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Studies on Characteristics of Ply Yarns by Different Techniques

Sunil Kr Sett, Robin Das, Rajib Kr Das, Subho Roy and Jit Pal
Department of Jute and Fibre Technology, Institute of Jute Technology
University of Calcutta
35, Ballygunge Circular Road, Kolkata
INDIA

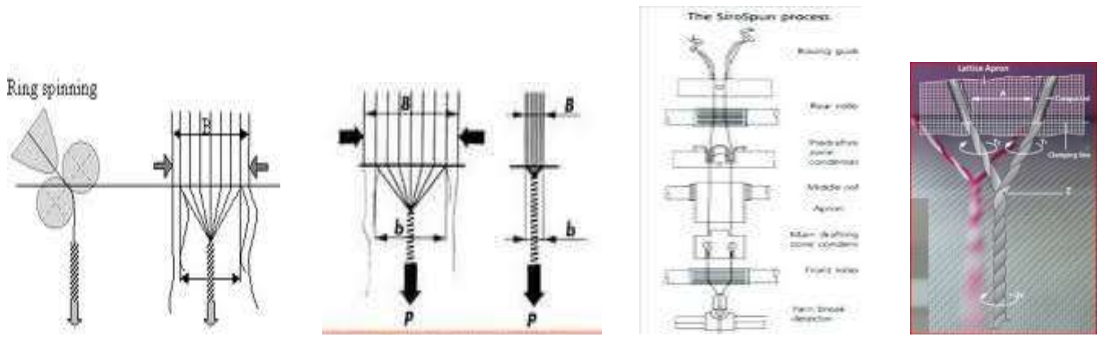
Abstract*: Various ply yarn producing techniques have been applied and the yarn characteristics of such yarns thus produced were compared. The yarn characteristics were also analysed based on their producing techniques. Standard ring spinning frame and Eli Twist technique were used to various yarns. Nominal 30s cotton yarns were produced using normal plying, SIRO (with and without vspace between rovings) techniques using standard spinning frame. With the same spinning frame, single mechanical compact yarns were produced then plied. Eli-twist spun yarns were also used with same rovings. In all cases ply yarn twist was kept in S direction. Yarn plied in Eli-Twist system showed significant improvement in properties due to its method of yarn formation and alignment of fibres in ply twisted structure. Detailed comparisons of properties of all such yarns were made and analysed in the present paper.*

Keywords*: Ply yarn, Compact spinning, SIRO spinning, Tensile properties Hairiness, Uniformity*

I. Introduction

Ply yarns are manufactured through a process of doubling two or more number of single yarns either in doubling frame or during spinning itself by using two rovings in different techniques[1--4]. Due to certain special characteristics like tensile properties, uniformity hairiness and others, plied yarns are acceptable for certain products than its single counterparts. Various techniques like normal, SIRO (with and without spacing between rovings) are attempted to produce ply yarn like yarns in spinning frame [2]. Compact spinning[3-4] is presently one emerging spinning technique which produces single yarn with better characteristic. This compact spinning technique is used by various manufacturers in various ways like mechanical compacting or pneumatic compacting. Even besides producing single yarn, ply yarns are also being produced in the compact spinning frame[5-6]. In the present study, various such techniques are used to produce ply yarns and comparisons of characteristics of ply yarns thus produced are made in this paper. Outlines of various yarn formation systems used in this paper is given below in fig. 1.

Figure 1: Yarn formation zones in different spinning techniques.



Normal yarn | Compact yarn | SIRO yarn | EliTwist yarn

II Materials and Methods

A. Materials

1. 1.24 Hank roving of 100% cotton was used for spinning various type of yarns using ring spinning frame having provisions for SIRO and Compact spinning systems. Same roving was used for spinning Eli-Twist spinning frame also. All spinning and process parameters remain unchanged for single and plied yarns except twist directions and amount of twist (single and ply yarns). Final yarn count was kept to 30s cotton count in all cases.

B. Methods

1. Two single yarns were spun using standard ring spinning frame without and with compact spinning attachment. From these single yarns, plied yarns of nominal count were spun imparting S twist and standard parameters. Same rovings were used to spin SIRO (keeping 1cm spacing between rovings) and SIRO (keeping no space between rovings) in the same ring frame using SIRO attachments and imparting S Twist. Eli-Twist frame was used to produce same count yarn from the same rovings. In case of single yars 60s Ne yarns were spun and plied them to 30s Ne. In case of SIRO(with and without spacing) and Eli-Twist direct 30s Ne yarns were spun feeding two rovings in one spindle only .Spindle speed of 15,000 rpm and 30 TPI were maintained in single yarn spinning and 16,000 rpm and 23.5 TPI were maintained in case of other yarn spinning. Yarns spun by various techniques are mentioned in Table I

2. To test the evenness properties USTER Tester III and for Lea Count – strength Products (LCSP) results, Statex Electronic Lea CSP tester was used.

III Results and Discussions

Results of certain yarn properties related to Lea C S P, Evenness Imperfections and Hairiness Index were presented in Table I and II. Table I shows mainly the LCSP values of the yarns produced by various techniques whereas Table II shows the results of Evenness and Imperfection values including Hairiness Index as obtained through Uster Evenness Tester (UT III). Analysis of the results is carried out considering the fibre behaviour at their yarn formation zone as presented in Figure I.

A. Effect of Different Yarn Formation Techniques on Lea Count-Strength Product

Lea strength of different yarns was tested and then Lea CSP values were corrected keeping the nominal count of the yarn. Figure II shows the diagrammatic representation of different corrected Lea CSP values. Lea CSP value of EliTwist yarn shows the highest value followed by Compact ply yarn.

Table I: Effect of Different Yarn Formation Techniques on Lea Count-Strength Product

Type of Yarn	Average Count (Ne)	Nominal Count (Ne)	Average Strength (lb)	Average LCSP	Corrected LCSP
Single Yarn without Compact	63	60	27.6	1739	1793
Ply Yarn without Compact	32	30	61	1952	1988
Single Yarn with Compact	62	60	33.1	2088	2151
Ply Yarn with Compact	31	30	69.4	2052	2169
Siro Yarn (1cm spacing)	32	30	64	2048	2084
Siro Yarn (without spacing)	31	30	63.4	1965	1983
Elitwist	30	30	75	2250	2250

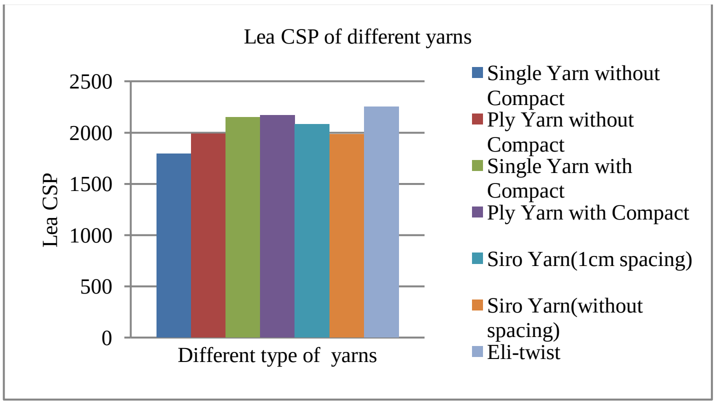


Figure 2: Lea Count Strength Product of Different Yarns

The variation of the Lea C SP value for different yarn formation techniques can be analysed in light of fibre movement in the respective yarn formation zone. In normal ring spinning system, delta zone at the yarn formation point is wider and longer and varies depending on the tension variations. End fibres emerging out of the front roller have tendency to move out of the yarn structure forming hairs or faults. Therefore percent utilisation of fibres in yarn yarn strength becomes lower compare to a controlled fibre movement at delta/yarn forming zone in other techniques like Compact or EliTwist spinning. More over in a compact yarn structure, fibre cohesion becomes more and restricts the fibre slippage, thereby property realisation of fibres in compact system is higher. Ply yarn with compact and EliTwist systems, fibre arrangement in yarn is more compact and as discussed above, the strength value is more compare to others.

B. Effect of Different Yarn Formation Techniques on Yarn Evenness and Imperfections

The data of the test results of evenness and imperfections along with hairiness of various yarns as tested by Uster Tester III are presented in Table II. The CVm% value which represents the mass variations in 1cm cut length of yarn is very much dependent on the presence of the short term irregularities in the yarn. More fibre in the cross-section tends to reduce the amount of irregularity due to doubling effect. As all yarns are produced from same roving maintaining identical conditions it is expected that irregularities generated during drafting remain same for all cases. In case of single yarns (with and without compact) control over the fibres at delta zone (yarn formation zone) creates the difference between normal and compact single yarn. Variation in delta zone geometry may also be a cause for change in irregularity as because the tension variation changes the position of the yarn formation point, thereby creating stretch in the fibre flow before forming the yarn. The same is true in case of SIRO yarn with 1cm spacing. EliTwist yarn which is having controlled compact as well as delta zone , shows better performance in this respect.

Table II: Effect of Different Yarn Formation Techniques on Evenness and Imperfections

Type of Yarn	Average Count (Ne)	CVm%	Thin Places/Km (-50%)	Thick Places/Km (+ 50%)	Neps/Km (200%)	Hairiness Index
Single Yarn without Compact	63	20.6	100	300	150	4.7
Ply Yarn without Compact	32	15.5	20	40	120	5.8
Single Yarn with Compact	62	15.5	90	30	115	4.3
Ply Yarn with Compact	31	13.0	02	5	45	5.5
Siro Yarn(1cm spacing)	32	19.1	46	260	115	5.9
Siro Yarn(without spacing)	31	13.5	2	10	55	6.5
Eli-twist	30	9.5	1	13	62	3.7

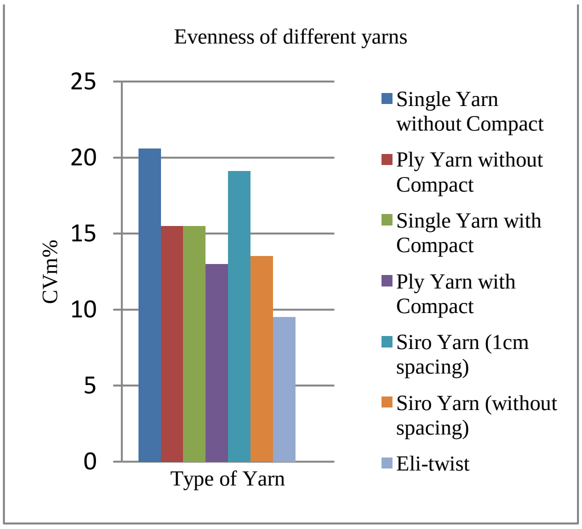


Figure 3: CV % of Mass variation in different Yarns

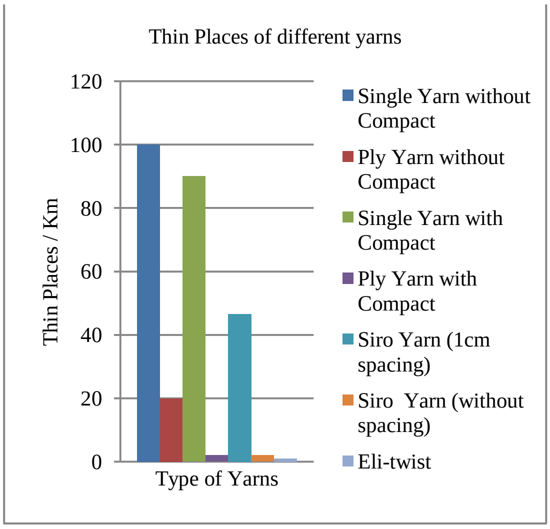


Figure 4: Thin places/km in different Yarns

The variations in thin and thick places/Km in different yarns produced using various techniques may be analysed in light of their yarn formation zones as mentioned above. But the variations in Neps/Km cannot be explained properly and more data is required for analysis. Figure 3, 4 and 5 represents the amount of thin, thick places and neps/Km in different yarns

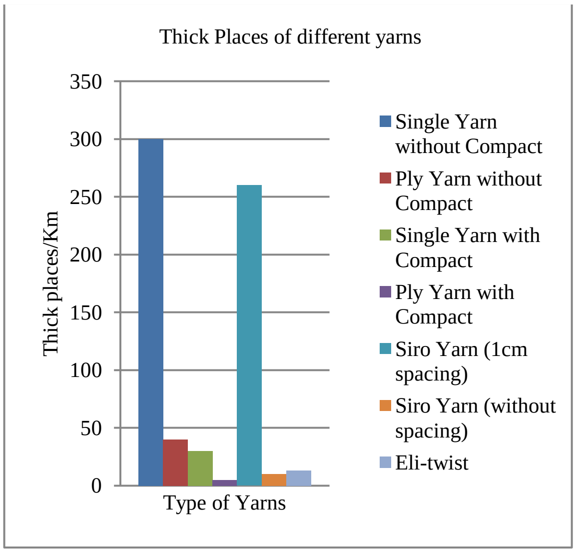


Figure 5: Thick places/km in different Yarns

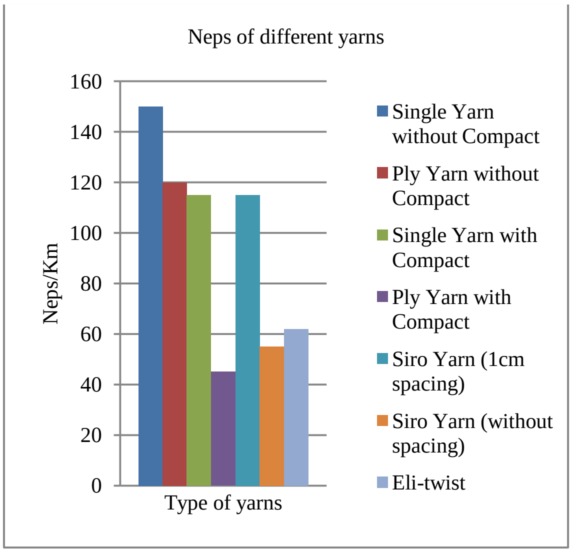


Figure 6: Neps/km in different Yarns

C. Effect of Different Yarn Formation Techniques on Yarn Hairiness

The Hairiness Index as tested in Uster Tester III is presented in Table II and in figure 7. The Hairiness Index represents the length of total hairs per unit length (1cm) of yarn. The amounts of length of hairs is always more in case of ply yarns corresponding to its single yarn which is reflected in case of single and ply yarns in both normal and compact systems. The control of fibres in the fibre formation zone is also reflected in the result. In Compact yarn again Hairiness Index is lower than normal yarn of same count. Due to control of fibres and steady yarn formation point, Hairiness Index of EliTwist spun yarn shows lowest value.

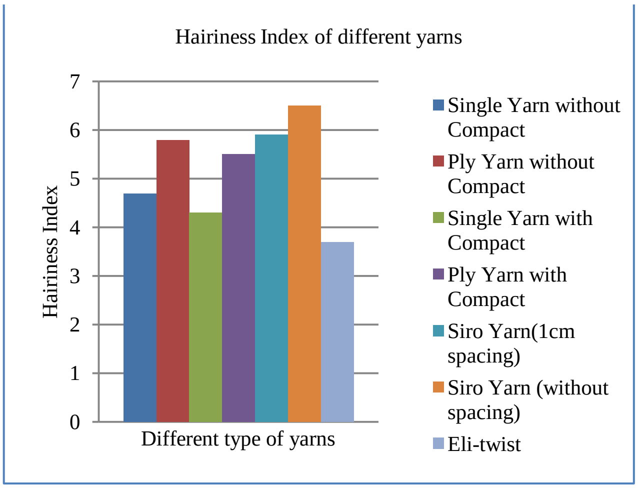


Figure 7: Hairiness Index in different Yarns

IV Conclusions

The importance of yarn formation zone in spinning frame commonly known as Delta zone plays significant role in forming the yarn structure, thereby yarn properties. As compact spinning system minimises the size of the delta, the properties are better in comparison to all normal yarns which is further improves with EliTwist system where both compact singles and plied yarns are formed in one spinning frame only.

References

[1] A Basu and R L Gotipamul , “Quality Characteristics of Polyester/Viscose and Polyester/Cotton Two Ply Yarns ”, Indian Journal of Fibre and Textile Research, vol. 31, June 2006, pp. 279-285.
[2] K P S Cheng and S P Chu , “SIRO Spun Vs Two Ply”, Textile Asia, 26(5), 1995, pp. 48-57.
[3] M Nikolic, Z Skenderi and D S Gorjanc, “Two-Ply Yarn Production on Ring Spinning Machine”, Tekstilec, 7-9/2009 , vol. 52, pp. 195-209.
[4] W Oxenhum, “Innovations in Spun Yarn Technologies – Present and Future”, Indian Journal of Fibre and Textile Research, vol. 31, March 2006, pp. 116-124.
[5] N Brunk, “EliTwist – Three Years after Market Introduction”, SPINNOVATION No. 22, pp. 10-16.
[6] S Ramasubbu, “Elite Compact Spinning System – A User’s View” SPINNOVATION No. 21, March, 2005, pp. 17 – 20.
[7] Xie Chunping, Yang Lili, SU Xuzhong and Feng Jie, “ Analysis of Compact effect and Yarn Structure of Compact Siro Spinning”, Journal of Textile Reserch, vol.28, 2007, pp. 9 – 12.