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Short Communications

Properties of cotton, tencel and cotton/tencel blended ring- spun yarns

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Yarn characteristics of pure cotton, 67:33 cotton/tencel blend, 33:67 cotton/tencel blend and pure tencel have been studied. Blending is done at draw frame. Machinery parameters are kept constant for studying the effect of fibre parameters on yarn characteristics. It is observed that the addition of tencel increases single yarn strength significantly at the higher tencel composition. Presence of tencel improves the elongation property. Packing fraction of tencel and tencel blended yarn is found to be more than that of cotton. Swelling diameter of pure cotton yarn is found to be lower than those of pure tencel and tencel/cotton blend yarns. Hairiness (H) decreases with the addition of tencel in the blend. It is also observed that the coefficient of friction (yarn- to- metal) of blend yarn reduces with the addition of tencel fibre in the blend.

Keywords: Packing fraction, Ring-spun yarn, Tencel, Yarn diameter, Yarn strength

Tencel fibre is increasingly used in spinning mills as it can substitute cotton for few characteristics. It is claimed as an ecofriendly fibre since the synthesis of tencel involves solvent which is recycled. Drape, moisture, and lustre of tencel are better than cotton. It is a common practice to blend various fibres to produce a yarn for obtaining the advantages of parent fibres. Many studies have been reported on blending of various fibres, and yarn characteristics have been analysed experimentally[1-7]. Barella and Manich[8] and Canoglu *et al*[9]. have analysed hairiness of blended yarn. Duckett *et al.*[10]. studied the contribution of interfibre friction to the breaking energy. Majumdar *et al.*[11]. analysed the properties of ring-and rotor- spun yarns made from cotton and regenerated bamboo fibres. Similarly, studies on jute based ternary blended yarns were reported by Sengupta and Debnath[12]. Studies on tensile properties of eri/acrylic blend yarn have been published by Choudhuri *et al.*[13]. Tyagi *et al.*[14]. have detailed the comfort behaviour of woven cotton ring and MJS yarn fabrics. Now-a- days viscose, modal, tencel fibres are blended with cotton to produce fabric with enhanced characteristics like comfort, drape ability, luster, etc. Musa Kilic[15] has reported the properties of cotton–tencel on different spinning systems for 50:50 blend proportions. Kilic and Sular[16] studied frictional properties of cotton and tencel yarns on different spinning systems.

In this study, the effects of composition of tencel fibre in cotton/tencel blend yarn on yarn strength, elongation, yarn diameter, packing fraction, hairiness, and frictional properties have been investigated.

Experimental

In this study, four different yarn samples of 30^s (Ne) count were developed using cotton and tencel fibres (Table 1), such as pure cotton yarn, pure tencel yarn, cotton/tencel blend (67:33), and cotton/tencel (33:67) blend. Shankar 6 cotton and standard tencel from Lenzing, Austria were used in this study.

Table 1—Properties of cotton and tencel fibres

Parameter	Value
Cotton	
2.5 % span length, mm	27.4
Bundle strength, g/tex	23.8
Fineness, micrograms/inch	4.0
Elongation, %	4.9
Moisture regain, %	7.26
Coefficient of friction (fibre-to-fibre)	
Static	0.27
Dynamic	0.18
Tencel	
Mean length, mm	39.1
Tenacity, g/tex	36.28
Mean denier, titre/tex	1.3
Elongation, %	9.7
Moisture regain, %	10.09
Coefficient of friction (fibre-to-fibre)	
Static	0.21
Dynamic	0.13

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In blow room, number of beating points and hank of lap (0.0014) remain same. In carding, lower speed was maintained for tencel, but hank of the sliver was kept constant for both tencel and cotton (0.13). Fibres were processed on a Trutscheler blow room and Trutscheler card. Cotton was processed up to combing. LMW LK 250 comber was used for combing.

Combed cotton slivers and carded tencel slivers were drawn on the first draw frame to get uniform sliver and to get required sliver hank for blending in the second draw frame. For 67 tencel /33 cotton blend yarn, five tencel slivers of 0.141 hank and three cotton slivers of 0.175 hank were blended in the second draw frame. Similarly for reverse blend five cotton slivers of 0.141 hank and three tencel slivers of 0.175 hank were used. For both the blends, the output slivers were produced with the hank of 0.136 and draft of 7.2. Slivers blended from second draw frame were drawn again in third draw frame to get better uniformity and to get better blending, keeping hank of sliver same. Reiter SB 20 draw frame was used for all drawing operations. For pure cotton yarn, combed cotton sliver was processed in draw frame to the hank of 0.136 and was ring spun into pure cotton yarn. The pure tencel yarn was made from 0.136 draw frame sliver after drawing and then ring spun. The hank of roving and spindle speed was 1.2 and 930 rpm respectively. LMW LF 1400A was used to produce roving. In ring frame, TM and spindle speed were 3.8 and 15000 rpm respectively. LR 6/s was employed in ring spinning.

Yarn count was determined as per ASTM-D1907:2001 standards. Evenness of samples was assessed as per ASTM – D 1425:1996. Twenty samples were taken randomly for count determination and the mean value was calculated. For evenness ten samples were tested in Uster tester 4 – SX R2 and mean value is reported. These parameters were tested as per Uster standards testing method. Uster Tenzorapid 3 V7.0 was used to test yarn samples with the testing speed of 5000 mm/min. Two hundred samples were tested and mean strength value in grams were converted to g/tex. Yarn hairiness was determined as per Uster standard testing method. Uster tester 4-SX R2.0 was used with the test speed of 400 m/min. Ten samples were tested and the mean value is reported. Yarn diameter was measured by using polarised projection microscope. An average of forty readings is reported. Similarly yarn diameter on swelling was measured. Coefficient of friction was determined as per ASTM D 3108:2007. Lawson-Hemphill – TENSION – W instrument was used. Wrap angle and input tension were 180^0 and 20 g respectively. Test results are given in Table 2.

Results and Discussion

Count on the absolute value of all four samples does not show variation and this could be attributed to the machinery parameters and machine conditions used to produce yarn. Coefficient of variation in count of pure cotton yarn is more than that of cotton/tencel blend and pure tencel yarn. Hence, it can be concluded that the blending of tencel fibre with cotton brings down the variation. U % of pure cotton yarn is also higher than cotton/tencel blend and pure tencel yarns.

Unlike filament yarn, spun yarn breaks either due to fibre rupture or due to fibre slippage. Fibre breakage in yarn is decided by the parent fibre strength and number of fibres in the cross-section to share load. On the other hand, yarn breakage due to fibre slippage is governed by fibre friction, lateral force due to twist and differential position of the component fibres in the blend to twist[17]. Apart from this, the position and orientation of fibre in the yarn matrix and fibre distribution and fibre migration also have their role in the tensile response of yarn[18]. It is

Table 2—Yarn characteristics

Characteristics	Cotton	Cotton/ tencel (67/33)	Cotton/ tencel (33/67)	Tencel
Actual count	29.2	29.3	29.5	29.7
Count CV, %	1.2	0.69	0.72	0.74
Single yarn tenacity, g/tex	19.12	19.32	20.74	28.49
CV %	7.24	7.22	7.64	7.97
CSP	3086	3617	4648	5054
CV %	3.54	3.67	3.15	3.17
Elongation, %	6.18	6.21	6.83	10.06
U %	10.0	9.67	9.41	9.58
Yarn diameter, mm	0.177	0.161	0.163	0.165
Yarn diameter, mm (Swelling)	0.225	0.224	0.221	0.222
Yarn diameter increase, %	27.12	39.13	35.58	34.55
Packing fraction	0.543	0.713	0.633	0.614
Hairiness (H)	5.7	5.43	5.32	5.22
Coefficient of friction (Fibre- to-metal)	0.15	0.07	0.06	0.06

observed that the presence of tencel fibre increases the strength of the blend yarns to a significant level. As compared to pure cotton, 67:33 cotton /tencel blend yarn does not show a significant increase in strength. Test of significance (Paired comparison method) also confirms the same. This may be due to the dominance of cotton in this particular blend. In the case of count strength product, the increase in strength is gradual from pure cotton to pure tencel. It is once again confirmed that the single yarn strength is determined mainly by weak spot in the yarn and load is shared among threads when group of threads are subject to strength testing. When the strength variation is analysed, both single yarn strength and count strength product values do not differ significantly. The strength of pure tencel yarn is very high both in single yarn strength measurement and lea strength measurements.

Elongation values of yarn show a similar pattern as in the case of single yarn strength. It is observed that pure cotton yarn has more elongation value than its parent fibre. This increase in elongation in cotton yarn may be attributed to fibre slippage and the opening of the fibre helix during tensile deformation. Similarly elongation of pure tencel yarn is more than the fibre elongation. Addition of tencel fibre marginally increases elongation of blend yarn and it may be due to the difference in frictional characteristics of parent fibres. Hence, it is concluded that the fibre slippage, opening of the fibre helix during tensile deformation and fibre elongation contribute to yarn elongation in cotton/tencel blend. The increase in yarn elongation will be useful in weaving preparatory and weaving machine and will reduce the end breakage rate for pure tencel and tencel cotton blend yarns.

Diameter of pure tencel and tencel/cotton blend yarns was found to be lower than that for pure cotton yarn. Packing fraction was calculated with the yarn diameter. Packing fraction for cotton yarn is found to be lower as compared to other samples. Packing fraction values of pure tencel and blend yarns are similar. This confirms that tencel packs itself well even in blends. It may be due to the higher fibre length and lower fibre modulus of tencel. Yarn diameter is also measured on swelling after wetting and it is observed that the percentage of increase in yarn diameter for cotton is comparatively less for pure cotton yarn. This difference may be due to the difference in moisture absorption characteristics of tencel and cotton fibres.

Hairiness in spun yarn is governed mainly by fibre length, level of twist, bending rigidity of fibres and spinning systems in which yarn is spun. In this study, spinning system and level of twist are constant. It is observed that 100 % tencel yarn has lower hairiness values as compared to blend yarn. Pure cotton yarn shows higher hairiness value. Addition of tencel fibre reduces hairiness (H) value. This may be attributed to absence of short fibres and lower fibre modulus of tencel.

Frictional characteristics of the blend yarn show significant decrease in value of coefficient of friction with the addition of tencel component as compared to pure cotton yarn. The difference in frictional characteristics, both static and dynamic friction, of parent fibres has an impact on the frictional characteristics of blend yarn. It is observed that even small addition of tencel fibre changes frictional coefficient significantly and this may be due to sheath effects of fibre present in the yarn, tencel occupying surface predominantly. The difference between hairiness values of all the samples is statistically significant. Hence, it is concluded that the presence of tencel fibre reduces the coefficient of friction of the resultant yarn.

This study shows that the addition of tencel fibre increases the strength of blend yarn to a significant level with higher tencel composition. Elongation of the blend yarn increases to only a marginal level with the increase in tencel composition. Yarn diameter of pure cotton yarn is more than those of pure tencel and tencel/cotton blend yarns. But on swelling due to the absorption of less water the percentage of increase in yarn diameter is comparatively less for cotton yarn. Hairiness (H) is reduced when tencel is blended with cotton. It is shown that the frictional characteristics of the blend yarn are influenced by the presence of tencel fibre even at the lower tencel composition. Frictional properties of tencel show good potential in improving the comfort property of fabric made of the cotton/tencel blend.

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References

1 Ratnam T V, Shankaranarayana K S, Underwood C & Govinarajulu K, *Text Res J,* 38 (1968)360.

2 Zurec W, Sobieraj I & Trzesowska T, *Text Res J,* 49 (1979)438.

3 Ishtiaque S M, Das A & Prashant Vishnoi, *Indian J Fibre Text Res,* 36 (2011)152.

4 Sett S K, Mukhejee A & Sur D, *Text Res J,* 70 (2000) 723.

5 Debnath C R & Bandyopadhyay S B, *Text Res J,* 45 (1975)404.

6 Debnath C R, *J Text Inst,* 65 (1974)393.

7 Sandeep D N, Shivaprakash A V & Maharaddi V H, *Man-Made Text India* 39 (2011)89.

8 Barella A & Manich A, *Text Res J,* 54 (1984)840.

9 Canoglu S & Tanir S, *Text Res J,* 79 (2009)235.

10 Duckett K E, Goswami B C & Ramey H H, *Text Res J,* 49 (1979)262.

11 Abhijit Majumdar, Samrat Mukhopadhyay, Ravindra Yadav & Achintya Kumar Mondal, *Indian J Fibre Text Res,* 36 (2011)18.

12 Surajit Sengupta & Sanjay Debnath, *Indian J Fibre Text Res,* 42 (2012)217.

13 Prabir Kumar Choudhuri, Prabal Kumar Majumdar & BijonSarkar, *Indian J Fibre Text Res,* 38 (2013)66.

14 Tyagi G K, Bhattacharya S & Kherdekar G, *Indian J Fibre Text Res,* 36 (2011)47.

15 Musa Kilic, *Text Res J,* 81 (2011)56.

16 Gonca Balci Kilic & VildanSular, *Text Res J,* 82 (2012) 755.

17 Balasubramaniam N, *Text Res J,* 40 (1970)129.

18 Rajesh D Anandjiwala, Bhuvanesh C, Goswami, Charles K Bragg & Jefferson D Bargeron *Text Res J,* 69 (1999)129.