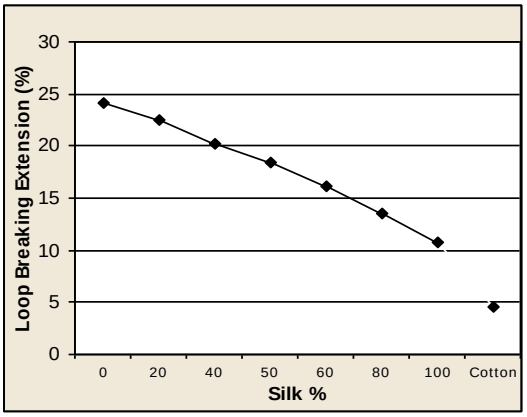
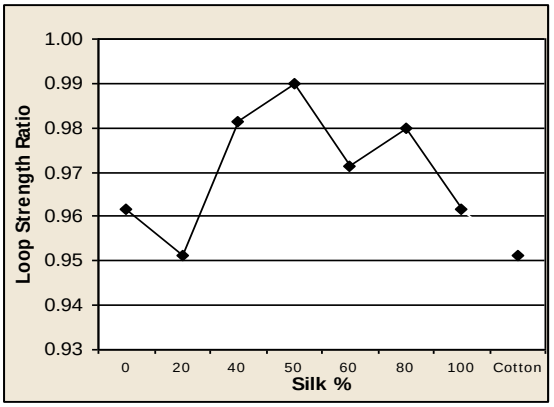


Fig. 4
Loop Strength Ratio of Acrylic-Silk Yarns



The acrylic-silk blended yarns show an increasing trend in the knot-breaking load values with the increase in silk content in the blend (Fig. 5). This may be attributed to the higher tensile strength of silk fibre in comparison to acrylic fibre. From Fig.6, a decrease in the value of knot breaking extension is observed with increasing silk proportion. Higher value of breaking elongation of acrylic fibre may be ascribed to this trend.

Fig. 5
Knot Breaking Load of Acrylic-Silk Yarns

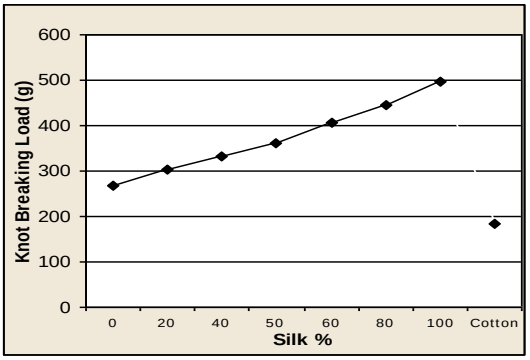
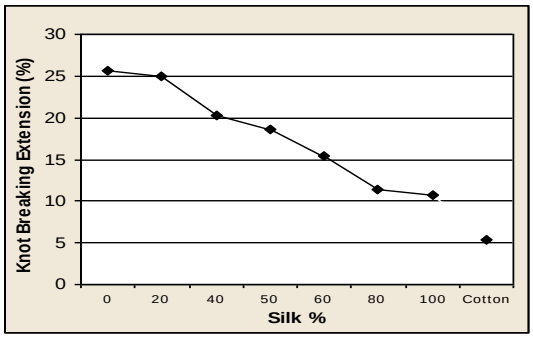
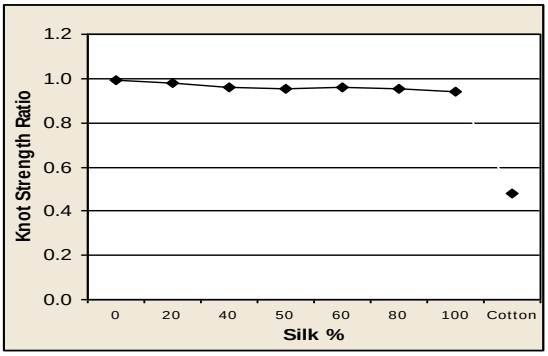


Fig. 6
Knot Breaking Extension of Acrylic-Silk Yarns



In general all the acrylic-silk blended yarns have good knot-strength ratio (more than 95%) as shown in Fig. 7. The results of loop strength ratio and knot strength ratio indicate that these yarns are expected to perform well during knitting.

Fig. 7
Knot Strength Ratio of Acrylic-Silk Yarns



Conclusion

1. Yarn metal friction of acrylic-silk blended yarns is slightly lesser than cotton yarn but increases with increase in silk content in the blend.
2. Loop breaking load and knot breaking load acrylic-silk blends is greater than cotton yarn. Loop breaking extension and knot breaking extension of acrylic-silk blended yarns is much greater than cotton yarn. Loop strength ratio and knot strength ratio of all acrylic-silk blended yarns is greater than 95%. All these results indicate that acrylic-silk blended yarns are suitable for knitting and are expected to perform better than cotton yarn during knitting.
3. Loop breaking load and knot breaking load increase with increase in silk % in blends, whereas loop breaking extension and knot breaking extension decrease with increase in silk % in the acrylic-silk blends.
4. All acrylic silk blended yarns are suitable for knitting purpose.

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