

Comparison of Properties of Siro-spun and Conventional Two-fold Yarns and of Their Fabrics

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A comparative study of the yarns and fabrics produced by the conventional doubling method and the new Siro-spun method, where doubling is done on the ring frame, was made. The process along with the doubled production on ring frame and omission of the intermediate machine, parallel winding machine and doubler twister gave a yarn with better uniformity and strength and a fabric with high strip strength, tearing strength and less stiffness. However, yarn abrasion resistance and pilling tendency were poor. Siro yarn had a greater diameter than the conventional two-fold yarn.

Keywords: Siro fabric, Siro yarn, Strand twist, Fleece

1 Introduction

The weaving performance of warp yarn on a loom depends critically on the state of surface fibres. Fibres which are not firmly attached to the body of yarn can be abraded from the yarn surface by the action of droppers, healds and reed. These fibres tend to build up knops on the yarn surface which continue to grow until they finally cause the yarn to break. Fibres protruding from yarn can also become entangled with the fibres from adjacent yarns and cause improper shedding. Excessive yarn hairiness will be noticeable first in the selvage where the yarn is most heavily stretched. Hence, untreated single yarns are unsuitable for use as warp yarn in weaving. To produce a satisfactory warp yarn, it is necessary to improve the binding between the surface fibres and the body of the yarn. Methods traditionally used to achieve binding are sizing (in the case of short staples) and doubling (in the case of long staples). The main disadvantage of both systems, especially in doubling, is the high cost. We have tried to eliminate the processes involved in the doubling by a system of production of double yarn directly on the ring frame, the system being termed as Siro-spinning. Two separate roves were introduced in the drafting zone and after being separately drafted the fleeces were separately twisted between the front roll nip and lappet and then retwisted together. A yarn with an appearance exactly similar to that of the double yarn and with better feel and handle was obtained.

2 Materials and Methods

2.1 Preparation of Samples

Prepared roves of polyester-viscose rayon fibres (each of 1.2 denier and 51 mm length) were taken. One

set of roves was used for preparing 34s count yarn on a ring frame and the yarn was doubled through a cone-winding/cheese-winding machine and twisted on a doubler and the cone-winding machine again. Another set of roves was used for preparing Siro yarn.

The special roving guides were manufactured so that they could be placed on the ring frame in place of the conventional roving guides. The objective was to maintain a constant rove spacing so that roves could be drafted separately and after the drafting the fleeces could be made to merge into cone after the front roll nip. The most obvious problem which would have arisen was that of singles, i.e. when one of the roves breaks, the other rove will continue to be drafted and be passed in the bobbin. If supplied to the loom shed, the yarn would create serious problems. The problem of singles was overcome by using a heavier traveller so that when one of the roves breaks the other would have automatically broken. Both these yarns were wound on the pirns and used as weft on the loom with a warp of 48/52 polyester-viscose. Fabrics were manufactured from these yarns by keeping the same set.

2.2 Testing of Samples

All the samples were conditioned in standard atmosphere (65% RH and $27 \pm 2^\circ\text{C}$) and tested in accordance with the machine specifications. A skein of 120 yards was prepared and tested on a Knowle's balance. The average count was measured on this machine. Single-yarn strength was measured on an Instron tensile testing machine, the cross-head speed and the ratio of cross-head to chart speed being kept at 110 m/min and 1.1:1 respectively. A clamping length of 100 mm was used and the full-scale load was adjusted to 10 kg. Yarn uniformity was tested on an

Uster evenness tester with a material speed of 50 m/min. Lea strength of the yarn was tested on a Goodbrands lea strength tester. For measuring the twist level in the two yarns, a novel method was used on a Eureka twist tester. Yarn was clamped in the jaws with a gauge length of 10 in. and twisting was continued in one direction to such an extent that the yarn was broken. The twist actually inserted at that level was noted, and then the yarn was twisted in the opposite direction till the breaking twist was achieved. The actual twist was calculated as half of the difference between the two values. The diameter of yarns was measured on a Projectina. The abrasion resistance of yarns was measured on a Forican abrasion resistance tester. The strip strength was measured on a Goodbrands fabric strength tester with a gauge length of 7 in. The tearing strength was measured on an Instron tensile tester and single-rip tear test was performed. The cross-head speed and the ratio of cross-head speed to chart speed were kept at 100 mm/min and 2:1 respectively. A clamp length of 100 mm was used and full-scale load was kept at 10 kg. The average tear strength of each sample was found from 5 observations for each sample. The bending length of the fabric was tested on a Shirley stiffness tester. For measuring the pilling tendency of the fabric, a Forican pilling tester was used. The fabric was cut and rolled on the roller and pasted with cello tape. The roll was then placed in the tester and the number of pills formed on the surface was counted at 18,000 revolutions.

3 Results and Discussion

3.1 Evenness

Table 1 shows that an important feature of Siro yarn is that its U% and other imperfections like thick places, thin places and neps are low. This is probably due to better drafting of fibres in the drafting zone and better chances of readjustment of fibres between the fleeces within the yarn, leading to better evenness.

3.2 Count

Table 1 shows that the actual counts of yarns were near their nominal values; yet the Siro yarn had a lower variation from the nominal value and less variation within the samples also. This can be due to greater uniformity in them.

3.3 Lea Strength

Table 1 shows an extremely high value of CSP in Siro yarn as compared to that in the conventional two-fold yarn. This can be attributed to the fact that fibres are more firmly bound within the yarn structure in this case, and that the maximum of fibre strength in the yarn strength could be exploited, leading to a high level of lea strength.

Table 1— Characteristics of Yarns

Characteristic	Siro Yarn	Two-fold yarn
Uster U%	3.37	4.34
Thick places	9.1	9.2
Thin places	18.2	15.4
Neps	16.2	19.1
Count	15.79s (1.65) ^a	16.87s (1.67)
CSP	4092 (3.55)	2588 (3.61)
Single-yarn strength, oz	4.14	3.78
Diameter	0.436 mm	0.43 mm
Twists/inch	50.64 (1.46)	81.36 (1.51)
Abrasion strength, cycles	3067	4336
Knot strength, oz	2.132 (3.43)	2.63 (5.68)
Breakage rate, breaks/spindle	5.11	5.01

^aThe values given in parentheses are CV%

3.4 Single-Yarn Strength

Table 1 also shows that Siro yarn has better single-yarn strength than the conventional two-fold yarn. A high single-yarn strength also shows a high level of uniformity and better fibre binding within the yarn.

3.5 Voluminosity

Table 1 shows that the Siro yarn has a greater diameter than the conventional two-fold yarn. This can be explained on the basis of greater number of nipping points and greater strand twist leading to a firmer and stiffer structure in the two-fold yarn and a bulky and fuller appearance of the Siro yarn. It can be visualized that a bulky and fuller yarn would result in a fabric with soft and fuller appearance and better cover.

3.6 Twist

The twist level in Siro yarn is lower than that in two-fold yarn (Table 1). This is because of the fact that the twist is partially lost in the fleeces and that its full amount is not utilized in the formation of yarn. Variation in twist in the case of two-fold yarn can only be due to the flexibility of process.

3.7 Abrasion

Siro yarn has less abrasion strength than the two-fold yarn (Table 1). This can be attributed to less nipping points in Siro yarn and due to the fact that fibres are more firmly gripped in the two-fold yarn. The effect of this property of Siro yarn is that it will be inferior to double yarn if used without sizing in the warp.

3.8 Knot Strength

Another disadvantage of Siro yarn is the low knot strength. This is mainly because of the opening of twist at the ends and after that virtually no cohesive force to bind the fibres properly. This can create a serious problem on the loom while mending of warp breaks. This problem can be overcome by the use of hand knotters or hand splicers for joining broken ends.

3.9 Strip Strength

Table 2 shows that the Siro yarn fabric has higher strip strength than the conventional yarn fabric, because of the higher strength of the new yarn.

3.10 Breaking Elongation

The breaking elongation in Siro yarn fabric is higher than in the conventional yarn fabric (Table 2). Better elasticity of the Siro yarn will result in better fitting properties of the clothes manufactured from this yarn.

3.11 Tearing Strength

The tearing strength of Siro yarn fabric is higher than that of the conventional double-yarn fabric (Table 2), but when we compare the difference in the tearing strength with the difference in the yarn strength, it is found that the extent of increase in tearing strength is less than that in yarn strength. This could be due to the tendency of grouping of Siro yarn in the delta region of the tear and hence less tearing strength.

3.12 Flexural Rigidity

The flexural rigidity of Siro yarn fabric is less than that of two-fold yarn fabric (Table 2). This is probably

due to a higher amount of stiffness in the conventional double yarn because of a higher number of nipping points. Furthermore, suiting fabrics made from Siro yarn will have inferior drape properties.

3.13 Crease Recovery

The Siro yarn fabric has a higher crease recovery angle than the double-yarn fabric (Table 2). This is probably because the configuration of the fibres within the yarn is such that they are in a more relaxed state than those in the double yarn. When such yarns are subjected to creasing they tend to recover at a faster rate than the normal yarn. This is why Siro yarn has better crease recovery.

3.14 Breakage Rate

The breakage rate in Siro yarn was slightly higher than that in the conventional two-fold yarn (Table 1). This is due to a higher traveller weight used here. The heavier traveller causes a higher yarn tension and hence a higher breakage rate. In Siro yarn the breakage rate was higher at the end than at the start of the doff and most of the breakages were due to the traveller flying out.

4 Conclusions

The production in Siro yarn is twice as much as in the conventional two-fold yarn. The Siro yarn is more uniform than the two-fold yarn with a fewer thick places and greater thin places; it has less variation in count than the conventional yarn. The count lea strength product of Siro yarn is considerably higher than that of two-fold yarn.

The single-yarn strength of Siro yarn is higher than that of two-fold yarn. The diameter of Siro yarn is more than that of two-fold yarn. Twist level in Siro yarn is lower than that in the two-fold yarn.

Siro yarn is less abrasion-resistant than the conventional yarn. The strip strength of Siro fabric is more than that of the two-fold yarn fabric.

The breaking elongation of the Siro yarn fabric is higher than that of the two-fold yarn fabric; tearing strength of Siro yarn fabric is almost equal to that of the two-fold yarn fabric.

Siro yarn fabric is less stiff than the two-fold yarn fabric, but has a higher crease recovery.

A greater amount of pills is formed on Siro yarn fabric than on the two-fold yarn fabric, and breakage rate is slightly higher in Siro yarn.

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Table 2— Characteristics of Fabrics

Characteristic	Siro yarn fabric	Two-fold yarn fabric
Strip strength, lb	161.82 (1.16)*	157.38 (0.928)
Breaking elongation, %	16.83 (3.7)	14.66 (5.74)
Tearing strength, lb	10.75	10.46
Flexural rigidity		
Warp	52.114	56.843
Weft	56.81	55.734
Crease recovery, degree		
Warp	110.5	106.5
Weft	112.0	105.0
Pilling tendency, No. of pills/18,000 cycles	23.2	13.3

*The values given in parentheses are CV%

References

- 1 Landstreet C and Ewalds P, *J Text Inds*, 117 (1955) 114.
- 2 Plate D E A, *J Text Inst*, 73 (1982) 107.
- 3 Plate D E A and Emmanuel A, *J Text Inst*, 74 (1983) 378.
- 4 Plate D E A and Feehan J, *J Text Inst*, 74 (1983) 204.
- 5 Plate D E A and Lakhage J, *J Text Inst*, 73 (1982) 99.
- 6 Plate D E A, *Text Horizons*, 2 (1982) 34.
- 7 Natarajan K S and Subramanyan B, *Proceedings, 24th joint technological conference of ATIRA, BTRA and SITRA (SITRA Coimbatore) 1983*, 8.1.
- 8 Dhavan K, Srivastava A, Nayal S Y and Mathur R S, *Proceedings, 26th joint technological conference of ATIRA, BTRA, SITRA and NITRA (ATIRA, Ahmedabad) 1985*, p 701.