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Original Article

Impact of blend ratio on the quality parameters of cotton-tencel blended ring-spun yarn

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ABSTRACT

The blending of natural fibers with synthetics fibers has been tremendously increased to minimize the poor quality and the cost of the fiber around the world. A comparison on the characteristics of 100% cotton yarn, cotton-Tencel blended yarn with 80:20, 70:30, 50:50 ratios, and 100% Tencel yarn of 12 Ne ring yarn with varying percentages of Tencel was studied in this research. 100% cotton yarn has shown greater unevenness, CVm, thick places, thin places, neps, and imperfection index than cotton-Tencel blended yarn but in the matter of count strength product, 100% cotton fiber has shown low-grade result compare to blend yarn. Among the blended yarn, 50/50 yarn has shown the best quality. The quality of the cotton-Tencel blended yarn was enhanced while the Tencel fiber ratio percentage has risen. The reasons are directly ascribed to the characteristics of Tencel fiber such as its longer fiber length, higher length uniformity, no neps, and fewer strength characteristics. The research shows that the blending of Tencel fiber has significant effects on the blended yarn properties. Spinning mills can use this result for their production of blended ring-spun yarn.

Keywords: Blend ratio, cotton fiber, count strength product, CVm%, imperfection index, tencel fiber, U%

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INTRODUCTION

Technological blooming has enriched the textile industry by product mix and varying structure to develop numerous types of yarns and fabrics with a special outlook.[1] Blending natural fibers with manmade fibers increase the good properties of fiber component such as comfort of wear with easy care.[2] Considering the market for fancy yarns, the esthetic appearance of the fabric or garment can be generated by adding color or texture, or both.[3] It is very difficult to maintain blend evenness appropriately in cross-section/longitudinal direction as opening and carding treatments of cotton and manmade fibers are different.[4] Due to the greatest comfort: softness, strength, and good appearance, the importance of natural and synthetics fibers is increasing day by day.[5-7] Viscose fiber (1st generation), Modal fiber (2nd generation), and Lyocell or Tencel (3rd generation) are the representatives of cellulosic regenerated fiber. Except for density, molecular mass, degree of crystallinity, and degree of polymerization, the chemical composition of all regenerated fiber is the same.[8,9] "TENCEL Fibre Process" is one of the significant developments in regenerated cellulosic fiber technology with the help of N-methyl-morphine-N-oxide (NMMO) by Courtaulds Fibers Ltd Company. Tencel is also known as Lyocell.[10] Lyocell fiber can be used in a less contaminant spinning process than the conventional viscose fiber due to the exclusive orientation of the crystalline arrangement of its cellulose units in the longitudinal axis of the fiber.[11,12] In the raw state, a smooth surface and a round cross-section, high luster can be found in this fiber.[13]

Several studies were done with the impact of blend ratio on the blended yarn characteristics. Musa Kilic and Ays, Okur investigated the impact of different spinning systems on cotton-Tencel blended yarn properties considering the effects of blend ratio and blend type. They stated that the mechanical properties of cotton-Tencel blended yarns are greater than cotton-Promodal yarns.[14] A correlation analysis was established among cotton-Tencel blended ring, compact, and vortex yarn properties.[15] The physical characteristics of Tencel/polyester and Tencel/cotton

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yarn were examined with varying blend ratios and twist factors on the ring, rotor, and air-jet spinning machine and proved that Tencel/polyester yarn shows better results than Tencel/cotton yarns.[16] A comparative study was also established among the ring, rotor and compact spun yarn quality.[17] Some mechanical, ultraviolet protection, thermal, and moisture transport properties of knitted Tencel fabrics were explored with different Tencel fiber properties.[18] Some authors have studied the hairiness of cotton/polyester blended ring yarn with different blend ratios[19] and the diameter and hairiness of the ring and rotor cotton polyester blended yarn.[20] The quality parameters of cotton/bamboo blended yarn with varying bamboo ratios were also studied.[21] A significant influence was found on recycled polyester/cotton blended yarn[22] and cotton/flax blended yarn quality.[23] Kilic and Solar investigated the influence of different spinning systems on the frictional properties of cotton and Tencel yarns.[24] Erdumlu *et al*. also assessed the cotton, viscose rayon, and 50–50% cotton-modal blended vortex spun yarn properties in comparison with conventional ring and rotor spun yarns.[25] Several works have also been studied on the characteristics of yarn and fabric produced from 100% cotton and 100% modal.[26] In a research, the unevenness properties of polyester/cotton blended yarn have been reported with varying top roller diameters.[27]

This experiment aims to investigate the impact of different blend ratios in cotton-Tencel blended yarn and is compared with 100% cotton and 100% Tencel yarn on yarn unevenness (U%), CVm%, thin (−40%), thick (+50%), neps (+200%), imperfection index (IPI), and count strength product (CSP).

MATERIALS AND METHODS

Materials

In the research, two types of raw materials such as cotton and Tencel have been used to produce 12 Ne yarn. The yarns produced for this research are given in Table 1 with blend ratio. All types of yarns were produced by ring frame machine. Important parameters of ring frame machine are shown in Table 2. Cotton samples were taken from the mills, with average values of fiber properties as fiber length 28.5 mm, fineness 4.5 ug/inch, uniformity index 80, strength 30.4 g/tex, short fiber 8.2%, reflectance (Rd) 75.6, yellowness (+b) 9.3, Spinning Consistency Index 138, while Tencel having quality characteristics as fiber length 38 mm, fiber fineness 1.2 den was used.

Yarn Sample Preparation

In this research, 12's Ne yarns were produced on a ring spinning frame in a yarn manufacturing industry. For this, we delivered 100% cotton from Unifloc and Tencel from Mixing Bale Opener (MBO) machine to Uniblend machine (in Blow room); this machine can be blended fiber automatically by the input setting (required Tencel and cotton ratio) of a specific ratio blended fiber. Then, it goes to carding through MBO, Unistore and Condenser the above-mentioned ratio then carded sliver was produced. After that, 8 slivers were passed through the breaker draw frame to get the more uniform and regular sliver. Then, delivered slivers fed to finisher draw frame. From them, 8 slivers were taken and were fed to simplex. From it, 8 roving's (0.65 Ne) were manufactured and creeled to the ring frame which is of 8 particular spindles. From the ring frame 8 ring cops of 12 Ne 100% cotton, cotton-Tencel blended yarn, and 100% Tencel yarn was spun. Finally, for testing all spun yarns were taken to the QC department.

Table 1: Blend ratio of cotton-Tencel blended yarns

S. No.	Blend ratio (Cotton: Tencel)
1.	100:0 (pure cotton)
2.	80:20
3.	70:30
4.	50:50
5.	0:100 (pure Tencel)

Table 2: Important parameters of Ring frame machine

Machine parameters	Value
Spindle speed (r.p.m.)	11,000
T.P.I	15.60
Twist Multifiler (T.M)	4.5
Traveler number	N-10
Roving hank (Ne)	0.65
Ring diameter (mm)	38
Spacer size (mm)	4.5

Testing Procedure

Yarn unevenness (U%), CVm%, Thin (−40%), Thick (+50%), Neps (+200%), IPI, and CSP were evaluated for this research. Yarn U%, IPI, CVm%, Thin, Thick, and Neps were tested in USTER TESTER-5 with a yarn withdrawal speed of 400/min. Yarn IPI is estimated as a total number of −40% thin place, +50% thick place, and +200% neps per km length of yarn. For each type of yarn, 8 readings were grabbed to measure the average U%, IPI, CVm, Neps. For the evaluation of CSP, 120 yards yarns are taken to measure count by Auto wrap reel and at last, using Lea Strength Tester, the strength of 120 yards yarn has been determined. The manufacturer name of the machine that was used for the testing of fiber and yarn properties are given in the Table 3.

RESULTS AND DISCUSSION

Impact of Tencel Ratio on U% and CV_m

Figure 1 represents the relationship of unevenness U% and CVm% among 12Ne of 100% Cotton yarn, 20%, 30%, 50% cotton-Tencel blended yarn, and 100% Tencel yarn.

It is revealed in the graph that U% and CVm% decreases gradually with the increase of Tencel proportion in the blended yarn. As the Tencel fiber length is constant and it does not contain short fiber so length uniformity of Tencel fiber is higher than cotton because of Tencel fiber. Hence, 50/50 cotton-Tencel and 100% Tencel yarn have the lowest value compared to other blend yarn.

Impact of Tencel Ratio on Thin, Thick and Neps

Figure 2 represents the relationship of thin (-40%), Thick (+50%), and Neps (+200%) among 30Ne 100% Cotton yarn, 20%, 30%, 50% cotton-Tencel blended yarn and 100% Tencel yarn.

It is revealed in the graph that 100% pure cotton yarn has a thinner, thicker place and more neps than cotton-Tencel blended yarn and 100% pure Tencel yarn. Short fiber, over-processing in blow room, immature fiber, biological contamination, e.g. seed coat fragments, bark, and stickiness, are the prime reasons for these defects in the cotton yarn. However, Tencel fiber does not contain short fiber and neps. Hence, thin places, thick places, and neps are decreased with the increase of Tencel fibers and 100% pure Tencel fiber has shown the lowest value.

Impact of Tencel Ratio on IPI

Figure 3 represents the relationship of IPI in the yarn among 30Ne 100% Cotton yarn, 20%, 30%, 50% cotton-Tencel blended yarn, and 100% Tencel yarn.

Table 3: Experimental instruments in lab

Machine name	Manufacturer
Lea strength tester	Italy
USTER@ TESTER-5	USA
Wrap reel	Italy
USTER@ HVI SPECTRUM	USA

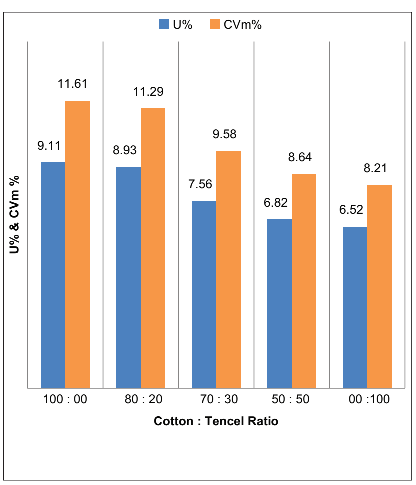

Figure 1: Impact of Tencel ratio on U% and CVm %

It is observed that IPI of the cotton Tencel blended yarn decreases with the increase of Tencel proportion in the blend that is believed the result from the higher length and length uniformity, absence of short fiber and neps of viscose fiber than those of cotton. Hence, 100% cotton yarn has shown highest value, addition of Tencel fiber helps to decrease IPI value and 100% pure Tencel has shown lowest value. Among the blended yarn, 50/50 cotton/Tencel yarn represents better result compared to other blend yarn.

Impact of Tencel Ratio on CSP

Figure 4 shows the CSP values of the 100% Cotton yarn, 20%, 30%, 50% cotton-Tencel blended yarn, and 100% Tencel yarn.

The graph reveals that an increase in Tencel proportion increases the CSP values of cotton-Tencel blended yarn. In general, the strength of the yarn is determined by the weak spot in the yarn. When the count variation and strength variation is examined, count variation in the yarns does not differ significantly but in the case of strength Tencel fiber shows greater because a weak

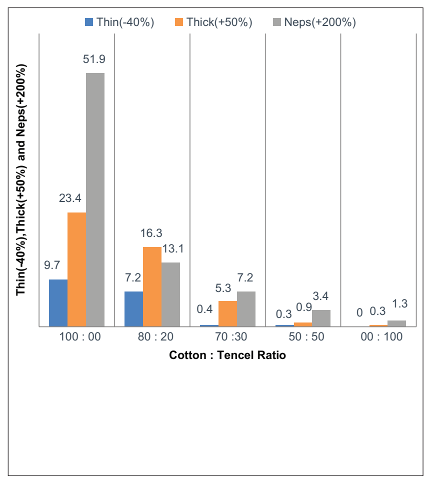

Figure 2: Impact of Tencel% on thin place, thick place and neps

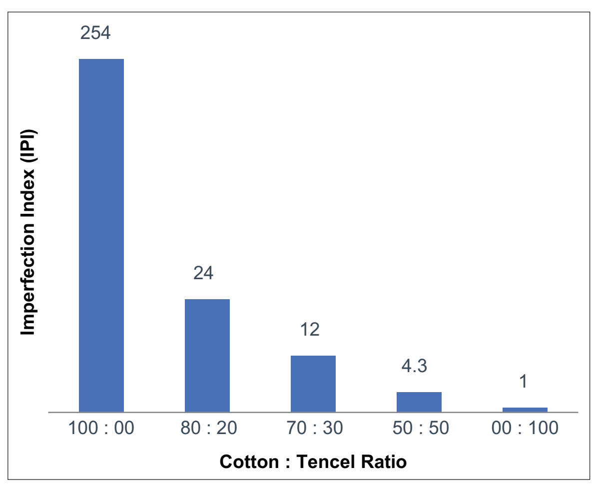

Figure 3: Impact of Tencel% on imperfection index

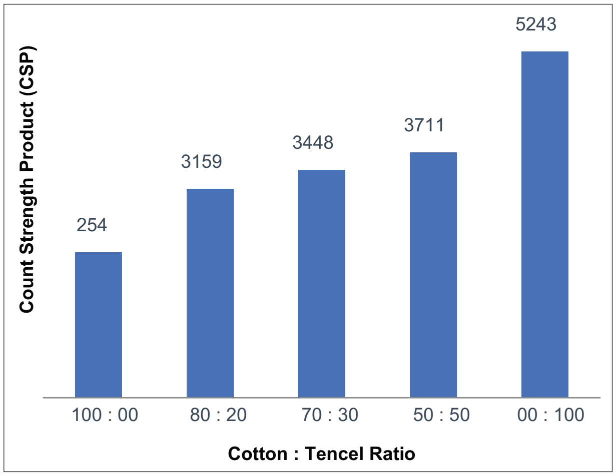

Figure 4: Impact of Tencel% on count strength product

spot in Tencel fiber is less than pure cotton fiber. However, blending other fibers reduces cohesiveness and compactness can be reduced with the increasing of blending. Cotton and count variation of blended yarns can also be accountable for differences in CSP. Hence, 50/50 cotton-Tencel blended yarn has the highest CSP value compared to 80/20 and 70/30 cotton-Tencel blended yarn.

CONCLUSION

This research shows that in addition of Tencel fiber has played a significant effect on the properties of cotton-Tencel blend yarn. Due to the fiber length variation, short fibers, immature fiber, the quality parameters of the yarn can be deteriorated. The quality parameters of cotton-Tencel blended yarn such as U%, CV_m%, thick (+50%)/km, thin (−40%)/km, neps (+200%)/km, IPI, and CSP were examined in this research.

With the increase of Tencel percentage, the quality parameters of blended yarn were exhibited better results. U%, CV_m%, thick, thin, neps, and IPI were showed a decreasing trend with an increasing blend ratio. Among the blended yarn, CSP in 50/50 cotton-Tencel was higher followed by 80/20 and 70/30 cotton-Tencel blended yarn. Due to higher length, higher strength and less short fiber, 50/50 cotton-Tencel blended yarn can easily be comparable to 100% cotton yarn. From this research, it can be proposed that blending of Tencel fiber along with cotton fiber is highly desirable to obtain necessary comport properties of yarn as well as fabric.

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