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Snarling Tendency and Package Density Measurements of Bulk Silk Yarns

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Abstract

The snarling tendency and package density of acrylic-silk blended yarns have been evaluated. Yarns prepared with different proportions of acrylic-silk were prepared, evaluated and compared with equivalent cotton yarn having same yarn count and twist. The properties of all the yarns were evaluated after steaming. Snarling tendency can be easily measured by allowing the ends of a length of yarn to be brought together and measuring the self-twisting of the loop. For measurement of bulk, package density of parent and bulk yarn package was measured. Snarling tendency of all acrylic–silk blended yarns is lesser than cotton yarn. Snarling tendency also increases with increase in silk content in the yarn. Package density is found to be minimum for 50/50 acrylic-silk blend. Yarn diameter increases after steaming but increase in diameter is maximum for 50/50 acrylic-silk blend.

Keywords: Spirality, Twist liveliness, Package Density, Yarn Bulk,Snarling Tendency, Acrylic-Silk.

Introduction

Snarling tendency is also known as twist liveliness. The twisted shape of fibres forming a yarn brings to the fore two of their main physio-mechanical properties; torsional rigidity and torsional buckling. The higher the torsional rigidity, stronger is the torsional buckling effect known as twist liveliness. It is the tendency of the newly spun yarn to untwist spontaneously.This detrimental yarn characteristic has two representatives – snarliness that occurs in the yarns and spirality that occurs in knitted fabric. Many problems originate due to snarliness. Unnecessary breakages in winding machine, problems in hank dyeing, yarn breakages in other stages of post spinning and knitting. In single jersey knitted fabrics, non-perpendicular disposition of wales with respect to courses creates the problem of spirality. Wales are not exactly vertical and form an angle depending upon snarling tendency of yarn. Spirality affects both the aesthetic and functional performance of the weft knitted fabrics. Fabric spirality is a complex phenomenon arising from many factors influencing the nature and degree of loop distortion in single jersey knitted fabric. Although twist setting induces a permanent set in fibres, reduces yarn residual torque and minimizes the degree of spirality in weft knitted fabrics. Unrelieved torque plays an important role in determining the dimensions and behavior of single jersey knitted fabric. Once the torque is overcome, yarn knit well and produces very acceptable fabric. Even after steaming or keeping the yarn in autoclave, some residual torque and twist liveliness is left and this is necessary to measure before knitting. The tendency of yarn to snarl due to unrelieved torque is important factor affecting the spirality of the knitted fabric. Yarns with lesser snarling tendency are favorable for knitting. But there is no standard method prescribed for testing the liveliness of a yarn.

Bulk is an important characteristic of yarns. The bulk of yarn can be assessed by comparing yarn diameter and thickness of plain knitted fabric. However it is difficult to derive bulk from apparent diameter of yarn because of hairiness and loops present on yarn surface. Bulkiness is normally measured by indirect methods. In case of bulk yarns an additional test to as certain yarn bulk is performed. Bulk can be measured by comparing weight of equal volume packages or by measuring package density of parent and bulk yarn. In the first method bulk can be assessed by equal volume package made from parent and bulk yarn and then comparing their weight. It is fairly difficult to wind packages of same volume hence a modified method by measuring package density is most commonly used. In this method the parent and the bulk yarn are wound on a package for equal time at same tension and speed. Then package density of these two packages is compared. While building packages either based on equal winding time or equal diameter, package size should be reasonably large for correct estimation of parent and bulked yarn package densities. The package density method and yarn diameter are the basis for finding out the maximum yarn bulk.

Review of Literature

Silk is considered queen of textiles and known for luxury, elegance, luster and comfort [1]. It can be used for producing woven as well as knitted fabrics. Kothari V. K. et al [2] has studied spirality of cotton plain knitted fabrics with respect to variation in yarn and machine parameters. They have studied various yarn and machine parameters on spirality of cotton tubular plain fabrics. The effect of stitch length, machine guage and yarn fineness on spirality of fabrics has been studied. Primentas A. [3] has studied different methods for direct determination of yarn snarliness. It has been found that factors such as yarn package form, yarn twist factor, time elapsed between production and processing stages of yarns and yarn conditioning have significant role in reduction of yarn snarliness. Primentas A. and Iype C [4] have studied spirality of weft knitted fabrics. The effect of partially detwisting steam-set yarns on spirality is studied. It is observed that partial detwisting reduces spirality of weft knitted fabrics significantly and in some cases it eliminates the spirality of weft knitted fabrics produced from singles ring-spun yarns. Standard methods are not available for testing the liveliness of a yarn. Hence the method suggested by De Araujo [5] and Lord P. R. [6] was used to determine twist liveliness. This is a simple method to measure snarling tendency.

Different methods are used to find bulk of yarn by different researchers. Tyagi G.K. et al [7] have studied influence of draw-off nozzle profile on bulk and related properties of acrylic-cotton open end rotor spun yarns. They have found that most bulky yarns are those spun from the higher proportion of acrylic fibres owing to the lower specific gravity of acrylic fibre. Snarling tendency of cotton majority yarns was found to be higher than acrylic majority counterparts. Kothari V.K. et al [8] have studied effect of winder type and winding parameters on package density and physical bulk of air-jet textured yarns. Bulk can be found either on equal time or on equal diameter basis. For the measurement of physical bulk in case of equal diameter, it is recommended to wind parent and bulk yarn of large diameter. In case of equal winding time, longer winding time is recommended to build parent and bulk yarn for measurement of physical bulk. Mukhopadhyay A. et al [9] have tried to find out bulk by image analysis method. They have concluded that physical bulk obtained through image analysis is ineffective in prediction of realizable yarn bulk in the fabric. However, the image analysis method is useful for evaluation of structural irregularity of textured yarn. Kaushik R.C.D. et al [10] have studied effect of steam-relaxation on characteristics of acrylic-viscose rotor spun yarns. It has been found that yarn diameter and bulk decrease with increase in twist factor but increase after steam-relaxation treatment. Tyagi G.K. and Dhamija S. [11] have studied bulk and related properties of acrylic-cotton jet-spun yarns. It was concluded that reasonably higher acrylic content is needed to enhance yarn bulk and bulk increases considerably after steaming.

Aim of the Study

The aim of the study is

1. To suggest simple method of measurement of snarling tendency.
2. To find out the effect of blend ratio of acrylic-silk blended yarns on snarling tendency.
3. To suggest method of measurement of yarn bulk which can easily be done in the industry.
4. To find out the blend ratio at which maximum bulk can be achieved.

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.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 dried at room temperature. 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 by keeping front roll speed 200 rpm and spindle speed 900 rpm on speed frame. From this roving, yarn was spun on ring frame. The as spun count and twist levels were decided by following the procedure stated below.

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. The bulk yarn count was fixed at 30^s N_e with a twist multiplier of 2.7. The twist level in the yarn would be 14.8 tpi. After steaming, shrinkage of 20% was observed in case of acrylic fibre. So to produce 30^s acrylic yarn after steaming, 37.5^s acrylic yarn should be spun at ring frame. It was calculated as given below.

$$\text{Actual count to be spun} = 30 \times \frac{100}{100 - \text{Shrinkage }\%} = 30 \times \frac{100}{80} = 37.5^s$$

Similarly if 14.78 TPI (30^s count and 2.7 TM) is required after steaming, then 12.31 TPI should be set on ring frame so that 14.78 TPI is achieved after steaming.

$$\text{Twist level in the yarn (before steaming)}\ 14.8 \times \frac{100}{100 + \text{Shrinkage }\%} = 14.8 \times \frac{100}{120} = 12.3$$

For acrylic-silk 80/20 (A8S2), value of count and twist was calculated by putting shrinkage value equal to 16 % in the formula because no shrinkage was observed for silk fibre after steaming. Similarly for A6S4, A5S5, A4S6 and A2S8, a shrinkage value of 12%, 10 %, 8% and 4% was taken respectively. All acrylic-silk blended yarns were produced with different values of count and twist , so that after steaming and shrinkage, same count 30^s and 14.78 TPI (TM 2.7) may be achieved for all the yarns. After producing yarn on ring frame the other operations and package produced is as follows, Ring frame (Bobbin), Winding and Clearing (Cone), Hank Winding (Hank), Steaming, Hank Rewinding (Cone), Winding and Clearing (Cone).

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.

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, because during hank rewinding there often occurs impacts due to incorrect yarn crossings in the hanks which result in uneven extension of the yarn of the bobbin. The second rewinding operation is, therefore, incorporated to smooth the tension variations in the yarn package and to ensure a uniform unwinding during knitting.

Snarling Tendency

The tendency of yarn to snarl due to unrelieved torque is important factor affecting the spirality of the knitted fabric. Yarns with lesser snarling tendency are favorable for knitting. There is no standard method prescribed for testing the liveliness of a yarn. The method suggested by De Araujo and Lord P. R. was used to determine twist liveliness. This method is simple and easily be performed. The assessment is usually made by allowing the ends of a length of yarn to be brought together and measuring the self-twisting of the loop. The technique is illustrated in Fig. 1. Yarn of length AB, substantially greater than 50 cm, was cut from the main sample, taking care not to lose any twist. A dead weight (W) was attached to one end and the other end was fixed. A small weight of 0.195 g was placed at a distance of 25 cm from one end, which was held fixed between the fingertips at C. End C was moved towards A until the yarn just started snarling from the center. The distance between points A and C was measured. This procedure was repeated 20 times, and the average was taken. The distance AC for different yarns is shown as value of snarling tendency.

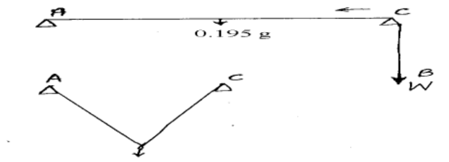

Fig 1

Method of Measurement of Snarling Tendency

Measurement of Package Density

For measuring package density the parent and bulk yarn is wound on the package for equal time under similar conditions and the calculations are done in the following way.

For assessing package density, all acrylic-silk yarns (before and after steaming) were wound on to a cheese for 20 minutes at same tension of 15 g and speed 600 m/min. The package density was calculated using the formula

$$\text{Package density (g/cm}^3) = \frac{M_{c+y} - M_c}{\pi \times (R^2_{c+y} - R^2_c) \times L}$$

where M_{c+y} = Total weight of cheese and yarn

M_c = Weight of cheese alone

L = Traverse length on the cheese

R_{c+y} = Overall radius of the cheese with yarn on it and

R_c = Radius of the cheese alone

The dimensions of the package are shown in Fig. 2.

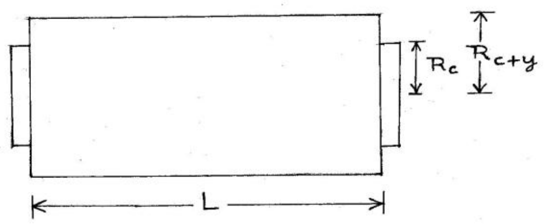

Fig. 2 Dimensions of A Cheese for Measuring Yarn Bulk.

Result and Discussion

The values of and snarling tendency, package density and yarn diameter of acrylic-silk blended yarns are shown in Table 1. Snarling tendency increases with increase in silk content in the blend but it lesser than cotton yarn.

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Table 1 Properties of Acrylic-Silk Blended Yarns for Knitting

	Acrylic	A8S2	A6S4	A5S5	A4S6	A2S8	Silk	Cotton
Yarn linear density (Tex)	19.9	19.7	20.1	19.5	20.1	19.5	20.2	20.1
	(3.1)	(2.5)	(3.3)	(2.7)	(2.1)	(2.6)	(3.8)	(3.6)
Snarling tendency(cm)	1.2	1.8	2.2	2.4	2.8	3.3	3.5	11.5
	(22.1)	(20.4)	(23.8)	(24.3)	(18.1)	(19.9)	(24.1)	(20.4)
Package Density g/cm^3	0.108	0.100	0.099	0.095	0.099	0.117	0.141	0.110
Yarn diameter (mm)	0.24	0.25	0.25	0.31	0.26	0.26	0.184	0.205
	(22.0)	(22.1)	(23.0)	(16.8)	(20.4)	(22.1)	(7.9)	(16.1)

(Figures in Parenthesis Represent CV %)

After steam relaxation, acrylic rich blends show lower values of snarling tendency in comparison to silk yarns (Fig. 3). This may be due to steam relaxation and good steam setting properties of acrylic fibre.

Fig. 3
Snarling Tendency of Acrylic-Silk Yarns

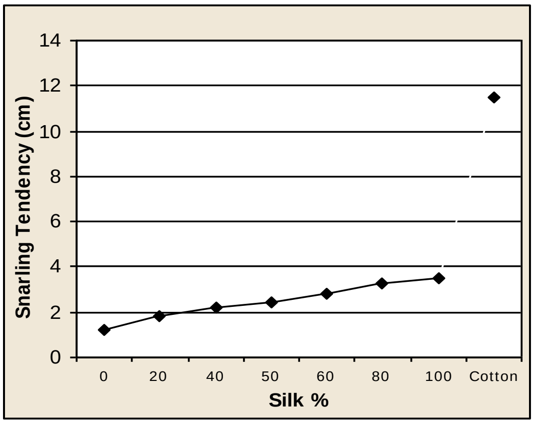
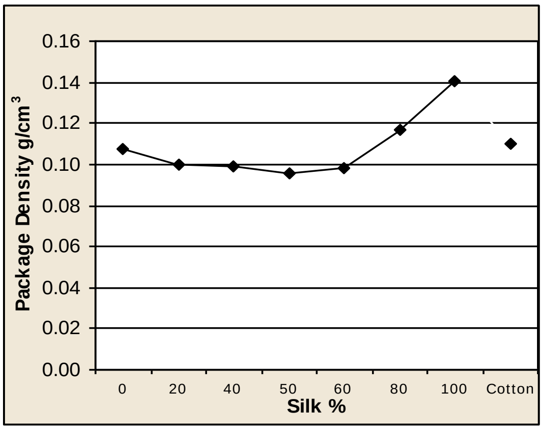
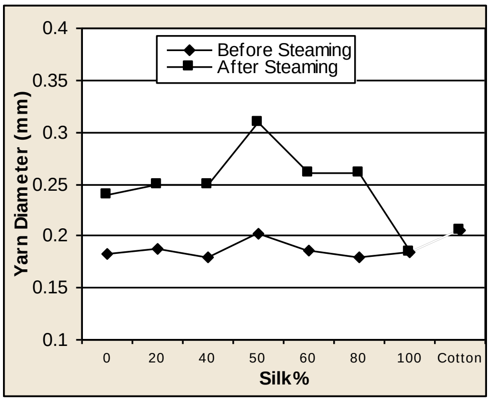


Fig. 4
Package Density of Acrylic-Silk Yarns



It is clear from Table 1 that package density first decreases and then increases with change in blend ratio. It is clear from Fig. 4 that package density is minimum for silk-acrylic 50/50 blended yarn. It indicates that yarn bulk is maximum when silk-acrylic blend level is 50:50. This results accords with yarn diameter values also (Table 1).

Fig. 5
Yarn Diameter of Acrylic-silk Yarns



The diameter of the yarns as measured on the microscope is shown in Fig. 5. Each acrylic-silk blended yarn is showing a increasing trend in the yarn diameter after steaming operation, but increase in diameter of the yarn is found to be maximum in case of acrylic-silk 50:50 blend.

Conclusion

The results of the study are as follows

1. Snarling tendency of acrylic-silk blended yarn is lesser than equivalent cotton yarn.
2. The method suggested by De Araujo is suitable for measuring snarling tendency.
3. Package density of acrylic-silk blended yarns decreases with increase in silk percentage in the yarn and reaches lowest level at acrylic-silk 50/50 blend.
4. Method of package density measurement by winding yarn for equal time is simple and easy to perform.
5. Yarn diameter is also maximum for acrylic-silk 50/50 blend. Hence we find maximum bulk at 50/50 acrylic-silk blend in this study.

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