A Comparative Study on the Physical Properties of 100% Bamboo Ring Spun and Bamboo/Polyester Core Spun Yarns

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Abstract: In this study, physical properties of 100% bamboo and bamboo/polyester core-spun yarns were studied by varying twist level and core-sheath ratios. Both ring and core-spun yarn samples were produced with a linear density of 14.76 with 24, 26, 28 twist per inch levels and core-spun yarns that were produced with 60:40 and 80:20 core-sheath ratios. From the results, it was concluded that the core-spun yarns exhibits good strength, elongation, CSP and RKM values followed by increased diameter, higher nep content, more thin and thick places, and less hairiness compared to 100% bamboo ring spun yarns. As the twist level increases yarn strength, elongation and unevenness increases and yarn diameter and hairiness index decreased in all samples. Yarn strength, unevenness, diameter, imperfections were increased in core-spun yarns with the increase in core content. Hence 80:20 bamboo/polyester core-spun yarns showed better strength, elongation, and uniformity than 100% bamboo ring-spun yarns and it shows less imperfection than 60:40 bamboo/polyester core-spun yarns.

Keywords: Ring spun yarns, bamboo/polyester core-spun yarns, linear density, twist level, core-sheath ratio.

I. INTRODUCTION

Bamboo is a regenerated cellulosic fiber from bamboo plants. It is a biodegradable green fiber having strength comparable to conventional glass fibers. 3-4-year-old bamboo fibers are used for fiber production. Starchy bamboo pulp produced by treating bamboo stems with alkaline hydrolysis, multi-phase bleaching, and chemical treatments. Various micro-gaps make bamboo fiber softer than cotton and increase its moisture absorption.

The fabrics made from polyester fibre are durable, elastic, resists wrinkles, retain shape, excellent wash-and-wear performance, and it is widely used in all kinds of apparel fabrics. Polyester fibre is poor in moisture absorption, its
clothing makes the wearer feel poor comfort by hot and sticky, produces static electricity easily which results in clothing absorbing dust and clinging to the body. To overcome this, polyester core spun yarns are produced to improve high strength, comfort and shrink proof qualities of yarn.

In core-spun yarns, the base yarn is completely wrapped by a second yarn which is created by twisting staple fibers around a central filament core, usually made of polyester for extra strength. The wrapping fibers can be natural or regenerated staple fibers like cotton, wool, rayon, tencel, modal and so on. The core-spun exhibits the advantage of the polyester core such as high strength, high elongation rate, less unevenness, and easy care, also with the advantages of wrapping fibers as moisture absorption, heat transportation, softness, comfort, pilling resistance, and antistatic properties. Core sheath fiber ratio reduces material and production costs and gives better fabrication.

Behera and Joshi (2005) studied the weavability of core spun yarns and opine that core spun yarn does not achieve the desired weavability compared to ring and rotor yarns. Shi and Xuling (2012) tested the tensile properties of polyurethane filament. As the strain in the yarn increases, the sheath fibres around the core are straightened from the curved state and strech progressively, where the sheath fibres will dominate the shape of the stress-strain curve of the core-spun yarn under high strain. The experiment and test results of Babaarslan (2001) show that core positioning has a direct effect on the structure, properties, and performance of these core-spun yarns.

Ertekin and kirtay (2015) studied the tensile properties of aramid/dyneema technical core spun yarns developed for protective textiles and concluded that the tensile strength of the core-spun yarns increases with increasing core/sheath ratio. The tensile characteristics of Dref-III friction spun yarns with jute as core and cotton as sheath components at three different traverse rates have been discussed by Vigneswaran and Chandrasekaran (2010). It was observed that the tenacity of these yarns shows increasing trend when the yarn traverse rate increases.

Radhakrishnaiya et.al (1993) observed the identically constructed cotton/polyester fabrics, made from polyester staple core/cotton-covered yarn and from blend yarn, were evaluated for mechanical properties. Polyester-core/cotton covered yarn exhibits high tensile strength, compressive deformation, bending rigidity and lower tensile elongation, and shear modulus. Kim et.al (2009) studied the effect of core sheath weight and twist on the yarn strength and reports that the core-sheath weight ratio had influence on the tensile properties of the ring core-spun yarns in several ways according to the core filaments used for the yarn. Increasing the twists yielded increasing strength.

II. MATERIALS AND METHODS

For this study, regenerated bamboo fibers were procured from Pallavaa groups, Pallipalayam, with the fiber properties of length 38 mm, linear density 0.156 tex, moisture regain 11.46%, and elongation 21.4%. 50 and 65 denier polyester filaments were procured from Reliance Polyester Ltd, Salem.

The process steps of fibre mixing, lap production, carding, drawing, rove-preparation and spinning were controlled to result in yarn linear density of 14.76 tex. 100% bamboo yarns with low, medium and high twist levels were processed in ring frame. Core spun yarns were produced in Trytex Core Lycra ring frame with a core spin attachment above the drafting unit. Polyester filament was passed through front drafting roller through the core spin attachment. Bamboo rovings drafted in back and middle drafting rollers with required core ratio. For 80:20 bamboo/polyester core spun yarn 50D polyester filaments were used and 65D polyester filaments were used for 60:40 core spun yarns with varying twist levels.

The ring spun and core spun yarn samples were evaluated for specific properties at SITRA lab, Salem, India. Yarn strength and RKM was tested using Uster TensoRapid-4, yarn count, CV% and CSP was tested using Applied Cascade, yarn irregularities and yarn hairiness were tested with an Uster Evenness Tester (UT5) from 10 Cops/Cones of 200 gms each, all of which performed under standard conditions of temperature and humidity.
III. RESULT AND DISCUSSION

FIGURE-1 YARN STRENGTH AND CV%

FIGURE-2 YARN ELONGATION AND CV%

FIGURE-3 YARN CSP

FIGURE-4 YARN RKM

FIGURE-5 YARN U%

FIGURE-6 YARN CV%
Fig 1 shows the influence of twist and core ratio on yarn strength for the ring spun and core spun yarns. When the twist increases, the yarn strength increases in all the samples. In core spun yarns increased polyester core content increases the yarn strength.

The effect of twist and core sheath ratio on yarn tenacity was displayed in fig 2. Increased twist level increases the elongation in all yarn samples. Increased bamboo content decreases the elongation values in core spun yarns.

It is observed from fig 3 and 4 that the RKM and CSP values of both ring and core spun yarns were decreased in low twist levels. CSP and RKM values increased with the increased core content. This statement agrees with the findings of Sowmya et.al (2016).

In fig 5 and 6 shows the yarn evenness results of 100% bamboo and 80:20, 60:40 bamboo/polyester core spun yarns. Yarn evenness was affected by low twist in all samples. When the bamboo content increases in core spun yarns, yarn unevenness increases. This statement agrees with the findings of Mahish et.al (2012).

From fig 7 it was observed that the ring spun and core spun yarns were more compact in high twist levels. In core spun yarns, higher bamboo content increases the yarn diameter which coincides with the findings of Hussain et.al (2015).

Fig 8 shows the influence of twist and core sheath ratio on nep content. The overall trend is that an increase in twist decreases the nep content. Higher nep content found in 60:40 core spun yarns when compared to other samples.

Thick and thin places in ring and core spun yarns were affected in low twist levels as shown in fig 9 and 10. 100% bamboo yarns shows least amount of thin and thick places, where as 60:40 bamboo/polyester core spun yarns shows higher thin and thick places by less sheath coverage. This statement agrees with the findings of Namiranian (2011).

Fig 11 and 12 shows that low twist increases the yarn hairiness in all samples. 100% bamboo ring spun yarns were found to be having more hairiness than core spun yarns and 80:20 bamboo/polyester core spun yarns exhibit less hairiness when compared to other samples which agrees with the findings of Dang et.al (2006).

**IV. CONCLUSION**

From the results, it is concluded that the increased polyester core content increases the yarn strength and elongation values in higher twist levels. Yarn tenacity, elongation, CSP and RKM values were found to be higher in 60:40 bamboo/polyester core spun yarns. 80:20 bamboo/polyester core spun yarns shows good strength, elongation and uniformity than 100% bamboo ring spun yarns and it shows less imperfection than 60:40 bamboo/polyester core spun yarns. The 100% bamboo ring spun yarns exhibits good uniformity and less neps, thin and thick places compared to bamboo/polyester core spun yarns. Yarn uniformity and imperfections were affected by the increased core content. Hence it is convincible to choose 80:20 bamboo/polyester core spun yarns to achieve the desired properties.

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VI. REFERENCES