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Comparison between Tencel-Flax Blended Slub Yarn and Cotton-Flax Blended Slub Yarn

Mohammad Nayemul Islam[1*], Lamia Latifun Rahman[1], Md. Imran Hosen[2], Jaglul Hoque Mridha[2], Md. Sakib-Uz-Zaman[2], Md. Shahin Hossen[3], Nazmus Sakib Khan[4]

[1]Department of Textile Engineering, Sonargaon University, Dhaka, Bangladesh
[2]Department of Textile Engineering, Primeasia University, Dhaka, Bangladesh
[3]Epyllion Limited, Epyllion Group, Dhaka, Bangladesh
[4]Auxicolour Bangladesh Limited, Dhaka, Bangladesh
Email: *201611001butex@gmail.com

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Abstract

The blending of different fibers is done for the manufacturing of yarn to ensure the presence of multiple properties in the resultant yarn which is impossible if we use only one type of fiber. Tencel is regenerated cellulosic fiber & flax is natural bast fiber. Tencel shows more versatility than flax. Tencel has a softer feel with a variety of end uses. Tencel is wrinkle-prone and stiff. Tencel shows extreme strength even in wet conditions and at the same time, it is more durable than linen. The most important fact is that the heat dissipation property of flax is 5 times higher than wool & 19 times higher than silk. Linen clothing can lower the body temperature by 3 to 4 degree celsius in hot weather than clothing made of wool and silk. A yarn made of both Tencel & linen (50:50) will contain the properties of both fibers. At the same time, we can make this yarn more aesthetic by incorporating a slub. It was observed that the slub yarn made by blending Tencel and flax fiber shows better properties than the slub yarn of the same count made from the blending of cotton and flax.

Keywords

Flax, Tencel, Slub, Blending

1. Introduction

A group of fibres having certain qualities is combined together during blending to improve the color, feel, strength and insulation of the resultant yarn, which is too challenging. During the blending of wool with polyester or acrylic, the comfort and insulation characteristics are provided by wool, whereas acrylic or po-

lyester helps to retain fabric shape, prevents creasing and limits the shrinkage of the fabric caused by wool [1]. The spinning process of multi-component blended yarn is difficult due to the difference in morphology of each component fibres and so research work [2] was done to summarize the selection of fibre, blending ratio and spinning process for making high quality multi-component blended yarn. Research [3] compared 100% cotton yarn, 100% Tencel yarn and cotton-tencel blended yarn of 12Ne having blending ratios 80C:20T, 70C:30T and 50C:50T in which more unevenness, CVm%, thick place, thin place, imperfection index, neps but lower count strength product were found for 100% cotton yarn than blended yarn and the best ratio was 50C:50T. Bast fibres such as jute and linen can be used instead of synthetic fibres for social, economical, technical and environmental benefits due to cost-effectiveness, good mechanical properties and lightweight nature [4]. Several studies [5] [6] [7] were performed to show the different advantages obtained by using flax fibre to make textile materials. Another research work [8] shows us the benefits of using flax fibre to reinforce polymer composites. Ngan Yi Kitty [9] evaluated how the tensile property of ring spun yarn is affected by blending method. In fancy yarn, interruption is introduced either in color or form or both to produce an enhanced aesthetic effect. Fancy yarns can be produced using modern spinning technologies some of which are studied by Gong, H [10]. Slub yarn is one kind of fancy yarn in which thick and thin places are introduced in a regular or irregular manner. A mechanical model provides us with twist distribution from which the mechanical properties of slub yarns can be explained [11]. The manufacturing techniques, properties and influencing factors of inject slub and some other fancy yarns were explained in different studies [12] [13] [14]. By using some chemical procedures, we can convert the mostly available polymeric material cellulose into lyocell (trade name of cellulose) fibre [15] [16]. Different studies [17] [18] [19] [20] show us the advantages of using Tencel in manufacturing textile materials. Ring and rotor spinning are not suitable for generating color blended yarn due to fixed linear density and blending ratio though ring and rotor spinning is the most popular method of yarn production but this problem can be solved by incorporating CNC technology which increases flexibility [21] [22]. Ring and traveler are used in ring spinning machine to impart twist into yarn which reduces production but twist is too important because it increases yarn strength. We can improve the throughput of ring spinning machines by minimizing ring-traveler friction which helps to balance productivity; energy consumption and traveler wear [23]. Another study [24] [25] was performed on drafting force and its effect on fibre breakage. In this study, we produced slub yarn by blending Tencel with flax fibre and compared its quality parameters with the yarn produced by blending cotton with flax fibres having the same count and same slub design.

2. Materials & Methods

2.1. Materials

Tencel fibre having an average length of 42mm and fineness 1.17 denier was blended

with Indian cottonized flax fibre having an average length of 40mm and fineness 1.2 denier to produce 16Ne Tencel-flax blended slub yarn. Again, Cotton fibre having an average length of 39mm and fineness 4.2 micronaire was blended with flax fibre to produce 16Ne slub yarn of the same slub pattern.

2.2. Methods

At first, American pima cotton was blended with flax fibre in 50:50 ratio by hand mixing technique and given to blowroom as input and then the output of blowroom named as chute were fed into Trutzschler DK-803 Carding machine from which card sliver having linear density 109 grains per yard was produced. These card slivers were fed into the rieter SBD-40 breaker draw frame machine from which we got breaker drawn sliver having a linear density of 78 grains per yard. These breaker drawn slivers were fed into rieter RSBD-45 finisher drawframe machine from which we got finisher drawn sliver having linear density of 78 grains per yard. These finisher drawn slivers were fed into Toyota FL-16 speedframe machine from which we got roving having linear density of 0.9 Ne. These rovings were fed into BS518-SM ringframe machine from which we got cotton-flax (50:50) blended slub yarn of 16Ne. Slub length was 54 - 94 mm, slub distance was 106 - 246 mm and slub dia was 1.59 - 1.59. Again tencel fibre was blended with flax fibre in 50:50 ratio using hand mixing technique and given to blowroom as input and then the output of blowroom named as chute were fed into Trutzschler DK-803 Carding machine from which card sliver having linear density 109 grains per yard was produced. 8 carded slivers were fed into the rieter SBD-40 breaker drawframe machine from which we got breaker drawn sliver of Tencel-flax (blending ratio is 50T:50F) having linear density of 78 grains per yard. These breaker drawn slivers were fed into rieter RSBD-45 finisher drawframe machine from which we got finisher drawn sliver having linear density of 78 grains per yard. These finisher drawn slivers were fed into Toyota FL-16 speedframe machine from which we got roving having linear density of 0.9 Ne. This rovings were fed into BS518-SM ringframe machine from which we got Tencel-flax slub yarn of 16Ne. Slub length was 54 - 94 mm, slub distance was 106 - 246 mm and slub dia was 1.59 - 1.59. During spinning, the highest arm pressure (red) was selected. The draft was calculated using the following formula.

$$\text{Total draft} = \frac{\left\{\left(\text{Average slub length} \times \text{Average slub dia}\right) + \text{Average slub distance}\right\} \times \text{Yarn count} \times \text{Roller slippage}}{\left(\text{Average slub distance} + \text{Average slub length}\right) \times \text{Roving hank}}$$

4 ring cops were produced for 16Ne cotton-flax blended slub yarn and 4 ring cops were produced for 16Ne Tencel-flax yarn having the same slub design. These ring cops were tested at 50 m/min for 0.1 minute in uster tester-5 machine. Mesdan lab strength tester was used to determine RKM (tenacity) where CRE principle was used, clamp speed was 500 m/min and sample length was 500 mm. Elestretch machine of mesdan lab was used to determine count strength product (CSP) in which CRE principle was used (Table 1 & Table 2).

3. Result

The detailed yarn quality parameters are given in Table 3 and Table 4. There are four readings for each parameters. Here, U% means the percentage of unevenness, CVm% means co-efficient of mass variation, IPI means imperfection index which is equal to the summation of thick place per km, thin place per km & neps per km. H means hairiness, CSP means count and strength product which determines bundle yarn strength, RKM determines single yarn strength.

Table 1. Process parameter of ringframe to produce 16Ne slub yarn.

Parameter	Value
Total draft	21.92
Break draft	1.28
TPI	18.4
Traveler number	2
Spacer	4.0 mm
Roller gauge	41 * 45
Roller slippage	1.05
Spindle speed	10,000 RPM
Efficiency	90%
Slub length	54 - 94 mm
Slub didtance	106 - 246 mm
Slub dia	1.59 - 1.59

Table 2. Speed pattern for ringframe : For the speed of 9500 RPM.

Length %	0	5	10	20	35	65	74	82	90	100
Speed	51	52	53	53	53	53	53	53	52	51

Table 3. Quality parameters of cotton-flax (50:50) blended slub yarn.

Sample (Ring cops)	U%	CVm %	Thin (−50%) per km	Thick (+50%) per km	Neps (+200%) per km	IPI	CSP	RKM (CN/Tex)	Elongation %
1	29.36	36.76	6100.00	3645.00	3866.00	12,521.00	1854.00	12.92	3.21
2	25.64	31.94	4432.00	3191.00	3220.00	10,754.00	1798.00	12.84	2.95
3	27.16	34.33	4821.00	3900.00	3701.00	11,522.00	1777.00	12.78	3.10
4	28.40	35.15	3200.00	3554.00	3455.00	13,243.00	1892.00	12.73	3.18
Mean	27.64	34.55	4638.25	3572.50	3560.50	12,010.00	1830.25	12.82	3.11
Standard Deviation	1.61	2.01	1194.60	293.48	282.93	1095.00	52.45	0.08	0.12
CV%	5.82	5.81	25.76	8.22	7.95	9.12	2.87	0.64	3.74

4. Discussion

Figures 1-9 show the comparison of the mean values of different quality parameters between cotton-flax (50:50) blended slub yarn and Tencel-flax (50:50) blended slub yarn. Regenerated fibres are a kind of man-made fibre that are

Table 4. Quality parameters of Tencel-flax (50:50) blended slub yarn.

Sample (Ring cops)	U%	CVm %	Thin (-50%) per km	Thick (+50%) per km	Neps (+200%) per km	IPI	CSP	RKM (CN/Tex)	Elongation %
1	24.11	31.75	5600.00	3400.00	3000.00	12,000.00	1952.00	13.23	7.22
2	23.09	32.22	4200.00	3200.00	3200.00	10,600.00	1958.00	12.99	6.91
3	22.24	31.89	4000.00	3800.00	3600.00	11,400.00	1888.00	13.02	6.99
4	24.60	31.23	3000.00	3600.00	3600.00	10,200.00	1798.00	12.96	7.08
Mean	23.51	31.77	4200.00	3500.00	3350.00	11,050.00	1899.00	13.05	7.05
Standard Deviation	1.05	0.41	1070.83	258.20	300.00	806.23	74.41	0.12	0.13
CV%	4.49	1.30	25.50	7.38	8.96	7.30	3.92	0.94	1.89

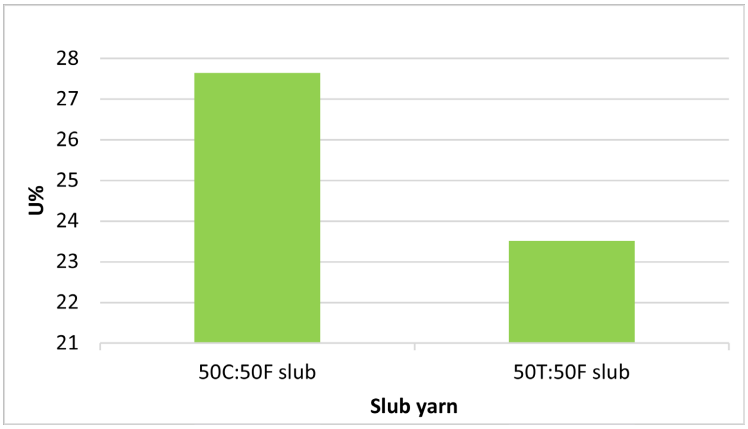

Figure 1. Comparison of unevenness of 50C:50F slub yarn and 50T:50F slub yarn.

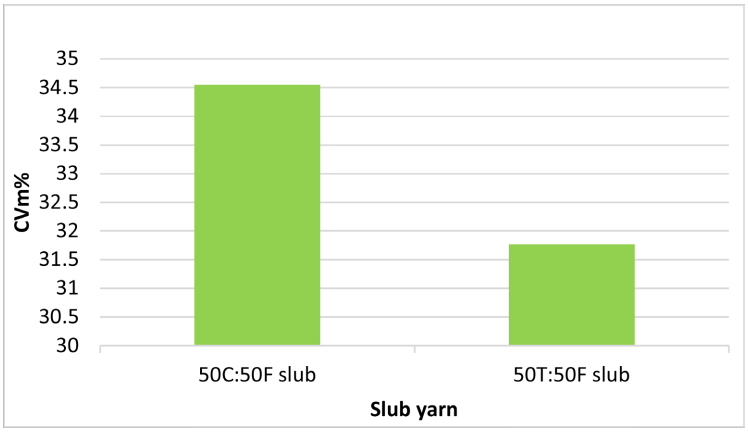

Figure 2. Comparison of co-efficient of mass variation of 50C:50F slub yarn and 50T:50F slub yarn.

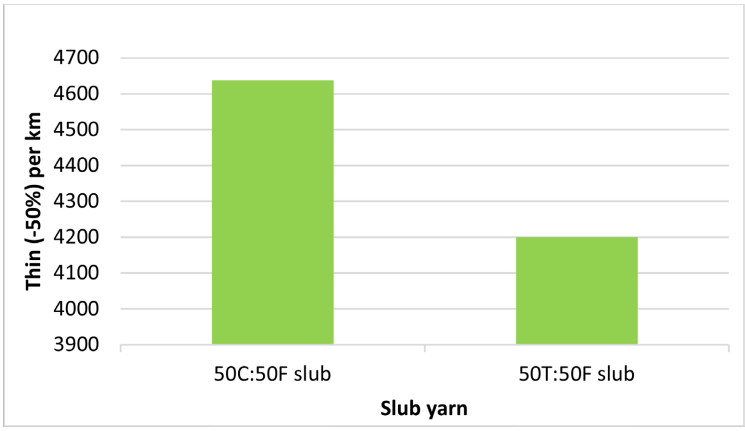

Figure 3. Comparison of thin place of 50C:50F slub yarn and 50T:50F slub yarn.

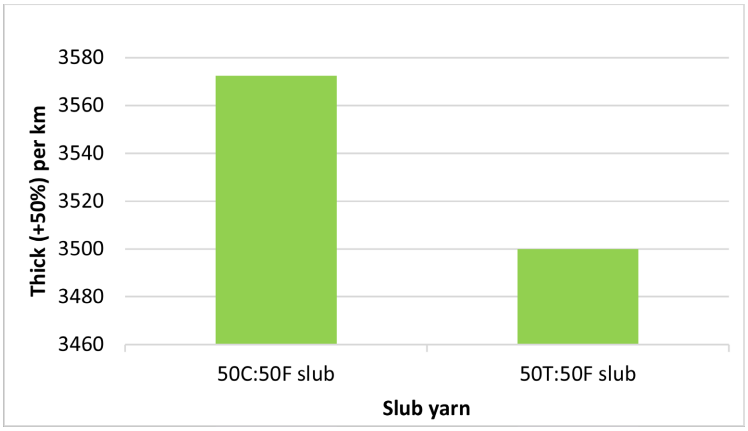

Figure 4. Comparison of thick place of 50C:50F slub yarn and 50T:50F slub yarn.

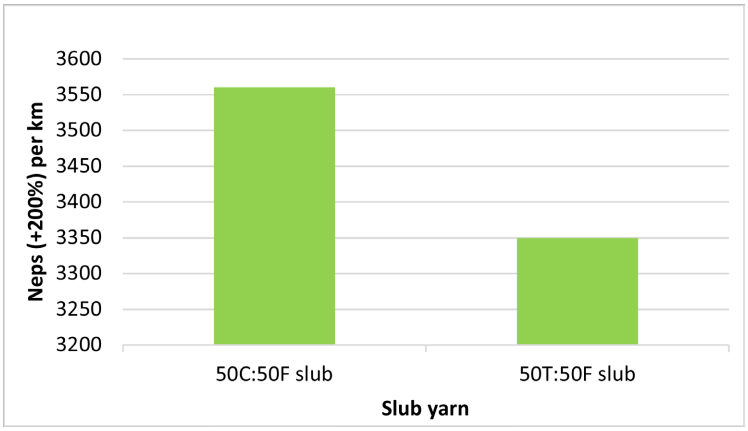

Figure 5. Comparison of neps of 50C:50F slub yarn and 50T:50F slub yarn.

produced by modifying the polymers collected from nature. Tencel is a regenerated fibre made with higher strength, good uniformity and excellent surface characteristics. On the other hand, flax fibre is a natural bast fibre whose properties are totally controlled by nature. Because of being a bast fibre, the evenness of flax is not so good as Tencel fibre. This phenomenon is reflected in **Figures 1-9**. The slub yarn made from Tencel flax blended fibre shows higher strength,

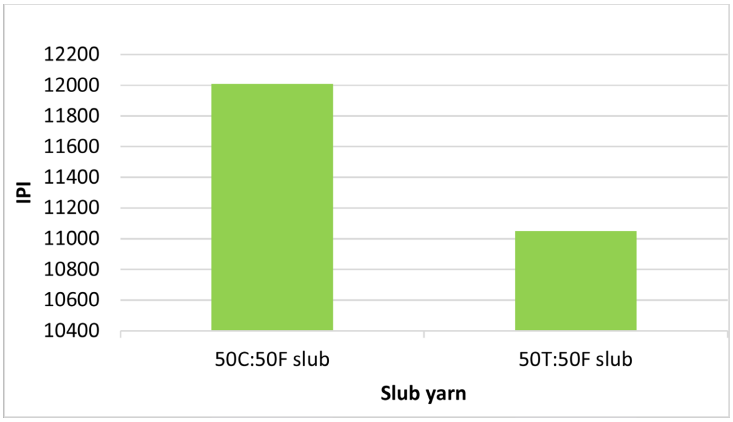

Figure 6. Comparison of IPI of 50C:50F slub yarn and 50T:50F slub yarn.

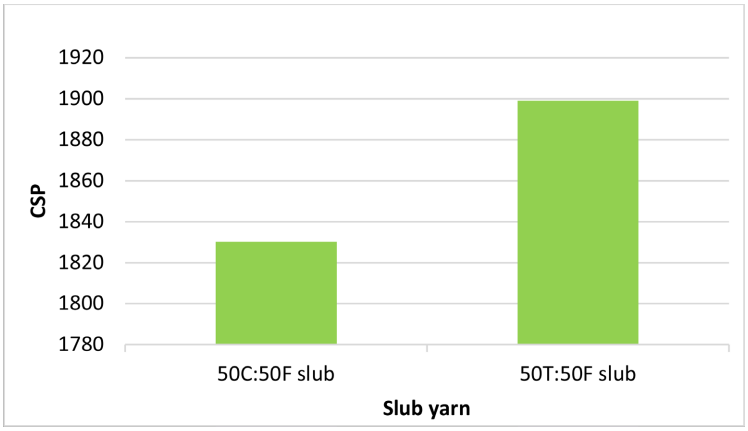

Figure 7. Comparison of CSP of 50C:50F slub yarn and 50T:50F slub yarn.

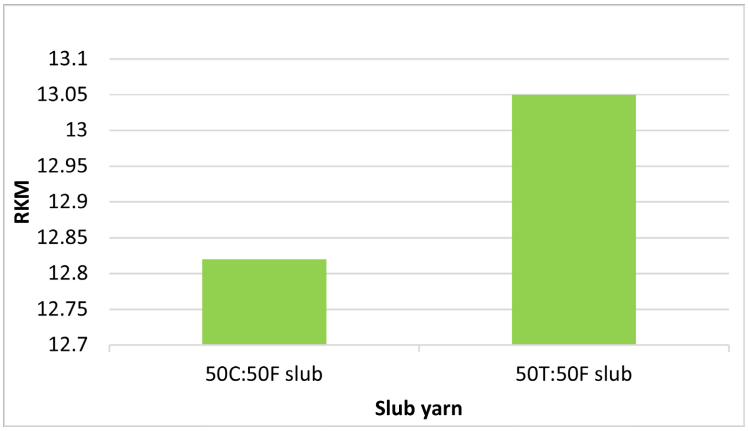

Figure 8. Comparison of RKM of 50C:50F slub yarn and 50T:50F slub yarn.

uniformity and elongation than the slub yarn made by blending cotton and flax.

5. Conclusion

This study was conducted to understand the impact of fibre blend on the unevenness, imperfection, strength and elongation of slub yarn. It was clearly seen that slub yarn made from Tencel-flax blend shows superior quality parameters

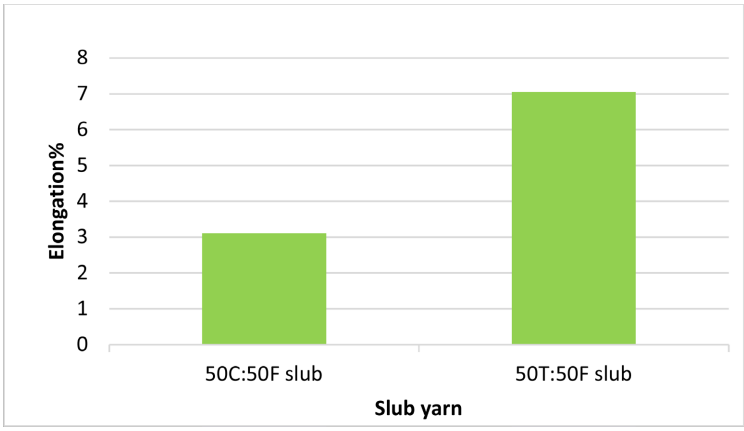

Figure 9. Comparison of elongation of 50C:50F slub yarn and 50T:50F slub yarn.

than the slub yarn made from 50C:50F fibre keeping the yarn count and slub pattern the same. The harsh and uneven nature of flax fibre is reflected on the slub yarn made from 50C:50F. On the other hand, the quality of both Tencel and flax fibre averaged out when we made slub yarn of 50T:50F. The higher uniformity of Tencel fibre compensate the uneven nature of flax fibre during blending. At the same time, the yarn made from blended fibre (50T:50F) shows good elongation characteristics due to the presence of Tencel fibre whose elongation is more than flax. Blending tencel fibre instead of cotton with flax has improved the overall quality of the resultant slub yarn. Finally, we can say that Tencel fibre is more compatible to blend with flax than cotton.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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