Effect of Strand spacing of SIRO Compact yarn on fabric properties

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ABSTRACT

Over the past 25 years the traditional twisting or folding operation has undergone considerable change and development. One technique still employing the ring spindle is that of stage twisting. This method is unusual in that, unlike many other developments, the main object has been to improve yarn quality rather than the more common aim of reducing costs.However, ordinarily the standards must be first spun and then two folded involves additional process cost. Therefore, the spinners have long demanded spinning and twisting in a single operation. The "SIRO SPINNING TECHNOLOGY" process offers the solution. In this project work an attempt is made to study the effect of strand spacing of SIRO yarn produced by using compact spinning system. Yarn was produced by 5 different strand spacing length with two different suction pressures. Various properties of these yarns were studied. The trials have been conducted by optimizing the distance between the two roving strands & varying the negative pressure applied in the suction zone. Finally the results has been optimized to find the in what parameter the Quality results of the eli twist yarn will perform better. In the second part based on the optimized results of yarn, the fabric has been produced with different combination and the properties of fabric have been studied. Based on the results obtained the best combination of yarn parameter has been found. For optimization of results the statistical tools and regression analysis were used

Key words: Siro Yarn Strand Spacing, Suction pressure, Regression analysis

1.Introduction

Doubling is the process in which two or more single yarn is combined together by means of twist. The yarns produced are known as ply yarns or folded yarns. These yarns are necessary for certain end uses were, for instance, superior strength or regularity is required. For any given in quality of yarn, folded yarn is more expensive than a single yarn of the same linear density. EliTwist is a patented process to produce economically a compact spin-twisted yarn with the EliTe Compact Set directly on the ring spinning frame. In SIRO or DUOSPUN the two roving drafted on one spinning position at a relatively large distance from one another are united in a twisting point when they leave the drafting system. A large twisting triangle is the result of the distance between the two roving. The twist in both legs of the twisting triangle is only about 70% of the twist of the double thread produced. Such conditions have been the reason for the high delicacy of such methods until now, and have prevented the success of this very interesting process in the short-staple sector.

2. Literature review

Wen-Yan Liu [1] studied the parameters such as the angle in "V" area in Sirofil spinning system, the tension and torque of the filament and roving with different feeding spacing. The optimal strand-spacing of different spinning materials is, thus, recommended. The configuration, strength and elongation, hairiness and evenness of the yarn were studied experimentally. The theoretical results agreed very well with experimental data. P. Soltani , M. S. Johari [2] studied the effect of strand spacing and twist multiplier on strength of Siro-spun yarns with reference to the yarn structural parameters. Of the various structural parameters for staple yarns, fiber migration has a crucial influence on the yarn strength, which in turn to a considerable extent is influenced by the strand spacing and twist multiplier. Achieving the objectives of this research, the yarns were produced from lyocell fibers at five strand spacing's and four different twist multipliers. Tracer fiber technique combined with image analysis were utilized to study the yarn migration parameters. Afterwards, the yarns were subjected to uniaxial loading by a CRE tensile tester. The findings reveal that, as strand spacing is increased, yarn tenacity increases up to strand spacing of 8 mm beyond which it reduces. Analysis of the results indicates that the higher tenacity values at the strand spacing of 8 mm can be attributed to the higher mean fiber position, higher migration factor, higher proportion of broken fibers and lower hairiness. Sun & Cheng [3] produced Siro yarns with 9 mm spacing of roving guides and found that Siro yarns were stronger than single yarn at all twist multipliers. This, according to them was due to strand twist. Su et al [4] measured the drafting force, which is an important parameter correlated to twin-yarn properties, of twin-spun yarns and found that with increase in roving spacing, the drafting force increased. Salhotra [5] while producing Siro yarns with 38 mm and 1.5 denier Viscose stated that with reduction in draft employed, there was substantial decrease in irregularity. The strand of ribbon being narrow with lower draft, the yarn packing coefficient improved. As the strength of Siro yarns depends little on migration, the proportion of fibre-rupture being higher with finer yarns, the tenacity is expected to improve. Cheng V. Subramaniam and K.S. Natarajan [6] stated that higher spreading width improves blend uniformity and lowers the colour difference, thus improving dyeing uniformity. Studies the frictional properties of a series of siro spun yarns produced from cotton, polyester/cotton, and viscose. The coefficient of friction of the yarns has been measured using Howell's method where the two yams slide against each other at right angles. Yarn-to-metal friction has also been measured using a modified version of Howell and Mazur. The dependence of strand spacing and twist on the coefficients of yarn-to-yarn and yarn-to-metal friction has been examined, and the frictional coef ficient increases with increasing strand spacing and twist. The probable reasons for this behavior are discussed in terms of the nature of the yarn surfaces. Gupte & Chiplunkar [7] found that with increase in roving spacing, the yarn strength increased, whereas hairiness reduced. They also found that in some instances, the strength of Siro yarn was even greater than doubled yarns of equivalent count. Sarvanan 8studied that blended cotton fibres with long staple strands of silk and polywool. He mentioned that with lower spindle speeds, it was possible to spin Siro yarns. He found that when short staple cotton component was added, yarn hairiness increased; however tensile properties of the yarn were more affected by major fibre component. Beceren et a l [9] focused on dimensional and selected physical properties of plain jersey fabrics made from viscose Siro yarns. Sawney et al [10] Dhawan reported about 14% higher strength with Siro yarns whereas Dhawan & Salhotra [11]stated that yarn quality improves with increase in spacing; attains an optimum value and thereafter deteriorates with further increase in spacing. Dhawan & Jai Prakas [12]reported that DRF yarns, at optimum spacing, were slightly superior to normal doubled yarns. EL SAYED, M.A.M AND SUZAN H. SANAD [13] studied the characteristics of cotton fabrics produced from siro spun and plied yarns. The use of sirospun yarns eliminates two processing stages in comparison with the two -fold yarns production process and consequently, reduces the cost of production. It is claimed that, it brings many advantages for yarn and fabric quality. Armin Pourahmad* and Majid Safar Johari [15] In their research, core-spun yarns with an acrylic sheath fiber and a nylon flat core have been produced on the Ring, Siro, and Solo spinning systems an d the effects of some factors were investigated. N. Gokarneshan , N. Anbumani & V. Subramaniam[6] This article investigates the influence of varying strand spacings in the case of siro or double rove yarns. Studies have been carried out on cotton, polyester and polyester–cotton yarns.

3.MATERIAL & METHODS

MATERIALS

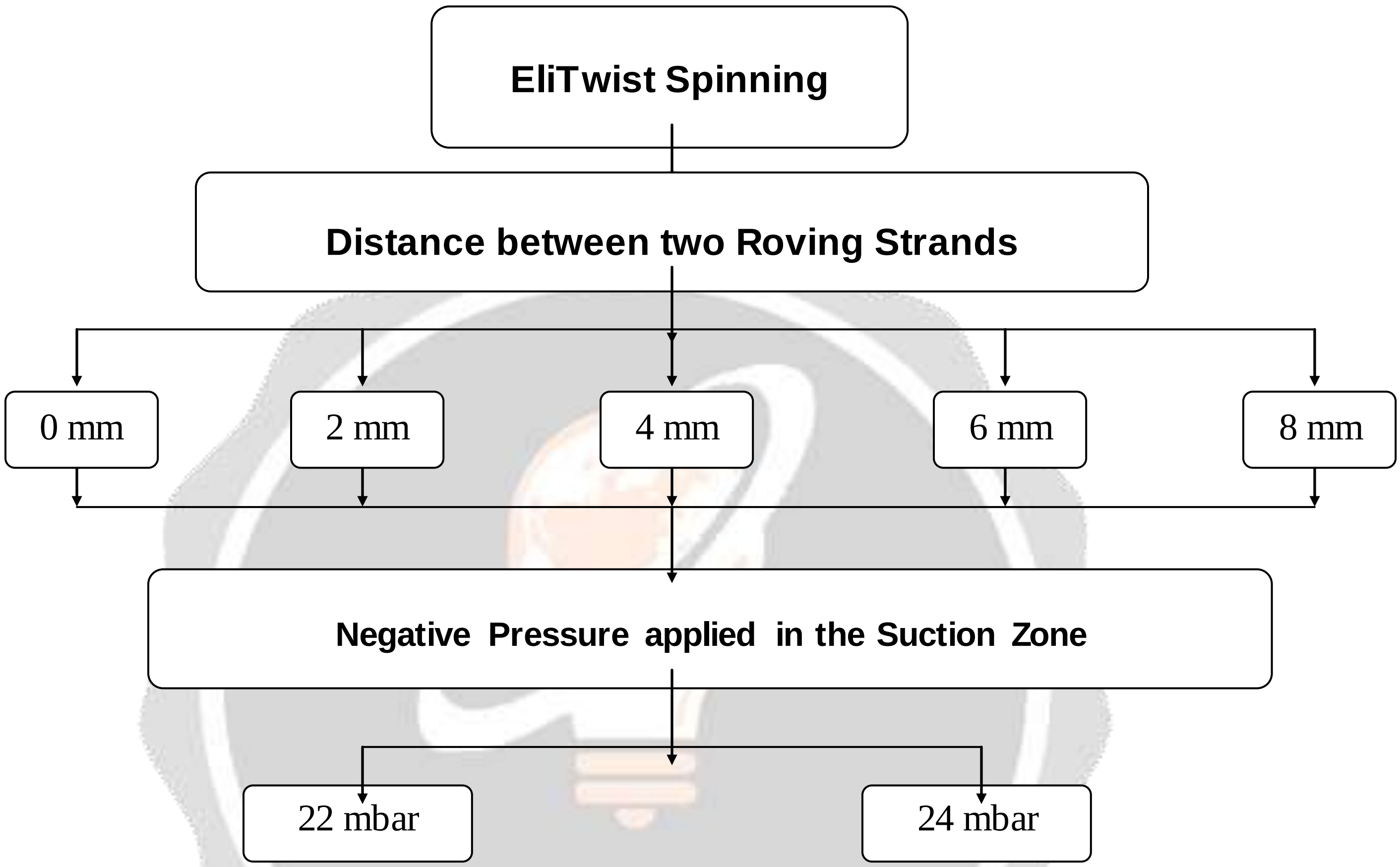
Material used in our trial are 100% Indian Cotton (Variety: Shankar – 6), which is processed controlled in the department up to spinning. The details of process path & important process parameters are mentioned below.

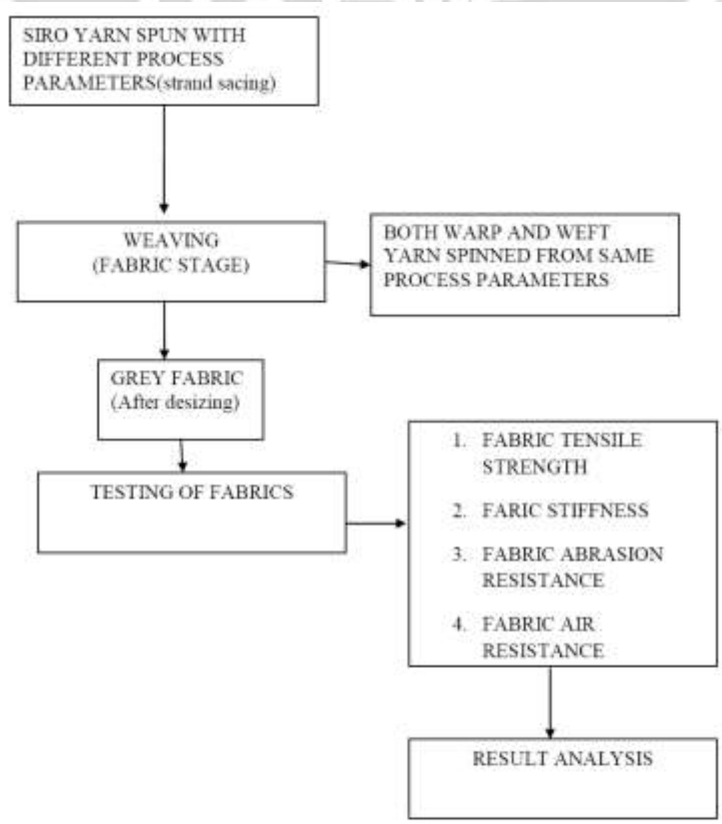
S.No	Parameters	Details
1	**Carding**	**LC 300 A V3**
	a) Delivery Hank	0.120
	b) Delivery Speed in mpm	120
	c) Production Rate (Kg/hr)	35.4
2	**Pre Comber Draw Frame**	**LD-2**

	a) No of Doubling	5
	b) Delivery Hank	0.120
	c) Delivery Speed in mpm	600
3	**Uni Lap**	**E-5**
	a) No of Doubling	22
	b) Lap Weight	75gms/mt
4	**Comber**	**E-65**
	a) Delivery Hank	0.120
	b) Comber Speed (npm)	450
	c) Noil %	18
5	**Finisher Draw Frame**	**D-40**
	a) Delivery Hank	0.120
	b) No of Doublings	8
	c) Delivery Speed in mpm	400
6	**Simplex**	**LFS 1660 V**
	a) Delivery Hank	0.9
	b) Spindle Speed (rpm)	980
	c) TPI / TM	1.40 / 1.48
7	**Spinning**	**LR-6 AX – Elitwist Converted**
	a) No of Spindles	1200
	b) Spindle Speed (rpm)	15500
	c) Yarn Count	40/2
	d) Twist Direction	Unidirectional – S on S
	e) TPI	18.1

Table. 1 Spinning Preparatory process parameters

The following flow chart will give the idea about the experimental status





SAMPLES	WARP	WEFT	SAMPLE SPECIFICATION	Construction (Warp x Weft) (Ends/ inch x picks/inch)	WEAVE TYPE
1	D1S1	D1S1	A1	56 x 52	PLAIN
2	D1S2	D1S2	A2	56 x 52	PLAIN
3	D2S1	D2S1	A3	56 x 52	PLAIN
4	D2S2	D2S2	A4	56 x 52	PLAIN
5	D3S2	D3S2	A5	56 x 52	PLAIN

RESULTS & DISCUSSION

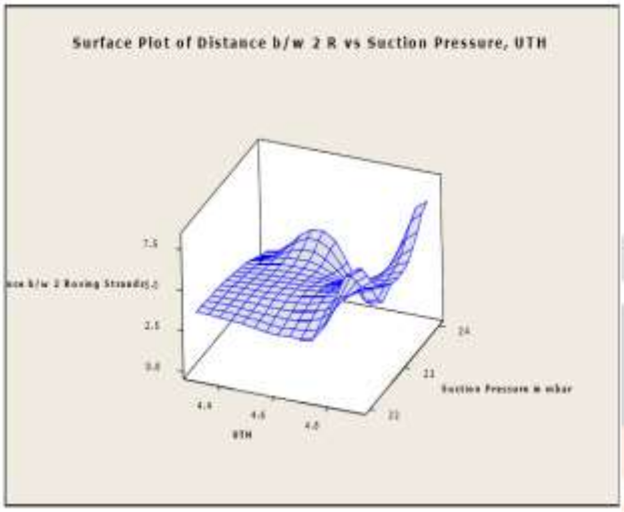
The Test results of the trials conducted in our above studies is tabulated below. Test results of the samples both at ring frame cops stage & the final cone stage is tabulated. Apart from the laboratory test results online data on the autoconer breakage, online Classimat & lab data is also included.

Equations have been derived for predicting the yarn quality at various distances between the roving strands & the negative pressure applied in the suction zone. With this we can predict the yarn quality results in future without conducting any trials in the future. This will helps the factory in saving lot of time and money involved in conducting trials.

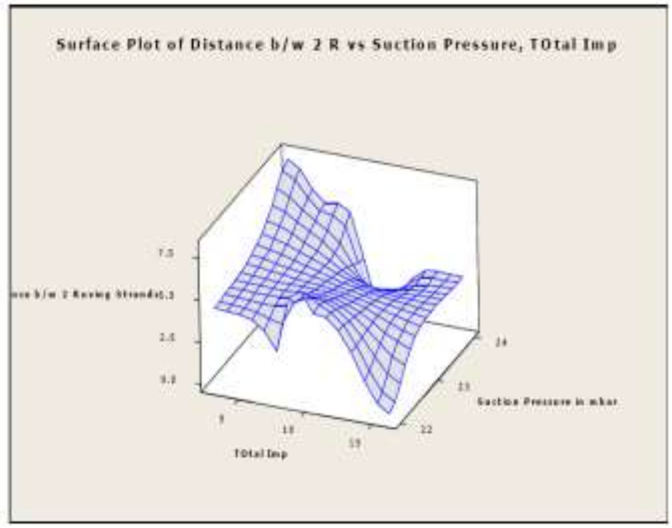
U %	= 7.78 - 0.0593 Dist between roving strands - 0.0210 Suction Pressure
Thick +50%	= 9.40 - 0.700 Dist between roving strands - 0.100 Suction Pressure
Neps +200%	= 15.5 - 0.125 Dist between roving strands - 0.400 Suction Pressure
Rkm	= 27.0 + 0.0275 Dist between roving strands - 0.270 Suction Pressure
Elong %	= - 10.4 - 0.0375 Dist between roving strands + 0.730 Suction Pressure
UTH	= 4.99 + 0.0375 Dist between roving strands - 0.0200 Suction Pressure
S3	= 1940 - 38.0 Distance between roving strands - 45.5 Suction Pressure
CMT	= 49.0 + 0.75 Distance between roving strands - 0.80 Suction Pressure

SURFACE PLOTS

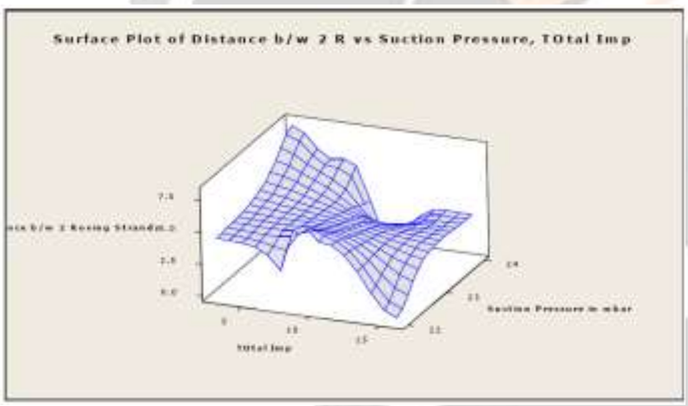
Hairiness Vs Suction Pressure Vs Distance



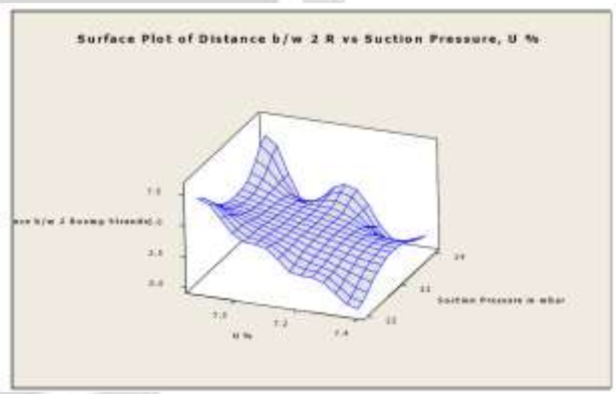
Rkm Vs Suction Pressure Vs Distance



Imperfection Vs Suction Pressure Vs Distance



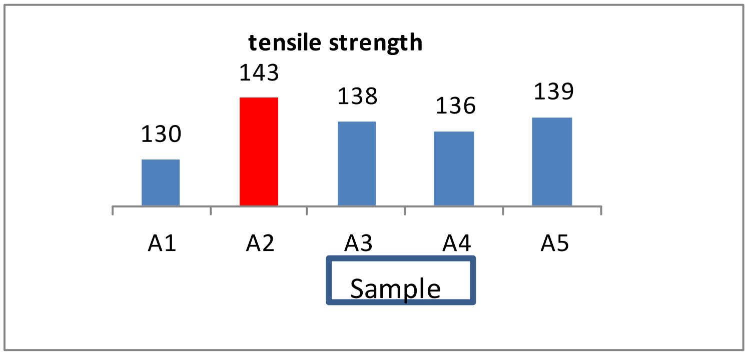
U% Vs Suction Pressure Vs Distance

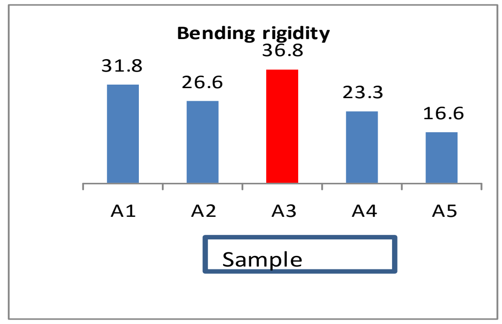


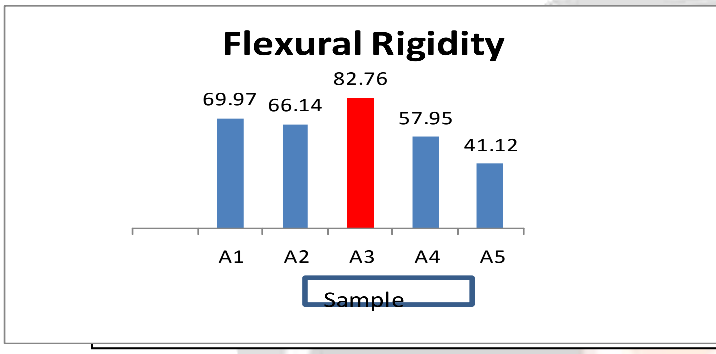
Effect of Siro Yarn properties on Tensile Strength of the Fabric

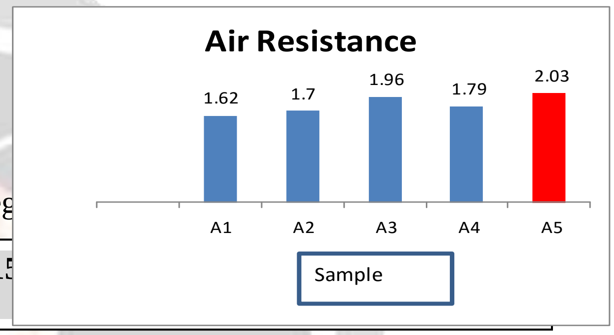
(grey stage)

Fabric Spec	Distance	Pressure	Tensile Strength	Bending Rigidity	Flexural Rigidity	Air Resistance
A1	4	22	130.0	31.8	69.97	1.62
A2	4	24	143.0	26.6	66.14	1.7
A3	8	22	138.0	36.8	82.76	1.96
A4	8	24	136.0	23.3	57.95	1.79
A5	6	24	139.0	16.6	41.12	2.03









Bending Rigidity - Grey = 466 - 92.4 U% + 4.98 Rkm - 0.030 Total Imp (Norm. Sens) + 2.32 Total Imp (Higher. Sens)

Air Resistance - Grey = 3.1 + 0.50 U% - 0.174 Rkm + 0.0003 Total Imp (Norm. Sens) - 0.0276 Total Imp (Higher. Sens)

Flexural Rigidity - Grey = 813 - 142 U% + 3.63 Rkm - 0.965 Total Imp (Norm. Sens) + 3.90 Total Imp (Higher. Sens)

CONCLUSION

As the quality of yarn is predicted by means of various parameters such as unevenness %, imperfection level, single yarn strength, elongation, Classimat performance of the yarn in further process, etc.,

All our analysis shows that the overall yarn quality is better in 8mm distance between the roving strands with 24 mbar negative pressure. Also the equations derived are very useful in future for predicting the yarn quality of Eli-twist yarn.

Apart from finding out the optimum parameter, by this approach we can able to find out the optimum parameters which is suitable for various end uses of yarn. As the end use of the yarn is changing we can fine tune the weightage given to each parameter as a results we will easily find out the optimum parameter which is suitable for that particular end use.

Though it is already established that the properties of raw materials is directly impact the fabric specifications & performance, On all our analysis reveals that the suction pressure at 22 mbar & distance between the roving strands at 8 mm which is giving better fabric results.

Regression equations which we have derived are helpful for predicting the fabric quality by knowing its yarn specifications. This will helps lot of time & cost involved in conducting trials.

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