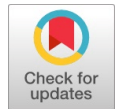


Influence of Blend Ratio on Physical Characteristics of Tencel / Bamboo Blends



C. Prakash, G. Karthikeyan, S. Kubera Sampath Kumar, M.B. Sampath

Abstract: An increase in the tencel content of tencel/bamboo blended yarns has a significant influence on the overall quality of the yarn in terms of yarn imperfections and mechanical properties, such as strength and elongation. The strength of 100% tencel yarn is more than tencel/bamboo blend yarn and 100% bamboo yarn. Elongation of bamboo yarn is more than 100% tencel yarn and tencel/bamboo blend yarn. Difference in fibre characteristics is the reason for this. When yarn unevenness is taken much difference is not seen. The observed variation is due to the variation induced by machine. It was also noted that the hairiness of bamboo yarn is lower than other yarns, close packing of tencel fibre makes the yarn diameter lesser when compared to pure bamboo and tencel/bamboo blended yarns. 100 % bamboo yarn is having lower frictional coefficient than other yarns.

Keywords: Bamboo, Blend ratio, Elongation, Tenacity, Tencel, Yarn.

I. INTRODUCTION

Textiles are very important part of our lives and form a necessary part of our daily routine. With the growing demand for more comfortable, healthier, and eco-friendly products to the consumers, a new kind of regenerated fibres, which are an alternative to conventional fibre like cotton, have gained importance in apparel and home textile manufacturing sectors. Presently, natural and synthetic cellulose fibres are important for the day-to-day performance of the textile industry. Tencel fibre as a new type of green environmental protection fibre is drawing attention from the society and people's favourite. Tencel fibre retains all the natural properties of a cellulosic with good moisture absorbency, lustre and comfort. On the contrary, this fibre has many advantages over cotton fibre and the replacement of cotton fibre by tencel fibre can improve the environmental friendliness. Like all cellulose fibres, tencel fibre absorbs water perfectly and gives hygienic properties to textile goods. One of the latest developments in new fibre researches is the use of bamboo fibre in various apparel textile products. The bamboo fibre has certain inherent properties. Fabrics made out of bamboo fibres have good moisture absorbency, excellent air permeability, soft feel, high elasticity, and better dyeability [1]. The properties of blended yarns primarily depend on the properties of the constituent fibres and their compatibility. Moreover, the proportion of fibres in the blend also plays a significant role [2]–[3].

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The knowledge of the importance of blended products in the textile industry and the general rising costs of production make the achievement of economic and good quality blends with different kinds of cotton more and more critical [4]. Tencel and bamboo blended yarns (eco-friendly cellulosic) are a vital role of the 'textile nature product' and are suggested for use in 'soft feel' textiles materials, like innerwear's, bath towels, knits, sportswear and socks, as well as in home textiles sourced by leading worldwide brands. Garments and mad-up with tencel have a high degree of comfort and is pleasing to touch and is fully biodegradable. Yarns of bamboo fibre provide the desirable properties of good hygroscopicity, anti-bacterial, permeability, soft feel and deodorizing in nature for apparels and made-ups. This study discussed the influence of blend on physical characteristics of tencel bamboo blended yarns.

II. MATERIALS AND METHODS

A. Materials

Regenerated bamboo, used in the production of the yarn samples, was obtained from a spinning mill; and the mean fibre properties were found to be: mean length 36 mm, fibre fineness 1.52 dtex, linear density 0.155 tex, moisture regain 11.42%, tenacity 22.84 g/tex and elongation 21.2%. The tencel fibre chosen for the study had the quality characteristics: mean length 39.1 mm, tenacity 36.28 g/tex, mean denier 1.3 titre/tex, elongation 9.7% and moisture regain 10.09%. Besides preparing 100% bamboo and 100% tencel yarns, blended yarn of blend proportions 70:30, 50:50 and 30:70 bamboo: tencel were also prepared for the study. It was emphasized that the bamboo fibres are the cellulose fibres manufactured from bamboo pulp. It was ensured that all of the yarns produced had the same mean linear density of 30s Ne.

B. Testing of yarn

Prior to the testing of yarns and fabric made by tencel/bamboo fibre for various properties, each samples is kept in the standard atmosphere of $21^{\circ}\text{C} \pm 1$ at a relative humidity of $65\% \pm 2$ for 48 hours. This is done to condition the samples. The yarn samples are tested using USTER Tester 5-S4 (UT5) and USTER TENSOJET 4 (UTJ4). Unevenness, breaking force, breaking work, thick, thin, hairiness, neps, tenacity, elongation, and TPI of the all five samples is determined as per the USTER standard testing method and mean value is reported. For each sample ten readings are taken and the mean value is reported. Yarn friction (metal to yarn) is also measured by using Lawson Hemphill DSE instrument as per the ASTM-D - 3108-2007 standard.



III. RESULTS AND DISCUSSIONS

The tencel and regenerated bamboo yarns are produced with five different proportions namely 100% tencel, 70% tencel / 30% bamboo, 50% tencel / 50% bamboo, 30% tencel / 70% bamboo, 100% bamboo. The physical properties of developed blended yarns are given in Table 1.

Table 1: Physical properties of tencel bamboo blended yarns

Yarn Linear Density	30 Ne				
Blend ratio (Tencel/Bamboo %)	100/0	70/30	50/50	30/70	0/100
Diameter (mm)	0.29	0.28	0.28	0.28	0.31
Unevenness %	8.72	8.73	8.71	8.94	9.18
Breaking Force gf	600.8	514.5	478.4	431.7	411.4
Breaking work gf.cm	1700	1477	1508	1479	1930
Thick /km (+50%)	4.3	1.0	3.5	5.3	4.3
Thin /km (-50%)	0	0.5	0.5	0.3	0
Neps/km +200	15.8	12.4	9.5	12.8	16.3
Hairiness (H)	6	5.73	5.38	5.34	5.25
Tenacity g/tex	30.52	26.14	24.30	21.93	20.90
Elongation %	9.02	8.98	9.80	10.37	14.04

A. Yarn diameter

The yarn diameter for different blend proportions of tencel/bamboo blended yarns is shown in Fig. 1. The diameter of pure tencel and bamboo/tencel blend yarns is found to be lower than pure bamboo yarn. The tencel fibres are having longer length than that of bamboo fibres. Besides, the bamboo fibres have lower bending and torsional rigidity [5]. Therefore, they are packed better in the yarn structure than the bamboo fibres. It is observed that the diameter of yarn reduces as the proportion of tencel fibre decreased and also for 100% bamboo having higher diameter. This is due to the longer length and lower flexural rigidity of tencel fibres.

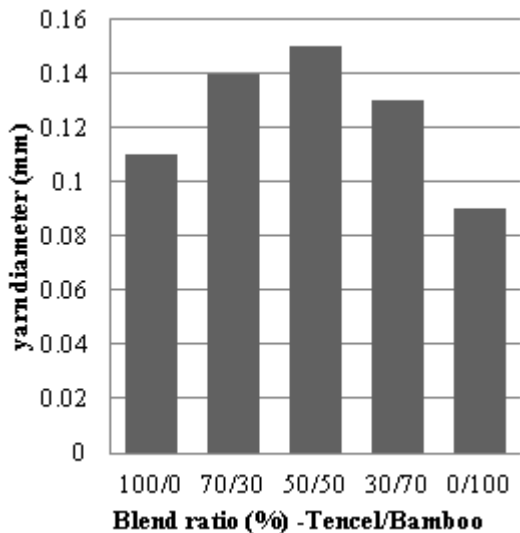


Fig.1. Effect of tencel fibre proportion on yarn diameter

B. Yarn unevenness

Fig.2 shows the results of yarn unevenness of tencel/bamboo blended yarns. It is observed that 100% bamboo yarns are showing higher unevenness values than the 100% tencel or tencel/bamboo blended yarns. When the bamboo fibre is blended with tencel, the difference in their lengths causes floating fibres and thereby increases the unevenness and imperfections. This is supported by Kilic and Okur [6], Mahish, Patra and Thakur [7], Prakash, Ramakrishnan and Koushik [8]. It is also observed that not much difference obtained in 100% tencel, 70% tencel / 30% bamboo, 50% tencel/50% bamboo.

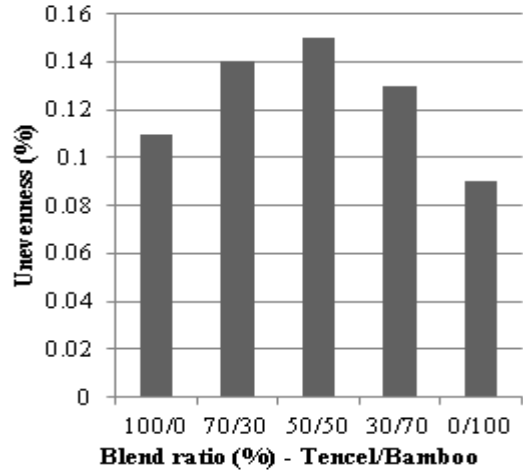


Fig.2. Effect of tencel fibre proportion on yarn unevenness

C. Yarn breaking force

The yarn breaking force value of tencel/bamboo blended yarns of different ratio is shown in Fig.3. It is observed that breaking force is decreased as the tencel content decreased in the blend. The pure tencel yarn is having high breaking force compared with pure bamboo yarn.

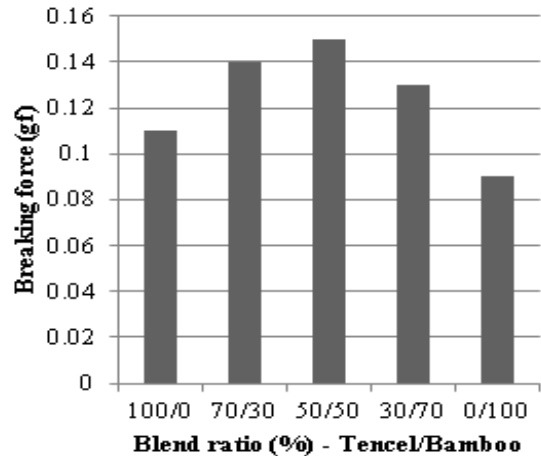


Fig.3. Effect of tencel fibre proportion on yarn breaking force

D. Thick place

The relationship between the yarn blend ratio and thick places of the blended yarns shown in Fig.4. It is observed that the number of thick places increases with the tencel content decreases in the blend.



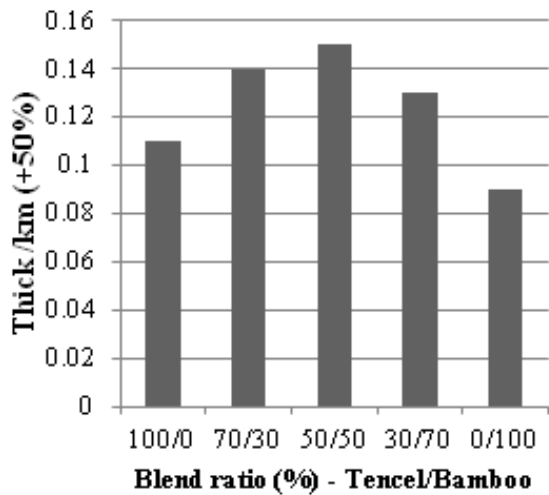


Fig.4. Effect of tencel fibre proportion on thick places

E. Thin place

Fig.5 shows the relationship between the blend ratio and number of thin places in the five sets of blended yarn. It is observed that the number of thin places increase with the content of bamboo in the blend, but in the same case the 100% tencel and 100% bamboo yarn observed that there is no thin place present, this may be concluded that this variation is due to the variations induced by machines.

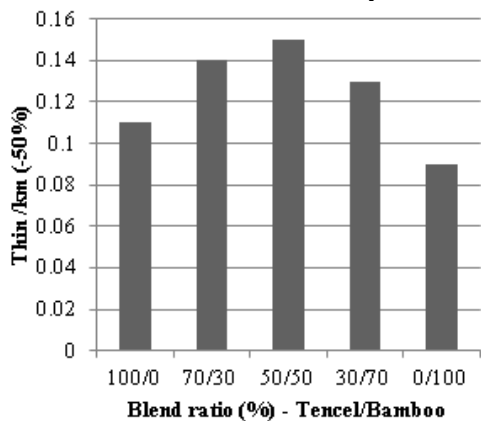


Fig.5. Effect of tencel fibre proportion on thin places

F. Neps

Fig.6 shows the count of neps/km for the different blended yarn. It is clearly shown that the increasing trend of neps with an increase in bamboo content in the blend. It is also observed that there is a marginal increase in neps in all blended yarns.

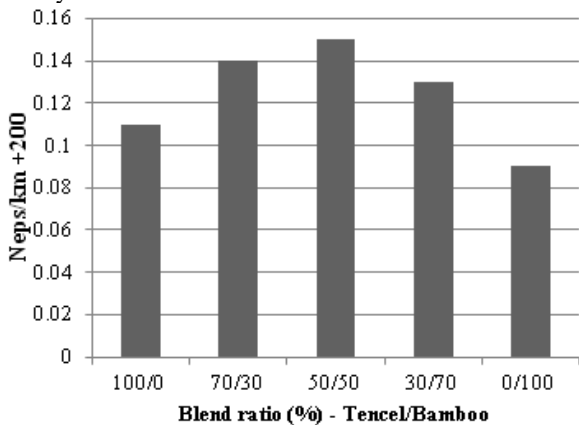


Fig.6. Effect of tencel fibre proportion on neps

G. Hairiness

The yarn hairiness (H) of the blended yarn is shown in Fig.7. It is clearly observed that hairiness decreases with the tencel content decreases. Therefore, bamboo fibres wrap very easily in the main yarn body when they emerge from the spinning triangle and thus, the hairiness reduces with the increase in bamboo fibre proportion.

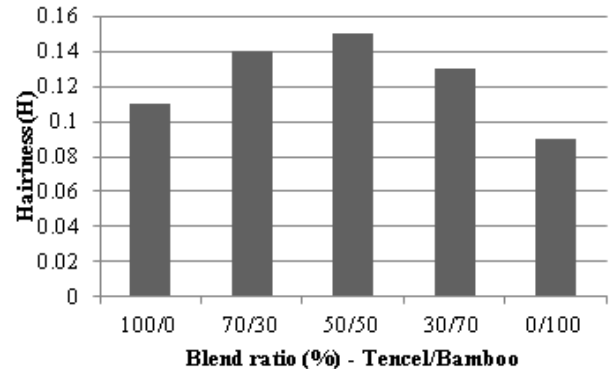


Fig.7. Effect of tencel fibre proportion on hairiness

H. Tenacity

The yarn strength is sensitive to the fibre type and yarn structure. The yarn tenacity in relation to the tencel/bamboo blend ratio for the five sets of blended yarn is shown in Fig.8. It is observed that the decrease in the tencel content decreases yarn tenacity. This may be reason for different breaking elongation of tencel and bamboo fibres. In the case of yarn breaking elongation, tencel fibre is much lower than that of bamboo fibre. Pan and Postle [9] investigated that fibre blend ratio it was found to influence not only the yarn strength but the yarn strength distribution also. Tencel round cross section and smooth, straight character of the fibre allow very close packing in the yarn structure and the higher cohesion resulting between adjacent parallel fibres is thought to add significantly to the strength of the yarns, mostly in ring spinning yarns. The strength of 100% tencel is high compared to other blended yarns. It is clear that; tencel adds strength to the yarn as well as enhancing the performance and aesthetic properties of the fabrics made from tencel fibre.

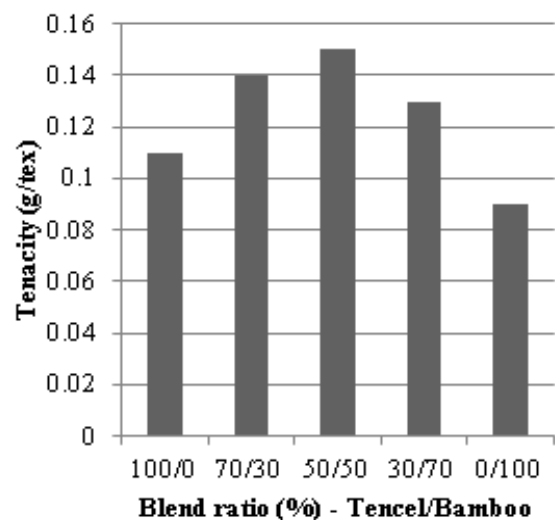


Fig.8. Effect of tencel fibre proportion on tenacity

IV. CONCLUSION

I. Elongation

The influence of tencel content in blended yarn on elongation is shown in Fig.9. It is clearly obtained that the increases in elongation with decreases in tencel content. It is observed that the overall trend appears to indicate that the tencel content definitely influences yarn properties. Fibre elongation value influences yarn elongation to a greater extent to the yarn, a high elongation value of regenerated bamboo fibre results in a high yarn elongation value.

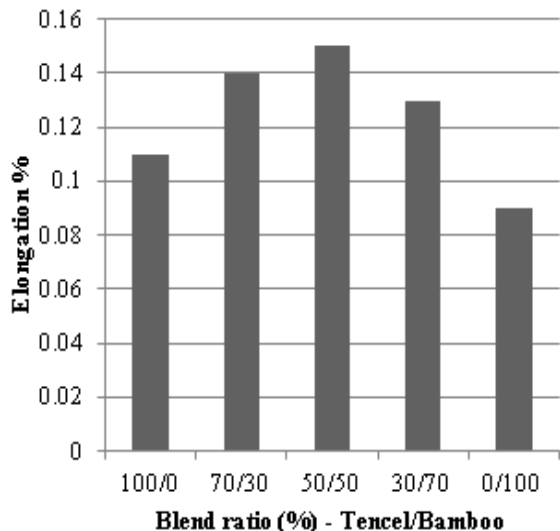


Fig.9. Effect of tencel fibre proportion on elongation

J. Friction

Yarn friction is important properties of textile materials and through the friction fibres are connected into yarns and the yarns made into fabric or knitting. Some of the characteristics of textile manufactured products, such as touch and felt properties, softness etc., depend on friction [10]. Frictional characteristics affect the quality and performance of yarns and subsequently of products made from them. Yarn friction is related to both surface properties and bulk properties of yarns. The influence of tencel content in blended yarn on yarn friction is shown in Fig.10. It is observed that higher yarn friction value obtained in 50% tencel / 50% bamboo blends compared to pure tencel and bamboo. The 100 % bamboo yarn is having lower frictional coefficient than other yarns.

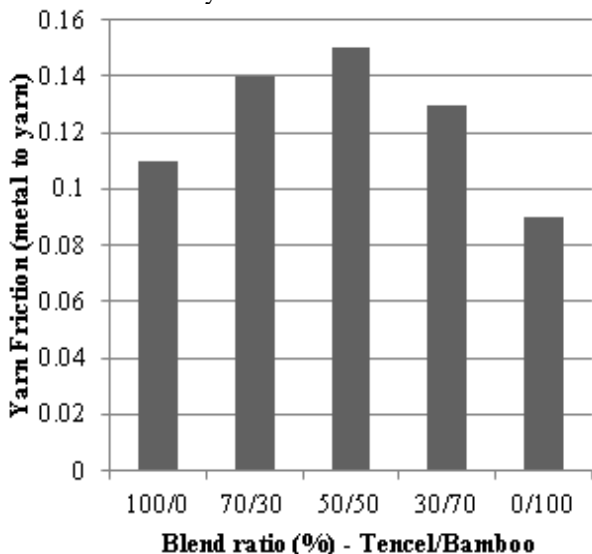


Fig.10. Effect of tencel fibre proportion on yarn friction

The strength of 100% tencel yarn is more than tencel/bamboo blend yarn and 100% bamboo yarn. Elongation of bamboo yarn is more than 100% tencel yarn and tencel/bamboo blend yarn. Difference in fibre characteristics is the reason for this. When yarn unevenness is taken much difference is not seen. The observed variation is due to the variation induced by machine. It is also noted that hairiness of bamboo yarn is lower than other yarns, close packing of tencel fibre makes the yarn diameter lesser when compared to pure bamboo and tencel/bamboo blended yarns. 100 % bamboo yarn is having lower frictional coefficient than other yarns. An increase in the tencel content of tencel, bamboo blended yarn has a significant influence on the overall quality of the material in terms of yarn imperfections and mechanical properties, such as strength and elongation. Therefore, the quality of characteristics of the blended yarn depends on the tencel content present in the blend.

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