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Feasibility of Bulk Silk Yarns

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Abstract

The feasibility of blending silk with shrinkable acrylic fibre has been explored. Yarns with different proportions of shrinkable acrylic and silk fibres has been prepared such as 100% shrinkable acrylic A10, 80% shrinkable acrylic 20% silk (A8S2), A6S4, A5S5, A4S6, A2S8 and 100% silk S10. Yarn properties such as tenacity, strain %, unevenness, total number of imperfections, hairiness, flexural rigidity, abrasion resistance, diameter and yarn appearance were measured. Acrylic-silk blended yarns have been compared with cotton yarn of similar construction i.e. same yarn count and twist. It has been found that tenacity of 100 % silk yarn is maximum. All acrylic-silk blended yarns have tenacity greater than equivalent cotton yarn. Acrylic-silk blended yarns have lesser unevenness, total imperfections, hairiness, flexural rigidity but higher values of abrasion resistance. Appearance of acrylic-silk blended yarns is good. These kind of acrylic-silk yarns may be suitable for fabrics requiring bulk and lusture both.

Keywords: Silk, Bulk Silk, Acrylic-Silk Blend, Shrinkable Acrylic, Blending.

Introduction

The bulk of silk yarn is low due to fine denier of silk filaments and fibre. Silk fabrics have exceptional natural lusture, soft handle and good comfort properties. Since the silk yarn possesses low bulk, more number of threads (lengthwise and widthwise) are required for producing better cover of fabric. Because of high density of threads, the silk fabric tears off like a paper very easily. If it is possible to increase bulk in silk yarn, this kind of high bulk silk yarn can not only give a new texture with better cover but also warmth. The fabric will also be light.

Bulk of silk yarn may be increased in many ways. One easy and simple way to achieve this objective is to produce high bulk silk yarn following the principle of high bulk acrylic staple yarn manufacture. In the industry shrinkable acrylic fibre is blended with non-shrinkable acrylic fibre. When yarn is steamed bulk of the yarn increases because of shrinkage of shrinkable acrylic fibre. In this case bulk may be produced by blending silk and shrinkable acrylic fibre. Bulk silk may be produced by blending silk with shrinkable acrylic fibre at blowroom stage and then processed on cotton system of ringspinning. The fabrics made from acrylic-silk yarns can find suitable place in outerwear fabrics, jerseys and sweaters also. These kinds of fabrics are expected to have outstanding characteristics of acrylic fibre like excellent resistance to atmospheric conditions, dimensional stability, heat settable, handling, easy care properties as well as elegant lusture, moisture absorption, permeating features of silk.

Blending of such fibres is relatively new to the industry and the properties of such blends are little known. Hence for comparison purpose cotton yarn of same count, twist was also prepared at the same time, so that comparison of acrylic-silk blends may be done with already accepted and established cotton yarn and fabric.

Review of Literature

Most of the studies are related to blending of silk with different fibres[1].Several production techniques have been tried to improve the bulk of silk fabrics.Choudhuri etal[2] have tried blending of eri silk and acrylic by drawframe blending and tensile properties were studied.In another study, silk noil was blended with acrylic fibre by hand mixing and processed on woolen set of machineries [3]. A mechano-chemical batch rocess to improve the bulkiness of

tasar silk filament yarn has also been reported[4].

The tasar silk filaments were twisted, treated with zinc chloride solution, washed, dried and untwisted and converted to hank form. In another method, mix-reeling technique was also tried and a composite yarn of silk and acrylic filament yarn was developed in Japan.[5] This yarn was produced by mixing silk and acrylic filaments in the raw silk reeling process. In China, bulk stretch silk has also been developed from raw silk by reprocessing the silk filaments [6]. Compared to normal silk it has excellent bulkiness, softness with remarkable elasticity and recovery. Some researchers have tried blending of acrylic with mulberry silk waste[7].

Aim of the Study

The objective of work is

1. To explore feasibility of producing acrylic-silk bulk yarn.
2. To prepare acrylic- silk yarns of with different ratios.
3. To assess the properties of such yarns.

Materials and Methods

The silk hanks were cut to a staple length of 64mm and then degummed using soap and soda method (Soap 6 g/litre, Sodium carbonate 1 g/litre, Temperature 90^{o} C, Time 90 minutes,Material: Liquor ratio 1:40).The degummed silk was opened. Shrinkable acrylic fibre of 64mm staple length and fineness 2.0 denier was selected for blending with silk as fine denier shrinkable acrylic fibres are not manufactured commercially.The properties of silk and acrylic fibres used in this study are shown in Table 1.

Preparation of Yarn Samples

Silk and acrylic fibres were blended in various proportions. These were 100:0, 80:20, 60:40, 50:50, 40:60,20:80 and 0:100 (denoted as Acrylic, A8S2, A6S4, A5S5, A4S6, A2S8 and Silk respectively).

A mixture of 5% water and LV-40, P-2152 (0.5% each) on the weight of fibres, was sprayed on the mixing to avoid static related problems during processing.The mix was conditioned and then the mixing was fed to the cards. The feed plate-licker in, cylinder-flats and cylinder-doffer settings were widened from 18, 15 and 6 thou. to 22, 18 and 8 thou. respectively, due to longer length and bulky nature of acrylic fibre. The carded sliver of 0.1 hank was produced.

Then card slivers were given two passages on drawframe. The roller setting was 68/72 in front/back zone and a trumpet of 4 mm dia. was used. From the drawn sliver a roving of 1.2 hank was prepared. From this roving, yarn was spun on ring frame. All these yarns are to be prepared for knitted fabric, hence the as spun count and twist levels were decided same for all the yarns (count30^{s} and 14.8 TPI, TM 2.7).

Table 1
Properties of Acrylic, Silk and Cotton Fibre

	Acrylic (Before Steaming)	Silk	H-4 Cotton
Tenacity (g/den)	3.5	4.1	2.2
	(17.9)	(12.0)	(12.4)
Elongation (%)	24.2	30.8	10.0
	(18.8)	(13.3)	(15.4)
Staplelength(mm)	64.1	64	25.4 (2.5%spanlength)
	(18.5)	(28.5)	(28.4)
Fineness (den)	2.0	1.2	4.0 (micronaire)
	(14.8)	(17.4)	(20.4)

(Figures in parenthesis represent CV %)

Fibre and Yarn Testing

All the fibre and yarn samples were conditioned in the standard atmospheric test conditions of 65% $\pm$ 2% RH and 27^{0}C $\pm$ 2^{0}C and then tested as per ASTM standards. Fibre fineness was tested on Vibroskop [8] and fibre tenacity was assessed on Vibrodyn [9]. Yarn tensile properties were evaluated on Instron Tensile Tester 4465 [10]. Yarn evenness and imperfections were evaluated on Keisokki evenness tester 80 and yarn hairiness was tested on Zweigle G 566 hairiness tester. To compare the hairiness of different yarns, the S3 value was chosen (number of hairs longer than 3 mm). Yarn flexural rigidity was tested on the Shirley weighted ring yarn stiffness tester[11].

Yarn appearance boards were prepared and grading was given as per ASTM standards. Flex yarn abrasion resistancewas tested on Custom Scientific Instruments abrasion tester following ASTM standards.

Result and Discussion

Yarn Properties

The properties of acrylic-silk blended yarns at various blend levels before steaming are shown in Table 2.

It has been observed that tenacity of cotton yarn is minimum among the yarns studied, It is further observed that addition of silk fibre in the acrylic-silk blend improves the tenacity of the blended yarn. The tenacity of acrylic-silk blended yarn improves gradually with the addition of silk fibre. All acrylic-silk blended yarns have higher value of strain % at break value than 100% cotton yarn.The evenness value of acrylic-silk blended yarns is better than cotton yarn.

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Table 2
Properties of Acrylic-Silk Blended Yarns (Before steaming).

	Acrylic	A8S2	A6S4	A5S5	A4S6	A2S8	Silk	Cotton
Yarn linear density (Tex)	16.4	16.9	17.6	17.9	18.2	18.9	20.2	20.1
	(3.2)	(2.1)	(3.1)	(2.1)	(3.1)	(2.6)	(3.8)	(3.6)
Tenacity(g/tex)	17.3	18.9	22.4	23.3	23.8	25.5	28.1	11.2
	(7.7)	(7.0)	(11.1)	(6.7)	(6.6)	(10.3)	(16.9)	(7.8)
Strain % at break	12.1	12.5	12.9	13.2	13.3	13.6	13.1	5.3
	(13.6)	(7.2)	(16.9)	(9.9)	(14.0)	(10.6)	(9.3)	(8.1)
Unevenness (U%)	13.7	14.2	16.6	11.6	11.9	13.9	10.3	18.3
Imperfections/250m								
Thin place (-50%)	32	18	10	5	5	16	3	92
Thick place (+50%)	15	32	36	10	40	52	10	106
Neps (200%)	10	60	65	45	10	60	18	216
Total imperfections	57	110	111	60	55	118	31	414
Hairiness value S3 (Hairs>3mm/100m)	2181	1908	1860	1807	1677	1704	2062	3055
Flexural rigidity*10^3 (gm*cm^2)	2.47	2.78	3.02	3.09	3.15	3.31	3.71	3.48
	(9.4)	(9.8)	(8.2)	(10.2)	(9.1)	(10.1)	(10.4)	(9.4)
Abrasion resistance (cycles)	110	135	230	252	302	398	587	110
	(25.4)	(24.4)	(26.4)	(28.1)	(20.4)	(26.1)	(28.4)	(28.1)
Yarn diameter (mm)	0.182	0.188	0.179	0.202	0.186	0.180	0.184	0.205
	(13.9)	(21.4)	(19.1)	(18.1)	(19.4)	(20.4)	(7.9)	(16.1)
Yarn appearance grade	B	B	B	B	B	B	B	C

(Figures in parenthesis represent CV %)

Total imperfections in acrylic-silk blended yarns are also lesser. Hairiness of acrylic-silk blended yarns is also lesser. It implies there is feasibility of better appearance of fabric.

Flexural rigidity indicates stiffness of yarn. With the addition of silk fibre flexural rigidity increases gradually. This is due to inherent property of silk fibre. Silk yarn is having maximum tenacity and elongation, hence addition of silk fibre in the blend improves abrasion resistance of acrylic-silk blended yarns. The variation in the diameter of yarns may be attributed to variation in hairiness of yarn as the count of all yarns is same. From the grading of yarn appearance boards, it can be concluded that acrylic-silk blended yarns may be used for producing good fabrics.

Conclusion

It is possible to produce acrylic-silk blends on cotton system of ring spinning. Tenacity of acrylic-silk blended yarns increase with silk content in the blend. All acrylic-silk blended yarns have tenacity greater than equivalent cotton yarn. Acrylic silk blended yarns have lesser unevenness, total imperfections, hairiness, flexural rigidity but higher values of abrasion resistance. Flexural rigidity acrylic-silk blended yarns increases with increasing percentage of silk. Appearance of acrylic-silk blended yarns is good. These kind of acrylic silk yarns may be suitable for fabrics requiring bulk and lusture both.

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