Influence of Core Sheath Ratio and Twist on the Physical Properties of Cotton/Polyester Core Spun Yarns

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Abstract: The present study compares the physical properties of 100% cotton ring spun yarn and cotton/polyester core spun yarns varying in core sheath ratio and twist levels. Both ring spun and core spun yarns were produced with a linear density of 14.76 tex with 24, 26, 28 twist per inch levels and Core spun yarns with 80:20 and 60:40 core sheath ratios. The test results revealed that 60:40 cotton/polyester core spun yarns with high twist showed good strength, elongation, CSP, yarn unevenness, neps, thick and thin places compared to 100% cotton ring spun yarns. As the twist increases yarn diameter decreases due to the compactness of the yarn and vice versa. 80:20 cotton/polyester core spun yarns are next to 60:40 cotton/polyester core spun yarns in strength, uniformity and imperfection properties because of the polyester content compared to 100% cotton ring spun yarns.

Key words: Ring spun yarns, cotton/polyester core spun yarns, linear density, twist level, core-sheath ratio.

I. INTRODUCTION

Cotton fibers are natural, soft, cool, breathable and absorbent fibers can hold 24-27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature. Since cotton wrinkles, mixing it with polyester improves strength and handling properties.

Polyester was the second synthetic fiber developed in 1942 and widely used for the balancing properties of great versatility, less expensive, low production cost compared with nylon. Polyester shows high strength, abrasion resistance, heat set properties in the performance point of view. When compared with nylon, polyester exhibits good resilience and high modulus which means it is springy and can recover well from strain. Polyester conducts moisture
away from skin and dries faster than nylon. Polyester core spun yarns are produced to improve high strength and shrink proof qualities of yarn.

Polyester is the perfect fiber for the application of water, soil, and fire resistant finishes because it does not absorb moisture, but does absorb oil. Low absorbency of polyester makes it naturally resistant to stains. In the finishing process polyester fabric undergoes preshrunk, thus polyester clothing resists shrinking and will not stretch out of shape. The fabric is easily dyeable and is not damaged by mildew. Filling pillows, quilting, outerwear, and sleeping bags are made up of textured polyester fibers because of the effective, non-allergenic insulating properties.

In recent years, an important development of core-spun yarn is the use of viscose, viscose and linen or cotton and viscose blended polyester core yarn, as well as cotton and silk or cotton and wool blended coated core yarn, these products are very popular. Recently, cotton wrapped staple core and filament core yarns reportedly much improved core-coverage, strip resistance, hand and bulk have been developed. These yarns exhibit 95% core coverage and an excellent strip resistance which are the essential parameters of core yarns. The filament in the core offers significant advantages in respect of production speed, strength, machine efficiency and its running behavior, while the staple fiber sheath provides desirable surface properties. The articles such as tarpaulins, sewing threads, tufted carpets, car safety belts, net twins, stretch fabrics, swim suits and other form- persuasive garments can be made from core spun yarns.

Core spun yarns have a structure in which one of the components, usually a mono or multi synthetic filament is covered by another component, a staple fiber sheath. The aim of using core yarn is to take advantage of the different properties of both components. The filament improves yarn strength and also permits the use of a lower twist level, while the sheath provides the staple fiber yarn appearance and surface physical properties. Core-spun yarns have the same feel as the shield fibers, and possess good moisture absorption because of the natural fibers wrapped around it.

The preparation technique of core-spun yarn is very simple and the selection of core and sheath materials can be made from a variety of fibers with predetermined end-use. There are several techniques used in core spinning which depends upon the economy and quality. Each technique has its own features. The conventional ring spinning is simple and economical but in the case of core spun yarns, the core positioning in the centre is difficult and major strip back problem may arise during subsequent process and the core filaments get twisted.

The core-spun yarn utilizes the fine physical properties of the core-spun filament yarn and the properties and surface characteristics of the contracted staple fiber, increases the strengths of the two fibers and remedying their deficiencies. Polyester-cotton core yarn feels very cool, anti-crease, easy to wash, fast drying, good absorbent, less electrostatic and pilling resistance.

To obtain the optimum yarn properties, twist and draft are essential, when the twist factor increases; it positively affects the tensile properties of the core-spun yarn. Core ratio is an important parameter that influences the tenacity and elongation at break of wrapped core spun yarns. The tenacity and elongation of core-spun yarn is affected negatively while increasing the core percentage.

Pramanik et al (2009) compared cotton covered polyester filament core yarns with 100 % cotton ring yarn and found that ring-spun core yarn is superior to air-jet in tensile properties whereas in terms of U% and imperfection, air-jet spun yarn is superior to ring-spun yarn. Erez et al (2014) studied the influence of both twist factor and filament blend ratio on the strength of yarn consisting of polyester filament covered with cotton fiber and concluded that the effect of core-sheath ratio on the yarn tenacity values and the yarn elongation were found statistically significant. The yarn tenacity value of core-spun yarn increased with increasing the sheath ratio in yarn. As the twist amount increased, it's seen that the yarn evenness and yarn hairiness values have been decreased. It has seen that the yarn
evenness value decreased with increasing the core ratio in yarn. Twist factor and roving positions have an influence on the strength of core-spun yarns opines Shahbaz (2002).

Rameshkumar et al (2009) investigated core positioning and sheath coverage, core-sheath ratios as well as plying effects on yarn and knitted fabric properties using polyester filament and waste silk and found that tenacity, elongation, and their CV are improved with increased percentage of core, high level of unevenness is observed in core-spun yarns and plying improves many of the yarn characteristics. Jeddi et al (1997) observed the properties of nylon monofilament core with 100 % cotton yarns in different twist factors and filament pretensions. The investigation showed that the optimum structural and mechanical properties of core-spun yarns could be achieved compared with the equivalent ring-spun yarn. Mahmood et al (2003) studied the better yarn count at a minimum twist factor. Optimum yarn strength of nylon monofilament core cotton ring spun yarn was obtained at the lowest spindle speed used.

II. MATERIALS AND METHODS

For this study, MCU 5 cotton fibers were procured from Compact Spinners India Private Limited, Dindigul with the fiber properties of 31 mm fiber length, 46% uniformity ratio, 4.1ug/in fiber fineness and 22.5g/tex fiber strength. 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 blended yarn of linear density 14.76 tex. 100% cotton yarns with low, medium and high twist levels were processed in ring frame. Core spun yarns are 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. Cotton rovings drafted in back and middle drafting rollers with required core ratio. For 80:20 cotton/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 and yarn irregularities and yarn hairiness 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
Fig 1-4 shows the influence of twist and core sheath ratio on strength, elongation, CSP and RKM properties of 100% cotton rings spun yarns and core spun yarns. In 100% cotton ring spun yarns, strength, elongation, RKM and CSP values increase when twist level increases. The same trend was followed in core spun yarns. Yarn strength, elongation, RKM and CSP increase when there is an increase in the polyester (core) content in core spun yarns. This statement agrees with the findings of Chattopadhayay and Salhotra (2000).

Fig 5&6 shows the influence of twist and core sheath ratio on unevenness of 100% cotton rings spun yarns and core spun yarns. High twist affects the uniformity in all the samples. 100% cotton ring spun yarns are more even when compared to core spun yarns; this statement coincides with the findings of Ndlovu et.al (2015).

Fig 7 shows that the diameters of the yarn samples were affected by the increase in twist. Yarn diameter decreases when twist level increases in all the samples. 100% cotton ring spun yarns were found to be higher in diameter when compared to core spun yarns. Diameter in both 80:20, 60:40 cotton/polyester core spun yarns were found more or less same in all twist levels.

Fig 8 describes about the effect of twist and core sheath ratio on nep content in 100% cotton rings spun yarns and 80:20, 60:40 cotton/polyester core spun yarns. Low twist increases the nep content. 100% cotton ring spun yarns show very less nep content than core spun yarns. In core spun yarns, the increase in sheath content contributes higher neps. 80:20 cotton/polyester core spun yarns showed higher nep content in low twist followed by 60:40 cotton/polyester core spun yarns. This statement agrees with the findings of Erez et.al (2014).

Fig 9 explains the influence of twist and core sheath ratio on the results of thin places of 100% cotton ring spun and 80:20, 60:40 cotton/polyester core spun yarns. It was noticed that when the twist level increases, thin places decreased. 100% cotton ring spun yarns showed very less thin places than core spun yarns. 80:20 cotton/polyester core spun yarns show lesser values when compared to 60:40 cotton/polyester core spun yarns.

Fig 10 shows that the thick places were increased in both 80:20 and 60:40 core spun yarns in low twist levels when compared to 100% cotton ring spun yarns which agrees with the findings of Pramanik et.al (2009).

Fig 11 and 12 shows the effect of twist and core sheath ratio on yarn hairiness index. Results of 80:20 cotton/polyester core spun yarns are lesser when compared to 60:40 cotton/polyester core spun and 100% cotton yarns. Decrease in sheath content increases hairiness, because it needs more cotton to cover the core material. This statement agrees with the findings of Tyagi and Goyal (2003) as ring spun core yarns is stronger, extensible, more hairy and less regular and has more imperfections and higher sheath- slippage resistance.
IV. CONCLUSION

It is concluded that the increase in core ratio increases tenacity and elongation properties which is influenced by the polyester core. Tenacity, elongation, CSP and RKM values increased in 60:40 cotton/polyester core spun yarns in high twist levels. 80:20 cotton/polyester core spun yarns showed better strength, elongation and uniformity than 100% cotton ring spun yarns and it shows less imperfection than 60:40 cotton/polyester core spun yarns. The 100% cotton yarns exhibit good uniformity and less neps, thin and thick places compared to core spun yarns. Increase in core ratio affects uniformity and increases the imperfections. Hence it is advisable to choose 80:20 cotton/polyester core spun yarns while designing fabrics for sportswear to obtain comfort and desired properties.

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V. REFERENCES


