



Effect of Core Yarn Twist in DREF 2 Friction Spun Yarn

Prof. S K Sett,
Department of Jute and Fibre Technology,
Institute of Jute Technology
University of Calcutta, 35, B C Road,
Kolkata 700 019, INDIA

Abstract: Core yarn in DREF 2 Friction spinning system has got pronounced role in not only control the yarn breakages, but significantly affect the twisted structure of the yarn. The yarn formation mechanism between two perforated spinning drums of the system justifies the formation of false twist in the core yarn placed at the centre of the spinning drums. A detailed study has been carried out to understand the generation of false twist during spinning and its propagation in the final yarn. Various combinations (single or ply, S or Z twisted or parallel) of core yarns are tried in the present study. Yarn property as well as core yarn twist variation before and after spinning were tested and suitable explanations are discussed on the test results available.

Keywords – DREF 2 Friction spinning, Core sheath structure of yarn, Tracer fibre technique, Twist Testing

I. Introduction

Amongst all the non-conventional spinning systems, DREF 2 Friction Spinning system is characterised by its yarn formation technique through implementation of friction with fibre mass and rotating metal rollers. Pneumatic suction plays very important role in this technique. Due to low tension during spinning, poor fibre orientation, low packing of the yarn and differential twisted structure, it is almost essential to introduce core (continuous yarn, filament, wire, tape or other suitable material) for smooth formation of yarn for specific end uses. Judicious selection of core and sheath or surface fibres leads to value added technical yarns inspite of its various limitations. Until the surface of the core is covered with surface fibres or sheath, false twist is generated within the core due to its frictional contact with the perforated spinning drums which lead to breakage of the core very often. A differential twisted structure in friction spun yarn between two layers of core and sheath was observed by Scientists^{1-4,7-9} a complex twist insertion mechanism of Friction spinning system results in a tangled arrangement of fibres in yarn matrix, having a dense core with higher twist and sheath of loosely packed fibre layers with lower twist. Twist variation in the different layers are also reported by salhotra⁵. During a detailed investigation⁶ on the structure properties of various yarns formed in Friction spinning system, it was observed that while working with a core yarn spun from long staple fibre like Jute or flax, a false twist which untwisted the core yarn at the feed end resulting in breakages at various doff position. This was prominent while Z twisted core yarn of short staple fibre. The present study deals with this interesting phenomenon and attempts were made to investigate the same using various combinations of core in a DREF 2 Friction Spinning machine.

II Materials and Methods

A. Materials

1. 30 tex dyed viscose yarn were spun in Ring spinning keeping both S and Z twist direction which were used as core in different combination for spinning various yarn samples for this study.
2. Viscose Sliver of 3.7 K tex for sheath material.

B. Methods

1. Seven yarn samples were spun using DREF 2 spinning machine (model DREF 2/86). Undyed viscose slivers were fed as sheath to cover viscose core yarn/s as mentioned in Table I. In all cases of yarn formation standard machine parameters were chosen.
2. Nominal 50 tex yarns were spun while using single yarn as core and 100 tex yarns were spun while ply (parallel or twisted) yarns were used.
3. To test the tensile properties Zwick UTM tester was used and standard twist testing instruments were used while judging the twist distribution in the core after yarn being spun after removing the sheath fibres by hand. A Stereo-Zoom Microscope was used to the distribution of twist in the core yarn by Tracer Fibre Technique. Photographs were also taken using attached camera.

III Results and Discussions

Results of different yarn properties with various core yarns were presented and discussed in the following little paragraphs. The study was conducted with special reference to the level of twist variation in the core yarn after spinning with viscose fibre as sheath.

Results of the experimental studies with 100% viscose fibre (both as core and sheath) have been presented in Table I to show how yarn tenacity differs as the core yarn varies, using single or ply yarns (with or without twists) at different twist directions.

Table 1: Tenacity and Extension of Core and DREF 2 Spun Yarns

Core Yarn Type	Twist Direction	Core yarn				DREF 2 Yarn				% change in (DREF 2/Core X100)	
		Count (Tex)	Br. Load (cN)	Tenacity (cN/Tex)	Br. Extn. (%)	Count (Tex)	Br. Load (cN)	Tenacity (cN/Tex)	Br. Extn. (%)	Strength	Tenacity (cN/Tex)
Single	S	29.1	344	11.8	9.1	49.7	358	7.2	8.9	104.1	61
	Z	27.5	374	13.6	8.8	47.2	396	8.4	8.4	106	62
2 Ply Parallel	S + S	58.1	655	11.8	11.2	100.3	842	8.4	10.8	122.9	71
	Z + Z	55.1	716	13.0	10.6	100.7	886	8.8	9.6	123.7	68
	S + Z	56.1	668	11.9	10.3	100.9	737	7.3	9.2	104.3	61
2 Ply Twisted	Z / S	60.4	821	13.6	11.7	100.7	856	8.5	10.2	104.3	62
	S / Z	63.4	733	12.2	10.2	102	809	7.4	10.9	110.4	61

The tenacity and extension values of core and DREF 2 yarns in their respective samples show expected values. The lower tenacity value of DREF 2 yarns in comparison with its core yarns is due to low contribution of the sheath fibre which is due to the open structure of DREF 2 yarns. However, improvement in tenacity of final Yarn to core yarn shows better values for core yarns with two parallel single yarns having same twist direction in comparison with other core yarns (specially with ply twisted yarns).

Besides its core to sheath fibre integrity in DREF 2 yarns, twist distribution in the core after the final yarn is formed were critically analysed and explanations of the results of Table I are proposed.

A Twist in Core of DREF 2 Spun Yarns

The twist level and its variability in core yarn (before and after spinning) and presented in Table 2. The twist in core of DREF 2 yarns were tested using stripping method that is by removing the sheath fibres, as the structure of the DREF 2 yarns doesn't permit normal twist testing.

Table 2 : Twist and Its Variation in Core Yarn Before and After DREF 2 Spinning

Core yarn type	Twist direction	Core yarn			
		Before spinning		After spinning	
		T. P I	CV%	T.P.I	CV%
Single	S	12.0	9.5	10.2	41.9
	Z	12.1	8.2	11.6	23.6
2 Ply Parallel*	S+S	0	0	1.6	88.9
	Z+Z	0	0	2.8	85.9
	S+Z	0	0	4.8	88.7
2 Ply Twisted	Z/S	9.6	9.6	9.2	32.1
	S/Z	10.2	12.1	7.1	28.8

*Only the numerical values of the Turns per inch have been considered while calculating CV values. For example, if two consecutive readings show 2 in S direction and 3 in Z direction, only 2 and 3 values are taken although the real difference is 5. Actual variations are given in figures.

During yarn spinning in DREF 2 spinning system, yarns are formed with the frictional contact between two perforated spinning drums. Fibres deposited within the nip zone of these two drums are passing through a torque zone between two drums and due to which false twists are generated in the core yarn of DREF 2 spun yarns. During working with Z twisted single jute yarn (long staple fibre) as core, untwisted strand of core yarn was observed at the entry side of the spinning drums. This signifies the generation of false twisting the core yarn during spinning. When opened fibres are deposited over the false twisted core yarn, certain quantity of the false twist may be entrapped within the body of the yarn. This entrapped twist changes level as well as variation of twist in the core of DREF 2 spun yarns. Variation of core yarn twist after spinning with different combinations is discussed in respect to each case.

1. Single yarn as core

The variation in core twist after spinning in DREF 2 system for both S and Z twisted single yarns are presented in figure 1 and figure 2. Although initial twist and variation do not show much difference (Table 2) but a significant difference is observed after spinning. Similar phenomenon was observed by Lord et al⁶ and explained considering uneven torque generation during spinning.

As observed in Table 2, the average twist level for S twisted yarn after spinning reduces more than Z twisted yarn. This phenomenon occurs may be due to the following reasons

- a) Loss of certain amount of twist during untwisting by false twist at spinning zone
- b) Retaining more amount of twist in Z direction.

The combined effect of 1 and 2 above reduces the twist level of S twisted core than Z twisted core yarn. In case of S twisted core there may not be any loss of twist but retained twist in Z direction reduces the twist level (S direction) of S twisted core yarn. In case of Z twisted core, loss is more than the retained twist but the combined effect of above 1 and 2 maintains the twist level in much better way than S twisted yarn which leads to low twist variation in Z twisted core than S twisted one.

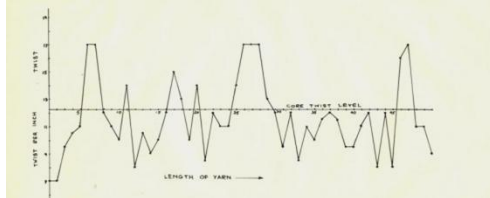


Fig. 1 Twist distribution in core of DREF 2 spun yarn
Core : S twisted single yarn

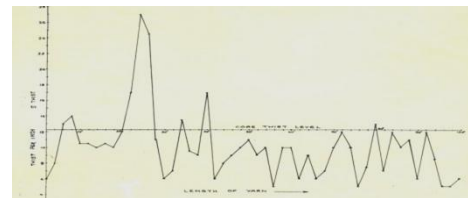


Fig. 2 Twist distribution in core of DREF 2 spun yarn
Core : Z twisted single yarn

2 Ply Yarn (parallel) as core

The level of twist and its variation in parallel yarns used as core are given in Table 2 and presented in graphical form in figures 3, 4 and 5. As discussed in case of single yarn, two S twisted single yarns (Ply without twist) showed lower twist level than the two parallel Z twisted ply yarn as core. Higher level of twist is observed in two opposite ply twisted parallel yarn due to more uneven torque generated by the single yarns of opposite twist placed in parallel as core. Photographs of the same phenomenon are presented in figure 6 (a, b and c).

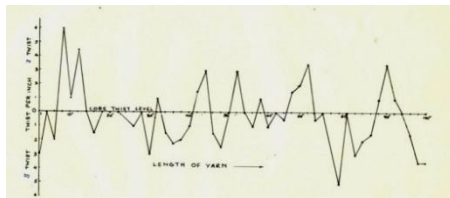


Fig. 3 Twist distribution in core of DREF 2 spun yarn
Core : Two Ply (S+ S) parallel yarn

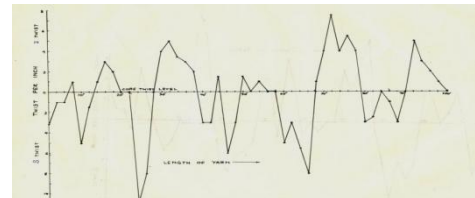


Fig. 4 Twist distribution in core of DREF 2 spun yarn
Core : Two Ply (Z+ Z) parallel yarn

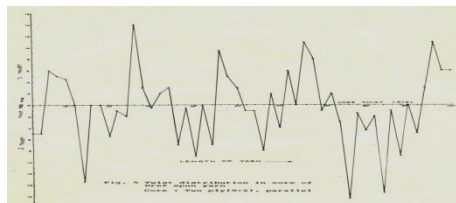


Fig. 5 Twist distribution in core of DREF 2 spun yarn
Core : Two Ply (S+ Z) parallel yarn



Fig. 6 a. Twist distribution in parallel yarns (S + S)



Fig. 6 b. Twist distribution in parallel yarns (Z + Z)

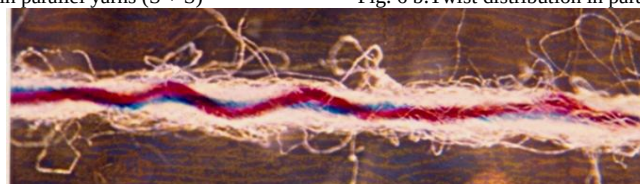


Fig. 6 c. Twist distribution in parallel yarns (S + Z)

3 Ply Yarn (twisted) as core

Figures 7 and 8 show the variability in twist of the core yarn (either S/Z or Z/S twisted). The variation in twist level (before and after spinning) is found to be minimum due to the same factors as in the case of single twisted yarns.

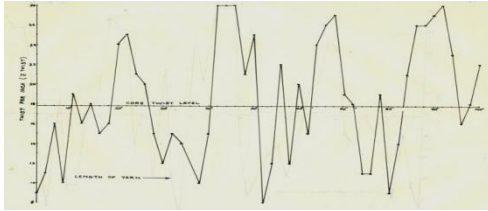


Fig. 7 Twist distribution in core of DREF 2 spun yarn
Core : Two Ply (S over Z)Twisted yarn

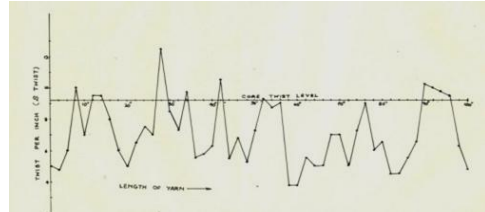


Fig. 8 Twist distribution in core of DREF 2 spun yarn
Core : Two Ply (Z over S)Twisted yarn

IV Conclusions

1. Although tenacity of DREF 2 spun yarns are lower compare to the core yarn which is due to low contribution of Sheath fibres towards the yarn strength. However, improvement in tenacity with parallel yarns with similar core yarn twist direction (S+S or Z+Z) as core is quite significant which is expected to be due to better sheath fibre entrapment within the parallel core yarns.
2. Changes in twist level in core yarns before and after spinning show some expected changes due to twist loss but variation in twist after spinning is quite significant specially in case of parallel ply yarns as core.
3. While selecting core yarns for DREF 2 spinning, two ply parallel yarns with S twist direction will produce stronger yarn and consequently lower breakage rate.

References

1. S K Sett, A Mukherjee, D Sur, "Structure - property relationship In rotor and friction spun yarns", - Milliard Textilberichte, GMBH, Germany 7 / 8. 1995 E135
2. S K Sett, A Mukherjee and D Sur, "Mechanical Behaviour of Jute-Viscose Blended Dref 2 Yarns at Varying Twists", Asian Textile Journal, October, 1999, 42-47
3. S K Sett, A Mukherjee and D Sur, "Tensile Characteristic of Rotor and Friction Spun Jute Blended Yarns", Text. Res. Journal, August, 2000, 723-728
4. Rei Yao Zhu, G.A.V. Leaf, and W. Oxenham, "Fibre Behaviour in the Twisting Zone of a Friction Spinning Process" J. Text. Inst, 1993, 84 No.1
5. Salhotra K R, "An overview of spinning technologies, applications and limitations" Ind. Journal of Fibre and Text. Res., Dec., 1992, 255 - 260
6. Lord P R, Joo C W and Ashizaki T, "The Mechanics of Friction Spinning" Journal of Textile Institute, November (\$), 1987
7. Stalder H & Soliman H A, "A study of yarn formation process during spinning" Milliard Textilberichte Int (Engl. Edn.), 70(2), 1989, E 44
8. S K Sett, "Study of Physical Properties of Jute Blended Yarns Spun on Different Spinning Systems"- Ph D Thesis, University of Calcutta, 1996.
9. Rameshkumar C., Anandkumar P., P.Kavinmurugan P., Manojkumar B., Anbumani "Influence of Core component on the properties of friction spun yarns" N. AUTEX Research Journal, Vol. 8, No4, December 2008 © AUTEX, <http://www.autexrj.org/No4-2008/106>