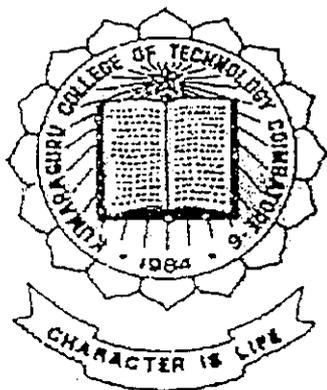


COMPARISON OF QUALITY OF DOUBLED YARN MANUFACTURED THROUGH TFO AND RING DOUBLER

Project Report



P-440



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SYNOPSIS

Use of TFO is gaining momentum in the doubling process as the knot free long yarn has become a prerequisite for the subsequent process with high productive modern machines to achieve high quality fabrics, which is in demand in the present market.

There is no doubt in respect of occurrence of number of knots in a doubled yarn at a particular length that the TFO system is superior to ring doubling system, but in yarn properties like variation of twist, strength and hairiness, the trend differs with the speed of TFO. So there is a need to optimise the speed to get best out of TFO.

In this work we have made an attempt to compare the quality of doubled yarn manufactured through ring doubler at a normal speed and TFO with various speeds.

For the comparison, three warp counts, Viz, $2/30^S$ [CP/C], $2/40^S$ K [100 % COTTON] and $2/32^S$ [100% COTTON] were selected and doubled on both ring doubler and TFO under the same level of twist. The spindle speed

of ring doubler is kept at 9,500 rpm, where as the speed of TFO changed between 7,500 rpm and 11,500 rpm in a step of 1500 rpm to 2500 rpm.

Yarn characteristics which are expected to get influenced, Viz, Single thread strength, elongation and its CV% [USTER TENSORAPID], CV of Twist, Hairiness count at various length [ZWEIGLE G565] were studied. The study reveals the following

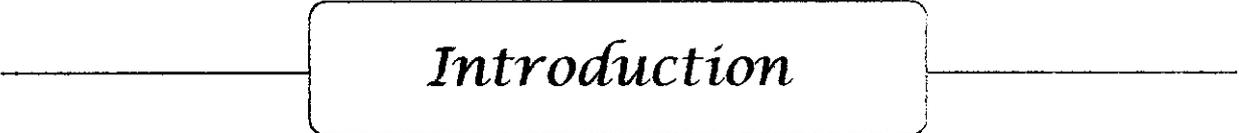
- Long knot free yarn for TFO doubled yarn compared to ring doubled yarn
- CV of Twist is high for all speeds of TFO compared to ring doubling.
- Breaking elongation of yarn is high for all speeds of TFO in comparison to Ring doubled yarn.
- There is a slight deterioration in the mean strength realized by TFO doubled yarn, compared to the ring doubled yarn but the influence with the speed of TFO is insignificant.
- In the case of blended yarn, upto a certain level of TFO ^{speed} there is a reduction of hairiness count for 1mm to 8mm length and any further increase in speed reverses the trend. Where as in the case of 100% cotton, increase in speed reduces the hairiness count.

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Introduction

INTRODUCTION

The rate and extend of technical innovations in the world is gaining momentum, when we are approaching a new millennium and entering 21st century . The globe has become a village with less barriers and there is a stiff competition to produce a best quality product at a competitive price. The modern technology plays a vital role in increasing the machine and labour productivity and achieve a better quality. In the field of doubling of yarn also there is no exception.

The two for one twister system of doubling is gaining world wide acceptance in comparison to ring doubling due to better quality achieved in the former, eventhough the capital investment and power cost is high(see annexure). This necessitated a review of performance of TFO with respect to quality in comparison to older system of ring doubling.

2. LITERATURE REVIEW

2.1 PLY TWISTING:

The methods of twisting two or more single yarns are called doubling or two-folding or ply twisting. Such yarns are designated as doubled yarn, folded yarns, plied yarns etc and machines intended for the purpose are called doublers, ply twister etc.

A ply-twisted or a two-folded yarn has now to be considered as a yarn of specific characteristic and properties, competing with other yarns of comparable effective count for the innumerable applications in the textile industry.

It is estimated that today 25% of all ring spun yarns are plied before use..

2.2 OBJECTIVES OF PLY-TWISTING:

The main objective of the ply-twisting are:

- a) At yarns stage:
 1. To improve the evenness of the yarn.

2. To improve strength and elongation of the yarn.
3. To improve lustre and smoothness of the Yarn.
4. To improve abrasion resistance of yarn.

b) At fabric stage:

1. To obtain higher stability against wear.
2. To obtain improvement in fabric cover.
3. To obtain modified specific handle and visual appearance.

Traditionally, ring twisters were used for ply-twisting spun yarn, and up-twistors were used for twisting filament yarns. Now-a-days, Two for One (TFO) twistors are gaining world wide acceptance both in the staple and filament sectors mainly because of their inherent advantage like

- (i) Production of long lengths of knot free yarn which facilitates better performance in subsequent processes
- (ii) Higher productivity per spindle sometimes more than two times that of traditional twistors
- (iii) Reduction in the number of pre and post- twisting operations and last but not the least
- (iv) Low man power requirements.

2.3 BASIC CONCEPTS OF TWISTING:

There are basically three principles of twisting , Viz,

- 1) Down-twisting
- 2) Up-twisting
- 3) Two-for-One twisting

In the machines operating on down-twisting or up-twisting principle either the take- up package, as in ring twister or the feed package, as in up-twister rotates around itself to impart twist into the yarn. One revolution of the traveller round the ring exerts one twist in to the yarn.

The concept of TFO spindle was originated because of the limitations in twisting very coarse counts. In the earlier method of ring traveller twisting, the yarn quantity on the take-up package was found to be insufficient for a continuous post operation, where the yarn length required was continuous and knot free, as much as possible.

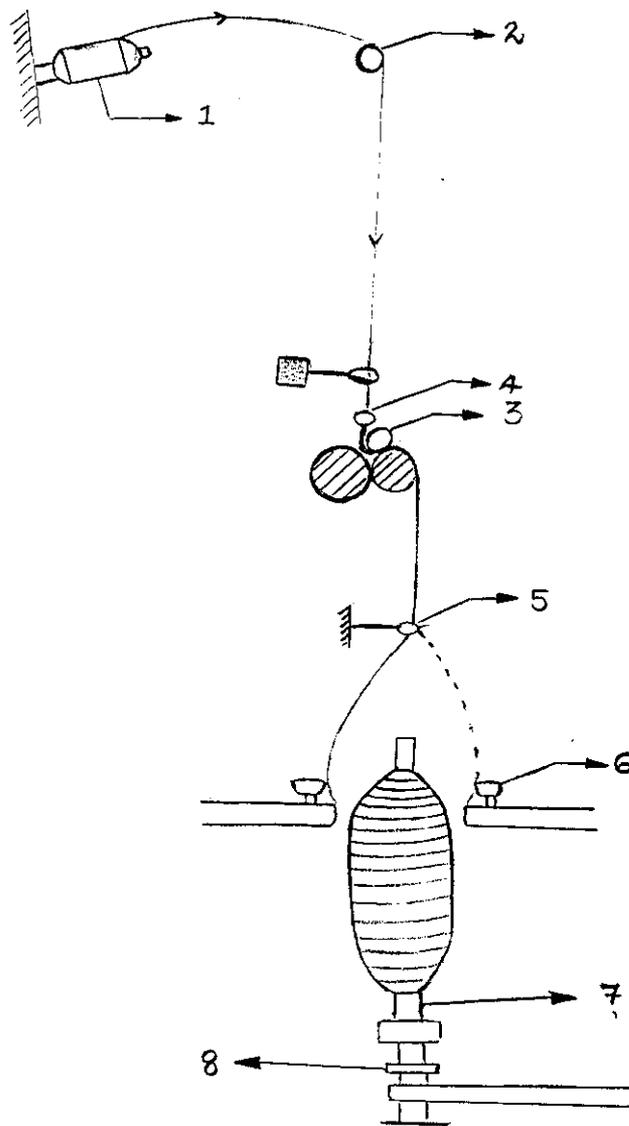
Hence the need for having twisted packages of longer continuous yarn length, without knot or with minimum knots, paved the way for designing a TFO twister, where longer knot free yarn will be available on a single spindle for post twisting operation.

The specific designation 'Two-for-One spindle' is derived from the fact that, for each revolution of the spindle, the yarn receives two turns of twist and is abbreviated for convenience as TFO.

The first half of the twist is inserted in the hollow shaft of the spindle, between the tensioning unit and the outlet of the rotating disc. The second half of the twist is in principle only inserted when the yarn has returned again from radial to axial movement, i.e., at the foot of the balloon.

A TFO spindle is normally designed in such a way that the feed package is placed inside the rotating yarn balloon, the delivery package being situated outside it. Nearly all TFO spindles for twisting textile yarns functionally resemble up-twisters.

2.4 WORKING PRINCIPLE OF RING DOUBLER:



- 1 - CREEL BOBBIN
- 2 - GUIDE ROD
- 3 - DELIVERY ROLLER
- 4 - TENSION GUIDE
- 5 - LAPPET
- 6 - RING AND TRAVELLER
- 7 - RING SPINDLE
- 8 - SPINDLE WHARVE

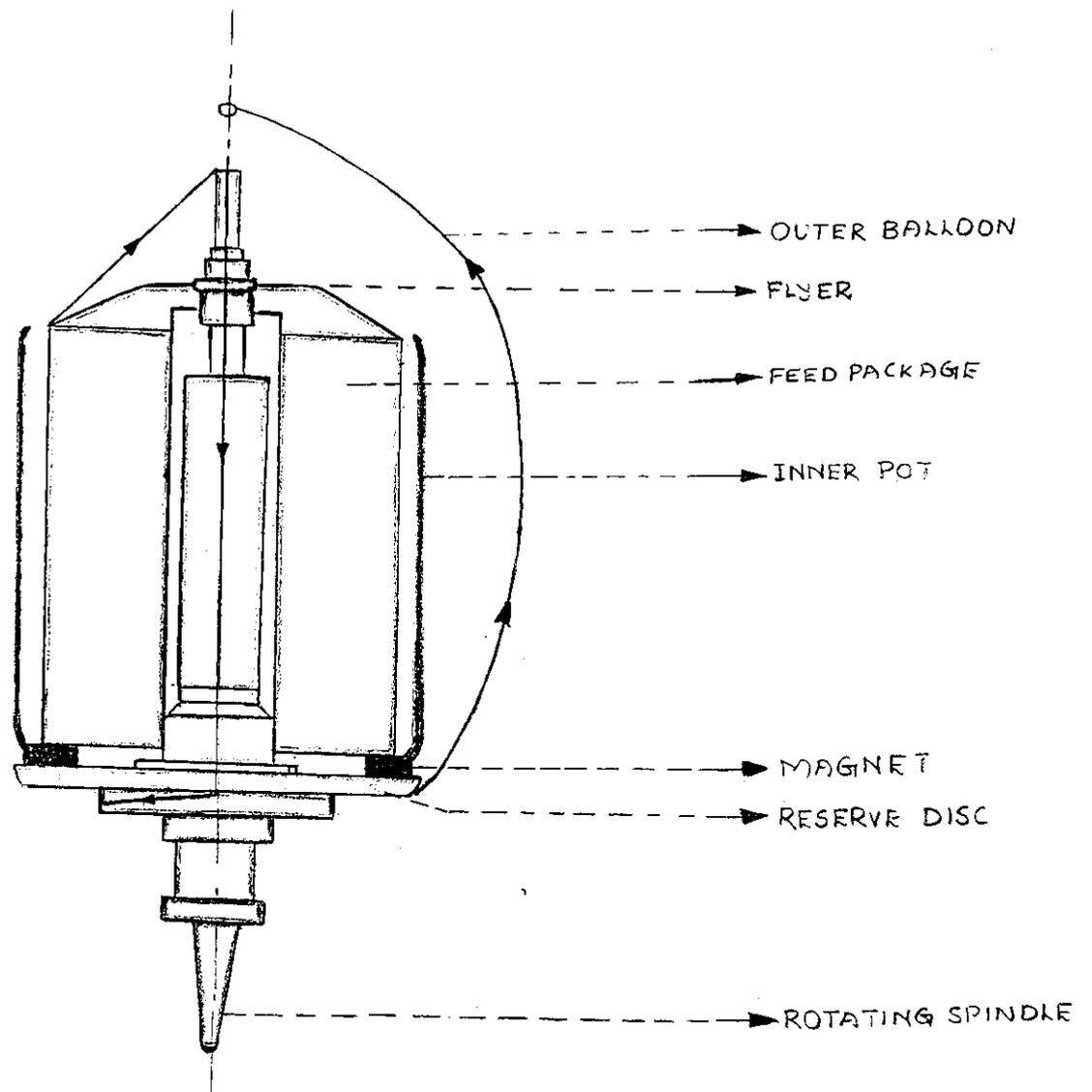
Ring doublers, in principle, are similar to the ring spinning machine except that instead of a drafting zone, a roller nip arrangement is used to deliver the component yarn at the required speed.

A process flow diagram of the ring doubler is as shown in the figure above. The package to be twisted are positioned on a creel, and the ends of the yarn are led down through tensioners, individual guides, vertical delivery rollers and lappet thread guides, between rings and traveller and on to the bobbins on the spindle.

The yarn gets twisted because of the movement of the traveller (Traveller movement once round the ring, inserts one twist on to the yarn) and the drag of the traveller through the yarn is because of the spindle rotation. Hence the amount of twist insertion will be the ratio of the spindle speed to the yarn delivery rate.

2.5.1 WORKING PRINCIPLE OF TWO - FOR - ONE - TWISTER

(VEEJAY LAKSHMI CATALOGUE)



With Two-For-One twisting system, the thread obtain two turns with one revolution of the spindle. The yarn receives its first turn between the yarn brake in the hollow axle and the exit in the spindle rotor (reserve disc).

The second turn is given with the outer balloon between spindle rotor and pig tail thread guide. To obtain this two for one effect, the pot with the untwisted feed package is kept motion less spindle rotor by permanent magnets.

$$\text{Number of Twists} = \frac{\text{Spindle revolution in rpm} \times 2}{\text{Yarn speed in meters / minute}}$$

2.5.1.1 WORKING METHOD OF TFO

The untwisted yarn, unwound from the feed package by means of an unwinding aid called as flyer (in the case of assembly wound feed packages) passes through the capsule portion and the hollow axle enters the reserve disc and leaves through the opening in the reserve disc.

The yarn at this point with one twist already inserted winds around the reserve disc and then enters the pig-tail forming a balloon, thereby the second twist is also inserted.

The twisted yarn runs over the pre take up roller and with the help of the traversing thread guide gets wound on to a cross wound bobbin which is kept in a cradle between two centering discs.

2.5.2 GLOBAL SCENARIO OF TFO:



TFO are available for twisting staple fibre spun yarn and filaments. The yarns ranging from 20 Denier to 450 Denier for filaments and from 2/1 to 2/100 Ne for staple spun yarns can be twisted in TFO twister, though in fine count range the process may be uneconomical.

The mechanical speed are as high as 15,00 rpm (resultant speed is around 30,000 rpm) for staple spun yarns and 18,000 rpm (resultant speed is around 36,000 rpm) for filament yarns.

2.5.3 NATIONAL SCENARIO OF TFO:

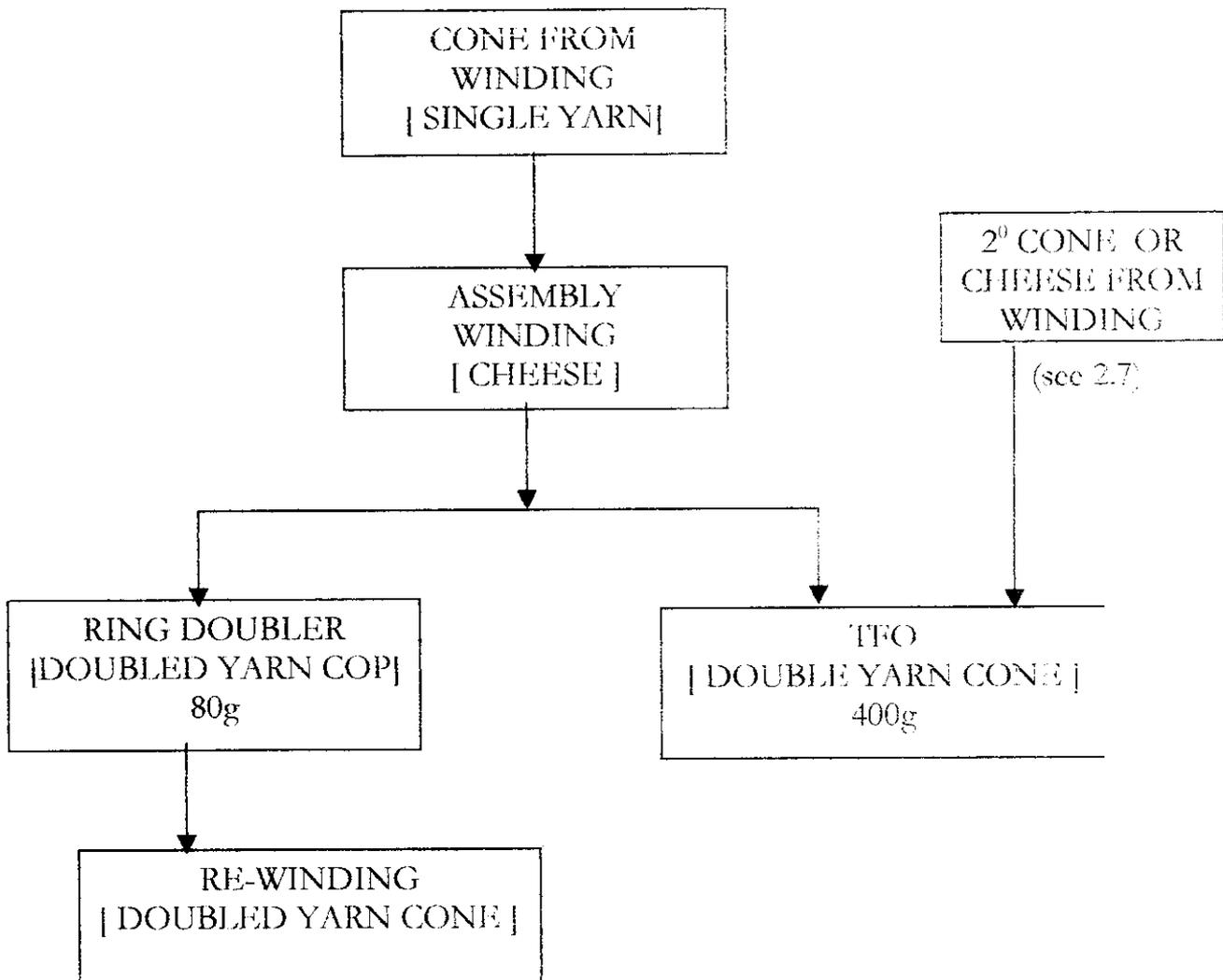
One of the earliest TFO twister for spun yarn in India was installed way back in early 1970.

Few TFO machine manufacturers are listed below

- 1) VEEJAYLAKSHMI – COIMBATORE**
- 2) PRERNA TEX INDUSTRIES (P) LTD – DAMAN**
- 3) UMW – COIMBATORE**
- 4) SVH – DHARWAD**

The first indigenous TFO machine for spun yarn was introduced on collaborations with SITRA by VeejayLakshmi Engg Works (P) Ltd.

2.6 PROCESS FLOW FOR RING DOUBLER AND TFO



- For TFO re-winding process is eliminated.

2.7 FEED PACKAGES FOR TFO TWISTING

According to SITRA FOCUS², an ideal feed package for TFO twister is parallel wound assembly package. In the assembly winding process, the TFO single ends are wound on a package. This ensures parallelity of the feeding yarn

before entering in to tension zone/ twisting zone thereby enables proper twisting. If two single end cheeses are directly used as feed package in TFO twister, snarling takes place.

In the case of bottom cheese, the yarn will be subjected to higher tension due to its longer path to the tip of the tension capsule as compared to the upper cheese which will have a shorter path and hence lesser tension. This variation in tension results in the formation of a loop.

Moreover, due to difference in the unwinding speeds, because of the position of the packages, the top package exhausts faster than the bottom package and hence the wastage of left-over yarn is considerable.

2.8 SPINDLE SPEED V/S YARN QUALITY:

According to Subramani ¹, et.al, the effect of speed on Two-of-One twisted yarn is a two- way affair. Its effect in case of machines with balloon limiter and without balloon limiter are slightly different. Generally, the yarn path in TFO is longer than that in the ring doubler. Obviously, the yarn is subjected to higher abrasion and friction during its course of twisting operation

in TFO. This will affect the yarn quality mainly in areas of fiber rupture and strength loss due to friction.

This can be minimized by practical methods, by controlling the yarn twisting speed and reducing the amount of friction during twisting operation, by using special yarn path elements with mirror finish and ceramic coating which will minimize the friction. In case of machines with balloon limiter which will give considerable power advantage, the fibre loss due to friction is more. Here the hairs in the yarn will be removed as well as the hairs are created. Hence to prevent the fiber loss in case of blended yarns special lubrication of yarn before twisting has to be done.

In case of machines without balloon limiters, the air-drag in the balloon results in the fiber loss, though the friction is less as compared to machines with balloon limiter.

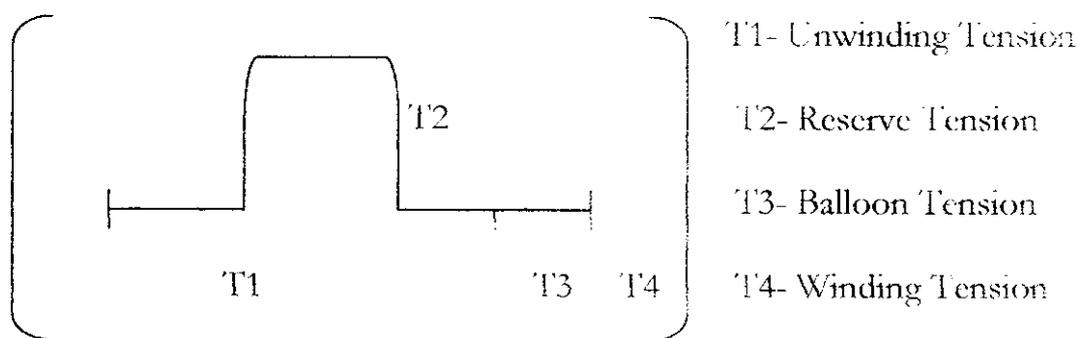
2.9 YARN TENSIONING DEVICES:

A tensioning device is provided to exert a tension for balancing the tension in the yarn created due to air drag on yarn balloon and hence keep the balloon stable. It also limits the upstream propagation of inserted twist.

The most commonly used tensioning device is the spring loaded telescopic capsule positioned between fixed on spring loaded ceramic eyelets.

Since the capsules are always in contact with the yarn, the contact of the capsule with the yarn is used as a sensing point to activate and transfer the impulses for operating various mechanism like package lifting mechanism, end-break signals and related production control data system.

From feed to delivery package, every portion of the yarn in the yarn path is subjected to tension. The magnitude of the mean balloon tension depends upon factors like spindle dimension, intrinsic yarn properties and angular speed. The tension in the yarn path is diagrammatically represented.



In a TFO twister, the unwinding tension is observed to vary smoothly and fluctuations in the unwinding speeds are developed instead. The tension

inside the hollow tube of the spindle is found to increase fourfold as compared to the unwinding tension which is in the vicinity of 10g.

2.10 HAIRINESS:

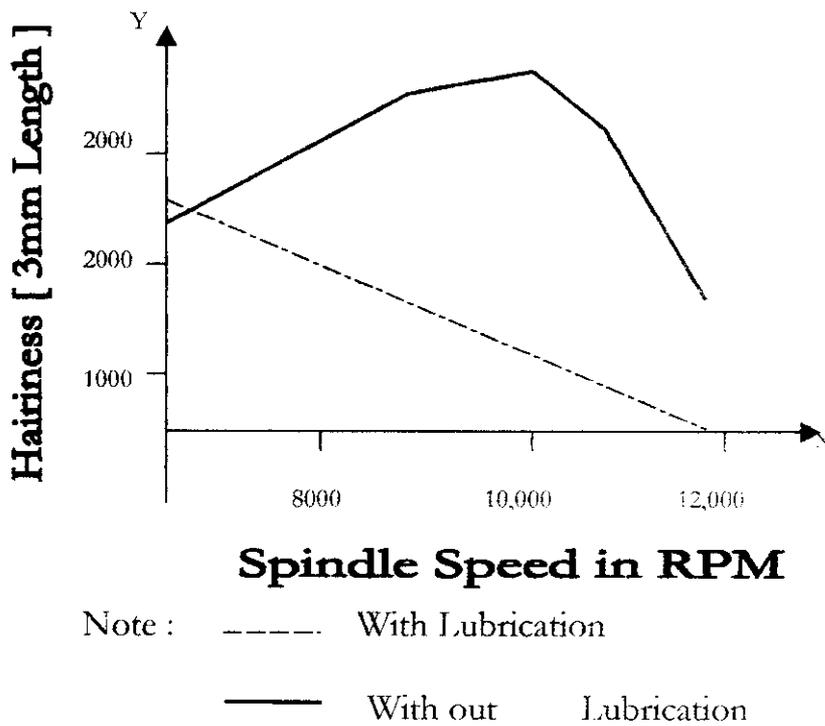
It is observed from the study of Subramani¹, et.al, that in case of open end spindle (no separator plate between spindles), where the balloon is in the air, the hairiness gradually increases with the increasing speed upto a certain limit and suddenly drops after that speed limit resulting in shaving of the fibres, thus improving the yarn appearance. The optimum speed at which the yarn starts creating the hairiness and loses the hairs is determined by practical application and study.

Other than this, the defects like out marks, burns and rough surface on the parts that comes in contact with the yarn also contribute to the fibre loss and then create hairiness on the yarn.

In case of closed spindle(with separator plate between spindles),which is more commonly used, the hairiness is created because of the excessive friction the yarn is subjected to, during its twisting in the balloon. The surface fineness of the balloon limiter also contribute to the increasing on decreasing of the

yarn hairiness. In addition to this, the speed at which the balloon rotates also determine the amount of hairs being created or removed during the operation.

Mr.subramani,et.al's,study reveals that the hairiness property of the yarn varies with the speed of the machine. This is illustrated in the following diagram.



2.11 YARN LUBRICATION SYSTEM

2.11.1 INSTA-LUBRICATION SYSTEM:

The untwisted yarn passes the apex of the spindle and before running in to the hollow axle it touches the moistening element whose capillary action brings the lubricant from the reservoir in to the contact zone by means of a wick which applies it to the yarn.

2.11.2 WAX APPLICATION:

Wax application is found favourable with the hosiery yarn where the twist in the yarn is less. The amount of wax application just before take up depends upon the speed and the tension between wax and disc and the strength of the yarn.

This is –ve type. In +ve type, wax application on the yarn is done by rotating the wax disc in direct contact with the yarn. TFO are supplied with both the kinds depending upon the design of the machine. The former act as a preventive system and the latter act as a corrective measure .

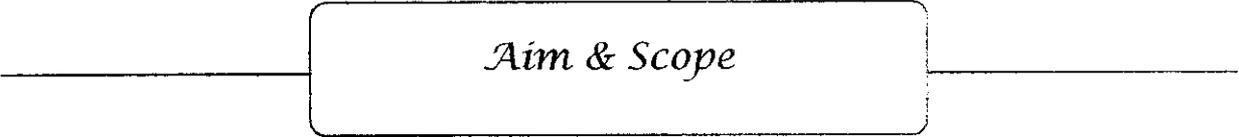
2.12 TPI AND ITS VARIATION:

According to SITRA FOCUS² the amount of twist inserted to the yarn in TFO is controlled by the spindle speed and winding speed.

Variation in the amount of twist may take place because of short term variations in winding speed (due to traverse motion, anti pattern mechanism and transient change in the wrap angle around the reserve disc), whereas in the case of ring twisting, where the twisting and winding zones are smaller one, the area of contact of a yarn with the traveller and the thread guide is almost constant and hence twist variation is very much controlled. Hence the TPI variation is expected to be slightly on the higher side for TFO compared to ring doubler.

2.13 SUMMARY OF REVIEW OF LITERATURE:

The above review of literature leads to a conclusion that there is a need for study on spun doubled yarn to know the influence of speed on yarn characteristics such as TPI variation, hairiness, single thread strength and elongation(mean and CV).

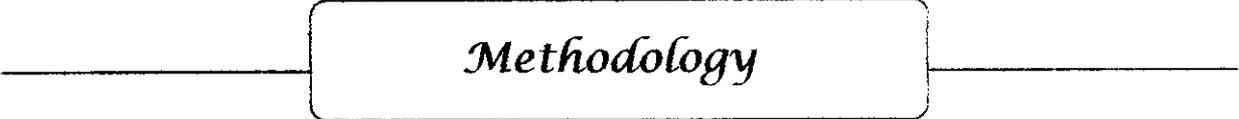


Aim & Scope

3.AIM AND SCOPE

The main objectives of our project are :

- To compare the doubled yarn quality manufactured through ring doubler and TFO. To study the influence of spindle speed of TFO on doubled yarn quality.
- The study is limited to 3 selected speed of TFO and one speed of ring doubling.
- One cotton yarn and one blend yarn are considered for the study based on the mills running count.



Methodology

4.METHODOLOGY

On the basis of aim and scope of the project, one speed is chosen for ring doubling system and three different speeds are attempted for TFO. To study the material influence a blended yarn and a 100% cotton yarn is chosen .

4.1.MACHINE DETAILS :

For the comparative study of two system of doubling, the following machines are chosen based on the availability of machines at the factory (The Coimbatore Pioneer Mills, Ltd;)

Ring Doubling - Textool DY 560.

Two - For - One Twister - Vj Hs 120.

4.2. COUNT AND MATERIAL :

The following are the count and material chosen for study.

Count chosen - 2/30s (CP/C - 48: 52/100)

2/40s k (100% Cotton)

4.3. SAMPLE SIZE :

Sample size of 20 cheeses of assembled yarn is taken for count and for each system of doubling namely Ring doubler and TFO for various speeds.

4.4. MACHINE SPEED :

For ring doubling only one speed is chosen and for TFO three different speeds are selected for the study. The details for each count is given below in the table.

COUNT	SPINDLE SPEED	
	RING DOUBLER	TFO
2/30s (CP/C)	9000 rpm	7500,9500 & 11,500 rpm
2/40s K(100% C)	9500 rpm	7500,9000 & 11,500 rpm

From the 20 assembled yarn cheeses , doubling was carried out after verifying that the conditions of machines were normal and samples were collected for study of yarn quality of doubled yarn.

4.5. COMPARISON OF YARN QUALITY :

The yarn path, contact material and points in the TFO system being different from that of ring doubling, a quality comparison study of yarn should

cover the following besides basic characteristic of yarn quality such as, Lea count, Lea strength and TPI.

- (i) Single yarn strength (RKM) and its CV.
- (ii) Breaking Elongation % and its CV.
- (iii) Hairiness count and its CV.

The details about the sample size and equipment used for testing are dealt in section 5. YARN TESTING.

Besides comparing yarn quality analysis is also carried out for the two different systems of doubling.

NOTE

During the survey of Machine condition prior to the study, it was revealed that the rings installed on the ring doubler were more than 10 years old. So an additional study was planned by replacing the old rings with new ones and take the comparative study for the above two counts already selected. Unfortunately at the time of replacement of ring, the factory was not running the above count and so trial with new ring was taken only with the available near by count 2/32s K(100% Cotton) and under the optimum TFO spindle speed.

5. TESTING

The yarns doubled on ring doubler and TFO machines are tested for the following basic and other Important characteristics.

Basic Characteristics :

- (i) Lea count :mean and CV.
- (ii) Strength :mean and CV.

Other Characteristics :

- (i) Single yarn strength - Tensorapid - mean and CV.
- (ii) Hairiness test - Zweigle G 565 -mean for 1,2,3,4,6&8mm length and CV.
- (iii) U % - Uster Tester 4.-mean and CV.

5.1 SINGLE YARN STRENGTH (USTER TENSORAPID - 3)

Ten out of 20 baby cones of each sample was taken and the Single yarn Strength was checked. The single yarn strength was found out using the USTER TENSORAPID 3.Ten tests were conducted on each baby cone.

Thus a total of 100 tests were done and the mean value, standard deviations, CV % and 95 % confidence level for each group of 10 baby cones was found out and then the over all results are tabulated and analysed(see tables).The yarn sample were tested at a standard CRI speed of 5000 mm/min.

5.2 HAIRNESS TEST - (ZWEIGLE G 565)

Ten baby cones out of 20 of each sample were taken and checked for hairiness in a Zweigle G 565. One test length of 100m was taken per baby cone and the mean value, standard deviation. CV value , 95% confidence level and number of hairs of different lengths were taken, tabulated and analysed for a group of 10 baby cones.Hair length of 1,2,3,4,6&8mm were counted(see tables).

5.2 LEA COUNT AND STRENGTH-(RMW LEA STRENGTH TESTER)

The Lea CSP was tested on a computer aided RMW lea Strength tester working on a CRT Principle (12" /min).Mean count,mean strength and its CV were found out for each group of each sample and the results are tabulated(see tables).

5.4 YARN UNEVENNESS (USTER TESTER 4)

Yarn unevenness was tested using USTER TESTER-4. A testing speed of 400 m/min was employed. Ten tests were taken for each baby cone. Results obtained are tabulated (see tables).

5.5 YARN TWIST - SITRA TWIST TESTER

The number of Twist per Inch of a single yarn were tested on SITRA TWIST TESTER. The tester works on the principle of untwist and twist method. Ten tests were taken per baby cone, thus a total of 100 tests were conducted per sample. The mean TPI value and CV% were calculated and tabulated (see tables).

6. RESULTS AND DISCUSSIONS

6.1 RESULTS OF YARN CHARACTERISTICS TESTED

Result of doubled Yarn characteristics tested as per the details given in the section-TESTING are given in the enclosed tables at the end of this section.

Tables 1,2,3 give the results (mean and CV) of lea count and strength, yarn twist, U %,for all the counts studied in various machine speeds stated earlier.

For the counts 2/30^S CP/C blended yarn, the **CV of twist** is more by 37% at slower speed of TFO in comparison to ring doubled yarn.

For the medium speed, the CV of TFO yarn increases by almost 100% than that of ring doubled yarn, but further rise in speed changes the trend equal to the slower speed. Similarly increase in CV of twist is in the range of 20 to 40% for 2/40^S K (100% cotton) and 60% for 2/32^S K (100% cotton) respectively. The variation is due to variation in the spinning tension and also due to the variation in winding rate.

For the blended 2/30^S CP/C and 2/32^S K (100% cotton) yarn there is a marginal reduction in the mean lea strength realized in double yarn manufactured through TFO for all speeds in comparison to ring doubler.

But in the case of 2/40^S K (100% cotton) there is no significant change in the average CSP.

There is no significant change in the mean U⁰% in both the systems of doubling for 2/30^S (CP/C) blended yarn, even though there is a slight deterioration seen in TFO yarn for both cotton counts, Viz, 2/40^S K and 2/32^S K in comparison to ring doubled yarn.

For all the count, there is an increase in CV of U⁰% in the case of TFO yarn. This may be due to high CV of TPI which has influence on the cross sectional shape change.

Table 4,5,6 shows the results of single thread strength and elongation (Mean and its CV). There is a deterioration of 5 to 15 % in the mean strength (Rkm) realized by the doubled yarn spun through TFO in comparison to ring doubled yarn. This may be due to high CV of TPI.

No significant change in the single thread strength Rkm CV for cotton yarn, where as, for blended yarn, the Rkm CV is more for TFO for all speeds.

The breaking elongation of TFO doubled yarn is 10 to 20% more for all the speeds compared to ring doubled yarn. In the case of CV of elongation, there is no significant difference between the two systems.

The doubled yarn ring cop weighing around 80g results in around 12 - 13 knots / kg more in the cone than the TFO doubled yarn cone.

Table 7,8,9 furnishes the hairiness count for range of fiber length between 1mm to 8mm. Graphs show the trend. In the case of blended yarn, there is a reduction in mean hairiness count for all the length tested in going from lower speed 7500 to medium speed 9500 rpm. Further increase to 11,000 rpm, there is a reversal of trend. This may be due to optimum doubling tension achieved at the medium speed. At higher speed the abrasion against the contact area increases and synthetic being a high tenacity fiber protrude outside without getting sheared.

Whereas for cotton, at high speed, because of the air drag shearing action and less tenacity, the fiber gets sheared off resulting in less hairiness

count at high speed. All length mean hairiness count for the ring doubled yarn with old ring has shown a significant high value than TFO against the normally expected result.

A repeat study on count 2/32^s K (100 % Cotton) with new ring has given a low value than TFO as expected. This is due to the old ring giving a higher spinning tension and consequent abrasion.

OVERALL YARN TESTING RESULT

SAMPLE - 1 2/30^s CP/C yarn

TABLE - 1

S.NO.	PARTICULARS	TFO 7500 RPM	TFO 9500 RPM	TFO 11000 RPM	RING DOUBLER 9000 RPM
1	Average Count (Nc)	15.05	15.23	15.14	15.27
2	Average Strength (lbs)	274.50	248.66	267.98	277.05
3	Average CSP	4132	3788	4058	4231
4	Corrected CSP	4101	3759	4028	4199
5	Count CV%	1.59	1.37	2.18	1.28
6	Strength CV%	11.39	11.49	11.89	4.59
7	Average U %	8.32	8.32	8.15	7.94
8	U% CV	4.0	8.0	4.3	1.9
9	Average T.P.I	14.55	14.23	14.39	14.78
10	T.P.I CV %	2.475	3.791	2.577	1.808

SAMPLE – II 2/40^s k (100 % COTTON YARN)

TABLE – 2:

S.NO	PARTICULARS	TFO 7500 RPM	TFO 9500 RPM	TFO 11000 RPM	RING DOUBLER 9000 RPM
1.	Average Count (Nc)	19.46	19.51	19.65	20.62
2.	Average Strength (lbs)	108.6	109.31	108.88	104.00
3.	Average CSP	2135	2133	2139	2144
4.	Corrected CSP	2173	2187	2203	2209
5.	Count CV%	2.03	2.03	2.38	2.44
6.	Strength CV%	4.38	5.11	4.85	3.01
7.	Average U%	12.93	12.91	12.82	11.15
8.	U% CV	8.5	6.6	7.6	5.1
9.	Average T.P.I	21.74	21.77	21.75	20.84
10.	T.P.I CV%	5.232	6.239	5.203	4.315

SAMPLE - III 2/32^s (100 % COTTON)
TABLE - 3

S.NO.	PARTICULARS	TFO 8500 RPM	RING DOUBLER 8800 RPM
1.	Average Count (Ne)	16.46	16.13
2.	Average Strength (lbs)	148.29	174.60
3.	Average CSP	2441	2800
4.	Corrected CSP	2514	2883
5.	Count CV%	2.1	1.97
6.	Strength CV %	4.8	4.05
7.	Average U %	9.55	9.03
8.	U % CV	5.2	4.4
9.	Average T.P.I	12.77	12.18
10.	T.P.I CV %	5.788	3.525

SAMPLE - 1 2/30^S CP/C YARN

TABLE - 4:

USTER TENSORAPID - 3

PARTICULARS		TFO 7500 RPM	TFO 9500 RPM	TFO 11000 RPM	RING DOUBLER 9000 RPM
MEAN VALUE	B- FORCE (gf)	953.9	957.4	965.2	1016.4
	Elongation (%)	9.88	9.8	9.82	8.94
	RKM (kgf * Nm)	24.23	24.31	24.51	25.81
	B-work (gf.cm)	2433.6	2447.8	2496.4	2535.7
S + / -	B- FORCE (gf)	126.4	87.8	72.5	67.7
	Elongation (%)	1.13	0.79	0.55	0.66
	RKM (kgf * Nm)	3.21	2.23	1.84	1.72
	B-work (gf.cm)	526.0	385.0	293.3	289.0
CV %	B- FORCE (gf)	13.25	9.17	7.51	6.66
	Elongation (%)	8.01	8.11	7.61	7.33
	RKM (kgf * Nm)	8.25	9.17	7.51	6.66
	B-work (gf.cm)	21.62	15.73	11.75	11.40
Q 95% + / -	B- FORCE (gf)	25.1	17.4	14.4	13.4
	Elongation (%)	0.22	1.16	0.11	0.13
	RKM (kgf * Nm)	0.64	0.44	0.37	0.34
	B-work (gf.cm)	104.4	76.4	58.2	57.3

SAMPLE – II 2/40^sk (100 % COTTON YARN)
TABLE – 5:

USTER TENSORAPID-3

PARTICULARS	TFO 7500 RPM			TFO 9000 RPM			TFO 11500 RPM			RING DOUBLER 9500 RPM						
	B-FORCE (gf)	Elongation (%)	RKM (kgf * Nm)	B-work (gf.cm)	B-FORCE (gf)	Elongation (%)	RKM (kgf * Nm)	B-work (gf.cm)	B-FORCE (gf)	Elongation (%)	RKM (kgf * Nm)	B-work (gf.cm)	B-FORCE (gf)	Elongation (%)	RKM (kgf * Nm)	B-work (gf.cm)
MEAN VALUE	414.4	6.12	14.03	661.1	444.9	6.19	15.07	701.2	439.9	5.63	14.89	653.9	420.4	5.09	14.23	598.6
	53.3	0.57	1.80	127.4	56.8	0.60	1.92	129.0	69.6	0.55	2.36	145.3	53.3	0.48	1.80	120.7
	12.86	9.31	12.86	19.28	12.77	9.64	12.77	18.40	15.81	9.83	12.81	22.23	12.68	9.47	12.68	20.16
	10.6	0.11	0.36	25.3	11.3	0.12	0.38	25.6	13.8	0.11	0.47	28.8	10.6	0.10	0.36	23.9
CV %	10.6	0.11	0.36	25.3	11.3	0.12	0.38	25.6	13.8	0.11	0.47	28.8	10.6	0.10	0.36	23.9
	12.86	9.31	12.86	19.28	12.77	9.64	12.77	18.40	15.81	9.83	12.81	22.23	12.68	9.47	12.68	20.16
	53.3	0.57	1.80	127.4	56.8	0.60	1.92	129.0	69.6	0.55	2.36	145.3	53.3	0.48	1.80	120.7
	414.4	6.12	14.03	661.1	444.9	6.19	15.07	701.2	439.9	5.63	14.89	653.9	420.4	5.09	14.23	598.6
Q 95% + /	10.6	0.11	0.36	25.3	11.3	0.12	0.38	25.6	13.8	0.11	0.47	28.8	10.6	0.10	0.36	23.9
	12.86	9.31	12.86	19.28	12.77	9.64	12.77	18.40	15.81	9.83	12.81	22.23	12.68	9.47	12.68	20.16
	53.3	0.57	1.80	127.4	56.8	0.60	1.92	129.0	69.6	0.55	2.36	145.3	53.3	0.48	1.80	120.7
	414.4	6.12	14.03	661.1	444.9	6.19	15.07	701.2	439.9	5.63	14.89	653.9	420.4	5.09	14.23	598.6

SAMPLE - III 2/32^S (100 % COTTON)

TABLE - 6:

USER TENSORAPID - 3

PARTICULARS		THO 8500 RPM	RING DOUBLER 8800 RPM
MEAN VALUE	B-FORCE (gf)	566.7	649.5
	Elongation (%)	6.07	5.13
	RKM (kgf * Nm)	15.35	17.59
	B-work (gf.cm)	904.8	929.8
S + / -	B-FORCE (gf)	48.9	66.1
	Elongation (%)	0.30	0.42
	RKM (kgf * Nm)	1.32	1.79
	B-work (gf.cm)	110.1	147.1
CV %	B-FORCE (gf)	8.62	10.17
	Elongation (%)	7.96	8.16
	RKM (kgf * Nm)	8.62	8.01
	B-work (gf.cm)	12.17	15.82
Q 95% + / -	B-FORCE (gf)	9.7	13.1
	Elongation (%)	0.06	0.08
	RKM (kgf * Nm)	0.26	0.36
	B-work (gf.cm)	21.8	29.2

SAMPLE – 2/30s CP/C

TABLE – 7:

HAIRNESS TESTER G- 565

PARTICULARS		TFO 7500 RPM	TFO 9500 RPM	TFO 11000 RPM	RING DOUBLER 9000 RPM
MEAN VALUE	1 mm	21305	19191	20679	25368
	2 mm	3280	2895	3186	4767
	3 mm	684	566	608	1131
	4 mm	163	124	130	324
	6 mm	5	4	3	21
STANDARD DEVIATION	1 mm	1665.93	2081.93	1186.22	1513.07
	2 mm	269.65	447.78	284.20	519.56
	3 mm	79.88	105.09	85.30	185.82
	4 mm	26.25	31.46	21.63	65.29
	6 mm	2.18	2.96	1.99	6.96
CV VALUE	1 mm	7.82	10.85	5.74	5.96
	2 mm	8.22	15.47	8.92	10.90
	3 mm	11.68	18.56	14.02	16.43
	4 mm	16.13	25.35	16.65	20.16
	6 mm	44.56	72.22	71.03	33.14
Q 95 % + / -	1 mm	5.60	7.77	4.11	4.27
	2 mm	5.89	11.07	6.38	7.80
	3 mm	8.36	13.29	10.04	11.76
	4 mm	11.54	18.14	11.92	14.43
	6 mm	31.89	51.69	50.84	23.72

SAMPLE-II 2/40^S K (100 % COTTON)
TABLE - 8

HAIRINESS TESTER G - 565

PARTICULARS		TFO 7500 RPM	TFO 9000 RPM	TFO 11500 RPM	RING DOUBLER 9500 RPM	
MEAN VALUE	1 mm	17295	17035	17006	20053	
	2 mm	2641	2198	2059	3547	
	3 mm	711	411	353	919	
	4 mm	236	80	62	271	
	6 mm	14	2	2	11	
	8 mm	0	0	0	1	
	S +/-	1 mm	1060.81	1612.62	1415.22	1378.44
		2 mm	434.55	282.83	130.79	365.24
3 mm		244.34	58.93	36.09	123.67	
4 mm		141.98	10.75	12.44	69.76	
6 mm		9.34	1.49	1.72	7.85	
8 mm		0.42	0.32	0	2.20	
CV VALUE		1 mm	6.13	9.47	8.32	6.87
		2 mm	16.45	12.87	6.35	10.30
	3 mm	34.38	14.33	10.23	13.46	
	4 mm	60.26	13.40	20.23	25.77	
	6 mm	69.16	87.91	114.40	68.25	
	8 mm	210.82	316.23	0	275.13	
	Q 95 % +/-	1 mm	4.39	6.78	5.96	4.92
		2 mm	11.78	9.21	4.55	7.37
3 mm		24.61	10.26	7.32	9.64	
4 mm		43.14	9.59	14.48	18.45	
6 mm		19.50	62.93	81.89	48.86	
8 mm		150.91	226.36	0	196.94	

SAMPLE - III 2/32^s (100 % COTTON)
TABLE - 9

HAIRNESS TESTER G - 565

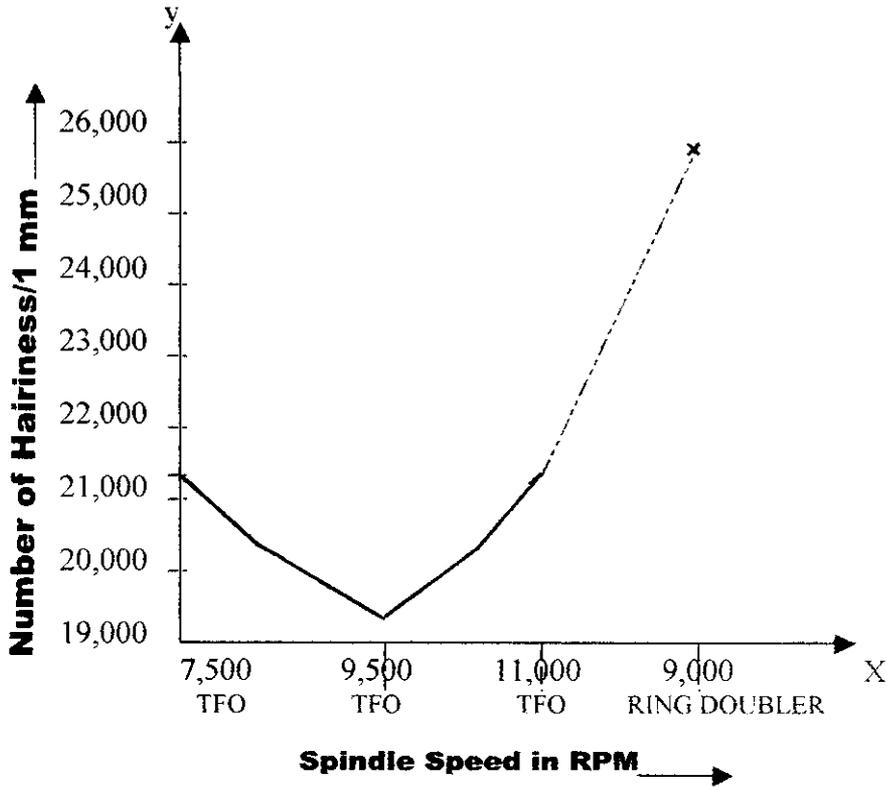
PARTICULARS		TFO 8500 RPM	RING DOUBLER 8800 RPM
MEAN VALUE	1 mm	31905	26616
	2 mm	5201	4696
	3 mm	1345	1384
	4 mm	358	489
	6 mm	11	31
STANDARD DEVIATION	1 mm	1379.32	1147.15
	2 mm	356.48	360.74
	3 mm	241.65	170.88
	4 mm	100.37	86.18
	6 mm	6.15	9.44
CV VALUE	1 mm	4.32	4.31
	2 mm	6.85	7.68
	3 mm	17.96	12.35
	4 mm	28.08	17.64
	6 mm	56.46	30.75
Q 95% + / -	1 mm	3.09	3.09
	2 mm	4.91	5.50
	3 mm	12.86	8.84
	4 mm	20.10	12.63
	6 mm	40.42	22.01

GRAPHS

SAMPLE - I 2/30^S (CP/c)

HAIRNESS V/s SPINDLE SPEED

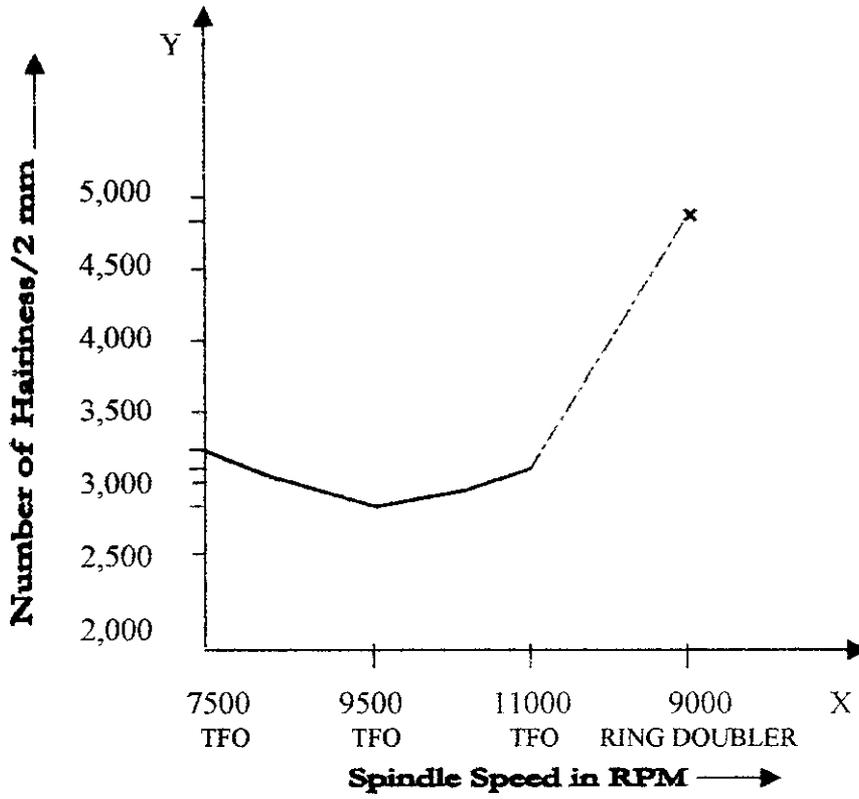
1.1



Note : ----- Ring Doubler
 ————— TFO

HAIRNESS V/s SPINDLE SPEED

1.2

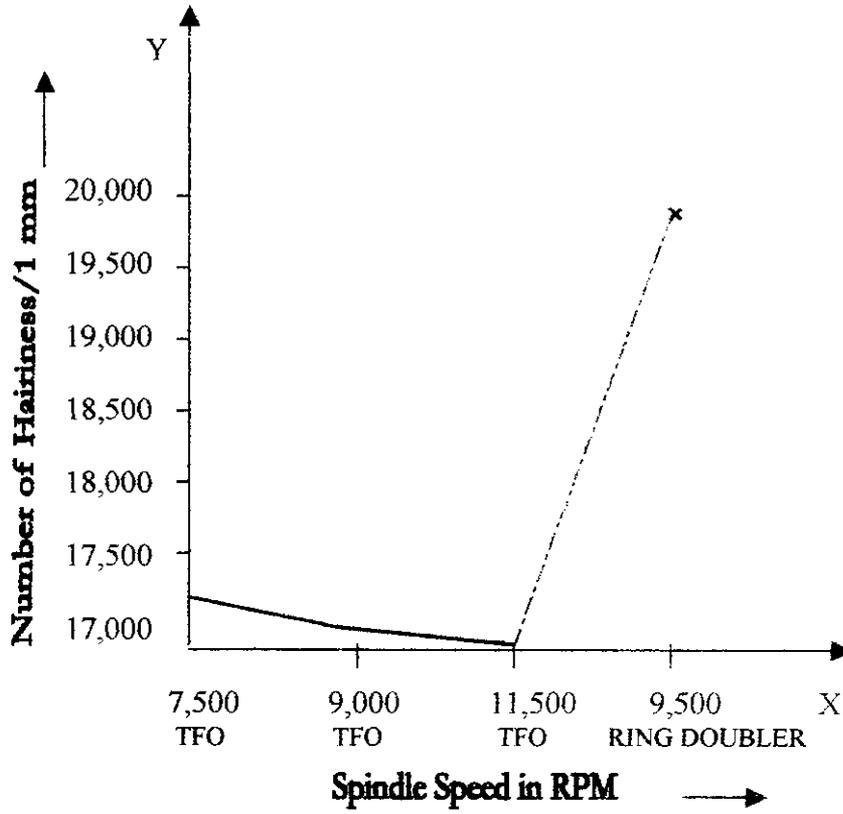


Note : - - - - - Ring Doubler
 - - - - - TFO

SAMPLE – II – 2/40^S K (100 % COTTON)

HAIRNESS V/s SPINDLE SPEED

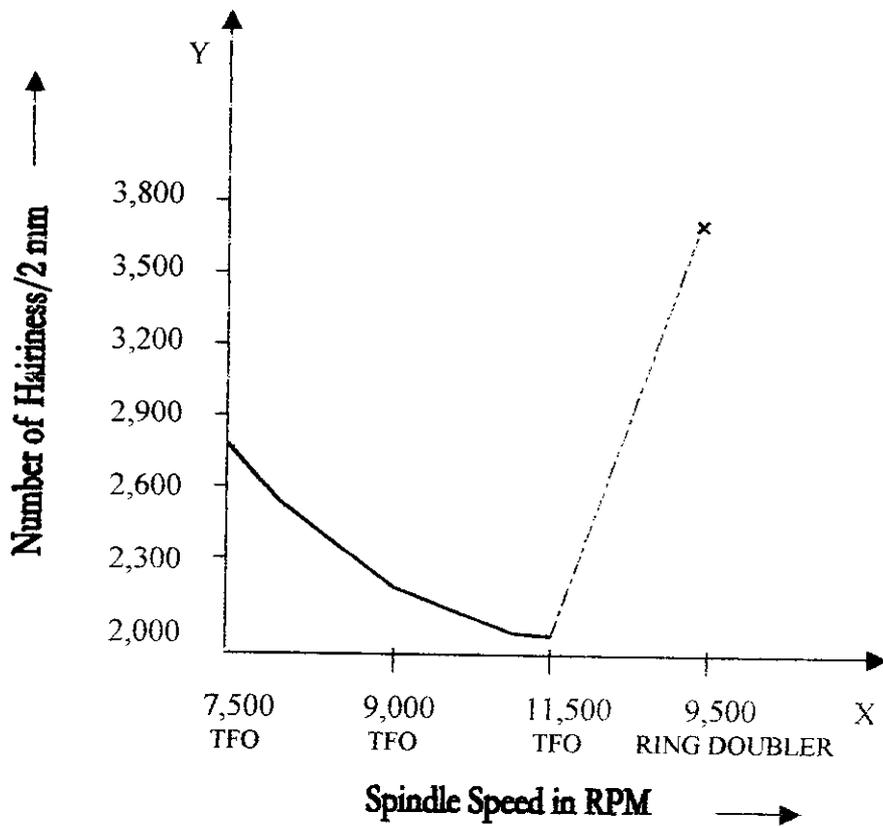
2.1



Note : ----- Ring Doubler
 ————— TFO

HAIRINESS V/s SPINDLE SPEED

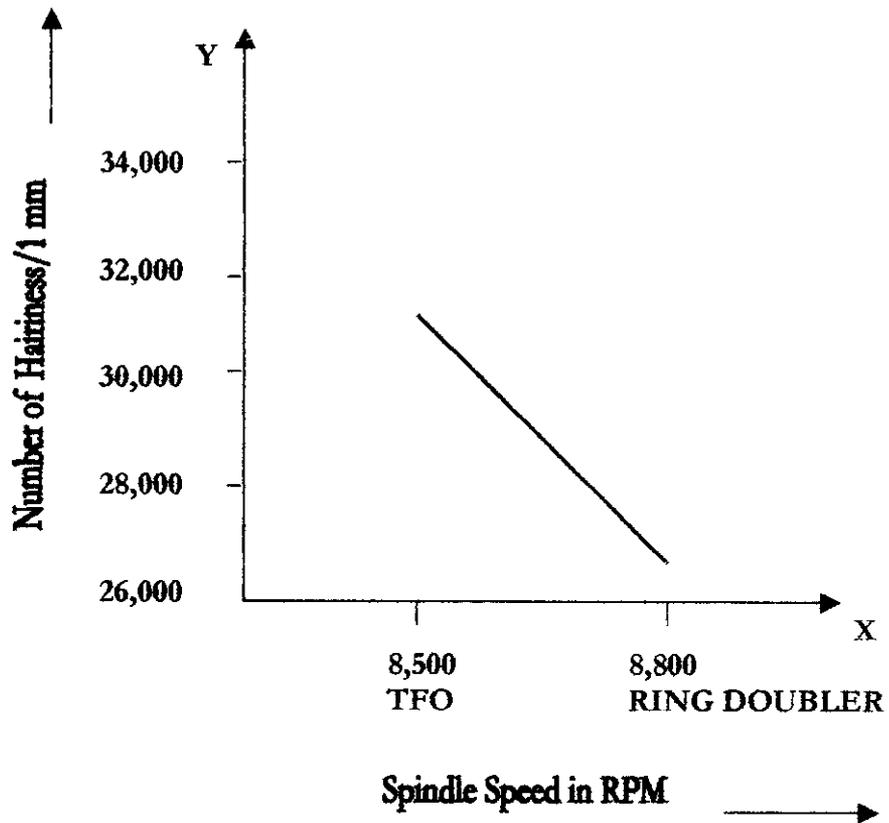
2.2



Note : ----- Ring Doubler
 ————— TFO

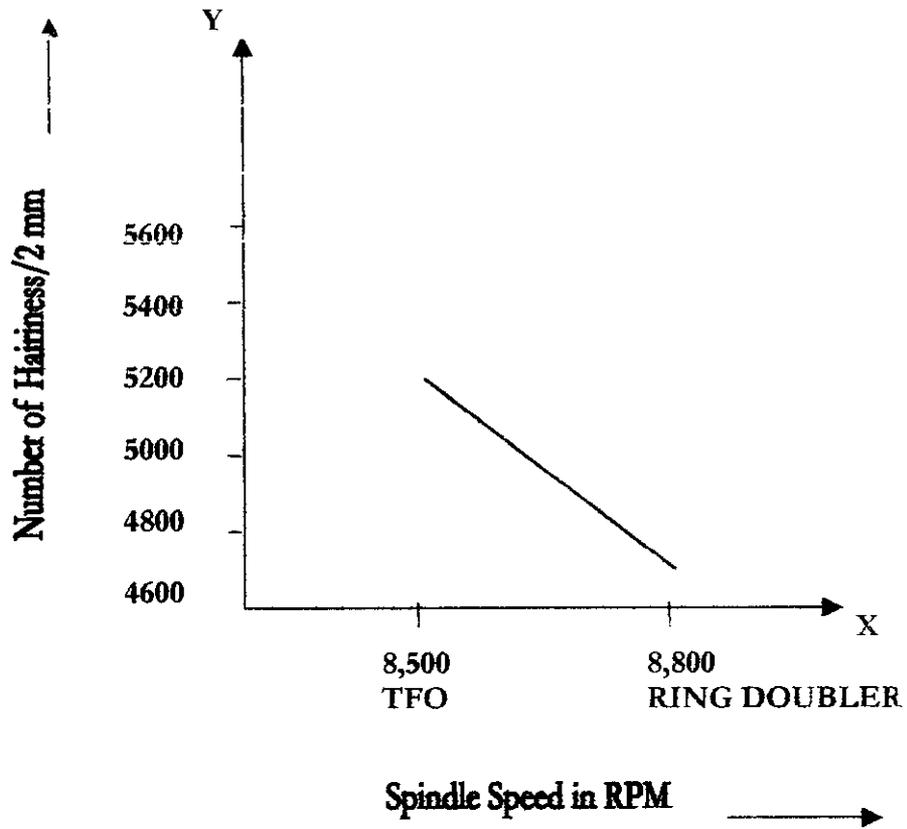
HAIRINESS V/s SPINDLE SPEED

3.1



HAIRINESS V/s SPINDLE SPEED

3.2



7. CONCLUSION

From the study and subsequent analysis of results the following conclusions may be drawn.

- CV of twist is high for all speeds of TFO compared to ring doubling upon the material.
- There is a marginal reduction in mean lea strength realized in TFO for all speeds in comparison to ring doubler even though in some cases it is not significant.
- There is a deterioration in the mean single yarn strength (Rkm) realized by TFO yarn compared to ring doubled yarn.
- Breaking elongation of yarn is high for all the speeds of TFO in comparison to ring doubled yarn.
- There is no significant change in the mean U% between two systems but the CV of U% is high for TFO yarn.

- For a blended yarn, a reduction in hairiness count of length between 1 to 8 mm is noticed at the initial stage of increase in speed between 7500 rpm to 9000 rpm and subsequent increase in speed results in the increase in hairiness. But in the case of cotton count, higher the speed less is the hairiness count for all the length between 1 to 8 mm.

- Less knots for a TFO doubled yarn compared to ring doubled yarn.

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9.ANNEXURE

ECONOMIC ANALYSIS

A detailed economic analysis has been tabulated for comparing ring doubled yarn and TFO yarn. The different aspects such as cost of machine, production, capital-cost, power cost, wage- Cost, reeling wages etc were considered and the different values were tabulated.

ECONOMIC ANALYSIS

	TFO	RING DOUBLER
Cost of Machine [Rs]	10 Lakhs	5.5 Lakhs
No.of Drums / Machine	144	400
Production / drum [gms]	320	160
Production / Machine / Shift [Kgs]	46.08	64
Production / day / machine [Kgs]	138	192
Capital cost [20%] Rs to be recovered	2.0 Lakhs	1.1 Lakhs
Capital cost / day Rs	547.9	301.3
Capital cost / Kg Rs	3.96	1.569
Power required / machine	30 Hp	12 Hp
Units required / machine	360	144
Power cost / day [Rs]	1440	576
Power cost / Kg [Rs]	10.43	300
Production / operative / shift	92 Kgs [2 m/c]	192 Kg [3 m/c]
Wage cost / Kg [Rs]	0.65	0.31
Rewinding Cost	Nil	Rs. 2 / Kg
Reeling production / operative	1.09	1.33

Consolidated :		
Capital / Kg	3.96	1.569
Power / Kg	10.42	3.00
Wage / Kg	0.65	0.31
Rewinding cost / Kg	-	2
Reeling wage	1.09	1.33
Total	16.12	8.209
Difference		7.911

