Feasibility of Cotton-Nylon Core-spun Yarn for Producing Spindle Tapes

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Two different tapes—one of core yarn and the other of cotton yarn—were made with the same processing parameters. Core yarn was produced by feeding the double rove at the back of ring frame and by inserting the filament at the front roller nip. The characteristics, and the performances, of the two tapes were tested and compared with those of the standard tape. In the case of core-yarn tape, an energy saving of up to 10.7% could be achieved; there was less twist CV% of yarn processed, which increased the CSP by 10%.

Keywords: Core-spun yarn, Cotton, Nylon, Spindle tape, Swivel loom

Core-spun yarn is a type of blending where the fibrous material is made to adhere around the surface of a continuous filament. Such blending is generally done on a ring frame, and the process reduces the end breakage rate and gives consistently superior-quality product by imparting better cover, better resistance, etc. As long filaments are present in the core and short fibres adhere as sheath on twisting, there is no problem of blending, and most of the load is borne by the filament which ultimately increases the spinnability of short fibres.

In most of the cases where strength is the main criterion, doubled yarns are used. Double core-spun yarns are mostly used in the manufacture of tent fabric, tarpaulins, industrial clothings, hoses, conveyor belts, V-belts and sewing threads. For the spindle tape the following properties are of great importance: strength and extension, abrasion resistance and bending modulus. It has been found that core-spun yarn tape possesses all these properties.

Materials and Methods

For the experiment 100% cotton was taken as the sheath material, three varieties of cotton, viz. Shankar-4(70%), MCU 5 (20%) and Varalaxmi (10%), being chosen. The mixing had the following characteristics: effective length, 34 mm; mean length, 26 mm; micronaire value, 36 μg/inch; and trash, 4.7%. Nylon multifilament (10 monofilaments) of 40 denier was taken as core. From the above mixing, roving was prepared (rove hank 2.3; TM 1.15) through the sequential stages of scutching, carding, pre-comb drawing, combing, post-comb drawing, and simplex. The final spinnning was done on a Texmaco ring frame. The doubled roving was fed and the filament was inserted at the nip of front roller through the tensioner and suitably made guides. The position of tensioner and guides was so adjusted that the filament could take a position in between the two rovings fed. For preparing the spindle tape, two types of yarns were prepared—core-spun yarn and all-spun cotton yarn. The yarns were plied through cone winding, parallel winding and twisting on doubler. These yarns were converted, with the help of a hand-driven spooling machine, into two spools—one spool of core-spun yarn and the other of all-spun cotton yarn. By using these spools, tapes were prepared on a swivel loom. The parameters for producing the tapes were: single yarn count/TM, 25.2s/3.4; plied yarn count/TM, 3/25.2s/6.2; number of ends on one spool, 50; tape width, 14 mm; PPI, 42; loom speed, 130 rpm; reed count, 42s; weave, Herring bone twill (2/2); and denting order, 4 ends/dent. Both the samples were prepared on the same sequence of machinery to eliminate machine-to-machine variation, the warp and weft counts being kept the same.

Before testing, all the samples were conditioned in standard atmosphere (RH 65 ± 2%; 27 ± 2°C) for 24 h. Standard testing methods were used for determining the tape characteristics. For assessing the performance of different tapes, power consumption at miniature ring frame was measured by means of a 3-phase energy meter. The performance of the yarns prepared by running these tapes was also tested.

Results and Discussion

Average breaking strength and elongation—Table 1 shows that the average breaking strength and elongation at break of core-yarn tape are higher than those of cotton-yarn tape but lower than those of the standard tape. This is because the strength and elongation at break of plied core-spun yarn are much
higher than those of the plied cotton yarn. Balasubramanian and Bhatnagar have shown that when a core-spun yarn is subjected to axial load, the core filament is strained to a greater extent than the surface fibre initially, when the load is shared by the core filament and the surface fibre. They found that the surface fibre continued to break at a strain much higher than that at which the staple yarn ruptured. In the case of standard tape the high strength and elongation at break were due to the greater number of threads in the tape. As yarn is coarser, thread diameter increases, resulting in higher surface contact. As the doubling twist is higher in the case of both yarns than in the standard cotton yarn, the extension at break would be less. In the case of core-spun yarn, it is nearly equal to that of standard tape in spite of the high twist, due to the fact that the nylon filament in the core gives better extension.

_Abrasion resistance_—Table 1 also shows that the abrasion resistance of core-yarn tape is maximum, followed by cotton tape, and least in the case of the standard tape. According to Backer, the rupture of material takes place mainly because of frictional wear, which also causes the drag out of the fibres from the yarn structure. The higher resistance of core-yarn tape is due to the presence of continuous filament in the core. The fibres are more easily dragged out from the cotton-yarn tape than from the core-yarn tape because in the latter fibres intermingle with the filament at high twist. The filament portion of the core-spun yarn cannot be dragged out owing to rubbing friction as the filaments are more stiff, smooth and continuous in nature. Hence, it requires a greater number of cycles to rupture: that is, the filament does not get abraded up to 7000 cycles.

_Weight per linear yard_—Table 1 shows that the weight per linear yard is highest for the standard tape. This is due to a greater number of coarser threads in the standard tape.

_Power consumption_—Table 2 shows that the power consumption is lowest in the case of core-yarn tape, followed by cotton-yarn tape and maximum in the case of standard tape. This trend is because the weight per unit length and the width of core-yarn and cotton-yarn tapes are less than those of the standard tape. According to Ranganathan, an increase in the tape width by 3 mm causes 9-10% increase in power consumption; the resistance offered by the increase width also increases. But in the case of the core-yarn tape the resistance is less owing to less bending stiffness.

_Flexural rigidity_—Table 1 shows that the flexural rigidity of core-spun yarn tape is less than that of the other two. The presence of twisted filament in the core-spun yarn makes the weft yarn stiffer. As a result, there is an increase in warp crimp and reduction in flexural rigidity. The flexural rigidity of the standard tape is higher because of stiff construction.

_Performance of different tapes_—The lea strength of core-yarn tape is highest, followed by that of the standard and cotton-yarn tapes. This is because the twist CV% of the yarn made by core-yarn tape is minimum. As CV% increases, the number of weak places in the yarn increases, which ultimately results in lower lea strength. The twist CV% in the case of core yarn is minimum because of the less slippage of the tape.

**Conclusions**

1. The breaking strength and elongation of core-yarn tape are greater than those of cotton and standard tapes.
2. The weight per unit length of cotton and core-spun yarn tapes is less than that of the standard tape.
(3) The abrasion resistance of core-yarn tape is quite high and hence its life-time high.

(4) The flexural rigidity of the tape made of core yarn is lesser than those of cotton and standard tapes. Hence, it has a better grip over the spindle wharf.

(5) Energy savings of up to 10.7% can be achieved in the case of core-spun yarn tape compared to the conventional tape.

(6) More uniform yarn is obtained by using core-yarn tape, which increases the CSP value up to 10% of the normal running tape.

(7) Core-yarn tape (14 mm) gives better performance than the 16 mm standard tape; cotton tape cannot, however, be used.

(8) The cost of production of core-yarn tape is lower owing to the lesser weight per unit length.

Cotton-nylon spun yarn could, therefore, be used for the production of spindle tape with better working performance than the tapes generally running in mills.

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References

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