INFLUENCE OF PROCESS PARAMETERS ON YARN QUALITY IN HIGH SPEED WINDING MACHINES

PROJECT REPORT

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CERTIFICATE

This is to certify that the project report entitled

Influence of Process Parameters on Yarn Quality

in High Speed Winding Machines

has been submitted by

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In partial fulfillment for the award of the degree of Bachelor of Technology in Textile Technology of the Bharathiar University, Coimbatore – 641 046, during the academic year 1998-99.

24/3/99

Guide

Head of the Department

Certified that the above candidate was examined by us in the project work viva-voce examination held on 24/3/99 ***and the University Register No. is*** __________.

Internal Examiner

External Examiner

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ABSTRACT

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Global competitiveness in the manufacture of quality yarn has acquired new dimension with the introduction of auto-coners. The quality of export yarn meets the requirements of the foreign buyers.

Normally the yarn is exported in the form of cones, winding has significant influence on yarn quality.

The project deals with the effect of following process parameters on yarn quality in auto-coners.

The project deals with the effect of:

1. Varying speed of winding.
2. Varying tension while winding.
3. Comparison of yarn quality and imperfections between the ring yarn and cone yarn.
4. Analysing the increase in imperfections after auto-coner.
5. Suggesting optimum speed and tension which improves the yarn quality in auto-coner.

The quality parameters analysed were U%, Imperfection, yarn hairiness, tenacity and elongation. The study was conducted at Lakshmi Mills in Murata Mach Coner by selecting two different counts 40^s and 88^s combed. The parameters like winding tension and speeds and their effect on yarn quality were analysed. The study revealed that there was an influence of speed and tension on the above quality, parameter but it varied from count to count.

CONTENTS

INTRODUCTION

Textile materials are known for their Visco elastic behaviour, they lose strength and elasticity when subjected to stresses and strains, the loss being depended on the amount of stress and the duration for which it is applied.

During winding the combination of operational conditions such as yarn speed, yarn tension, humidity level etc influence the stresses and strains put on the yarn as well as the degree of abrasion of the yarn with different parts of the machine. Thus in turn may be expected to affect yarn properties like imperfections, hairiness, tenacity etc. In addition to abrasion there is also directional effect during winding. During spinning the yarn (fibrous mass) is twisted and wound in one direction. But during winding the yarn unwound from the cops in the opposite direction (opposite to the direction in which it is wound on the cops). Due to this directional effect some redistribution of fibres on the yarn surface takes place. This fibre redistribution can also be expected to have some impact on wound yarn quality attributes.

The development of new spinning techniques (open end, self twist etc) implies the introduction of new yarn structure in which hairiness is a parameter to be taken into account in the valuation of yarns and qualification in view of the future practical applications. Yarn hairiness is an important characteristic that affects the final specification of both produced yarn and fabrics. It is the most important for weaving by shuttleless and particularly air jet looms to decrease hairiness on account of high heald speed. Highly hairy yarn however is weavable only on slow speed looms.

If proper care is not taken, winding machines can be a major source of increasing yarn hairiness, especially for the low twisted hosiery yarns. Hairiness occurs because some fibre ends protrude from the yarn body, some of these protruding fibres form themselves into loops. Hairiness is generally caused by the shorter fibres and it definitely depends on the fibres on the outer layer of the yarns and do not directly adhere to the core. Yarn hairiness is made up of protruding ends, loops and the wild fibres.

With the increasing thrust towards yarn exports it is important that the quality of yarn meets the stringent requirements of the foreign buyers and consistency in quality is maintained for long periods of time. Yarn is normally exported in cone form and it is therefore necessary that the export yarn meet the requirements after winding.

Excessive hairiness not only adversely affects the performance of yarn during weaving especially on high speed looms and shuttleless looms as well as during knitting, but also adversely affects the fabric appearance. Hairiness leads to poor shed formation during weaving.

Hairs of neighbouring yarns get entangled and do not permit the alternate set of warp threads to cross neatly and to form a clear well separated shed. This entanglement of protruding hairs also leads to formation of stitches in the woven fabrics as well as breaks in the loom shed. The hairiness is also known to create undesirable influence like weft stripeness in fabrics and shade variation in yarn dyeing.

INTRODUCTION:

Over the last few years there has been an increase in the number of faults attributed to yarn hairiness and this has led to demands for control of this somewhat elusive yarn property. This chapter summarises important published literature which deals with the imperfections and hairiness of cotton yarn in it's different aspects such as it's measurements, it's nature, the parameters proposed for expressing it, the influence of fibre characteristics and mechanism of reducing hairiness.

1.1 SITRA SCAN:

K.P.Chellamani & co (1) conducted a study on influence of winding tension, winding speed, effect of ring spun yarn quality on imperfection raise & effect of wax on imperfection increase on latest high speed auto winders for the following materials:

i. Cotton counts – 16^s carded to 100^s combed
ii. Viscose yarns – 20^s to 40^s
iii. P/V & P/C yarns of popular counts

The work revealed the following:

1. Winding increases frequent imperfections and hairiness in spun yarn due to abrasion, stretching and directional effects.
2. The extent of increase due to winding is influenced by parameters like type of yarn, and it's basic quality attributes, winding conditions maintained, use of tension controllers, package weight maintained, usage of wax, humidity conditions in the department.
3. When winding tension is maintained from 8-10% of single yarn strength, the deterioration in yarn quality is minimal, at this condition the imperfections increases after winding and is about 15 to 20% in coarse/medium counts and 30-40% in fine and super fine counts.
4. The yarn quality deterioration due to winding is influenced by the level of imperfections and hairiness in ring yarn.
5. Use of tension controllers in auto winding machines helps to increase the winding speed by 10-12% without any deterioration in yarn quality.
6. When the wound yarn is waxed there seems to be minimal of no increase in imperfections after winding.
7. The practice of maintaining higher cone weights of 2-2.5kgs adversely affects the imperfections increase during winding at the initial stages of cone formation.

1.2 ATIRA SCAN:

R.R.Kanungo (4) conducted a study on various influence in factors like tension level, winding speed, condition of tension shoe, waxing & unwinding accelerator at winding on modern automatic cone winding machine for 30^s cotton hosiery yarn and revealed the following:

1. The winding speed need not be reduced for controlling yarn hairiness.
2. The winding tension should be maintained at the lowest level.
3. Tension shoes should be cleaned thoroughly and frequently and any worn out tension shoes should be replaced immediately.
4. Unwinding accelerator should be used and it's setting and alignment should be properly maintained.
5. Proper quality wax should be used for reducing yarn hairiness.

1.3 NATURE OF HAIRINESS:

The classification of the protruding fibres as proposed by Morton and further adopted by Barella (5) to explain the contribution of each type of fibre on the surface depicting hairiness, is explained in figure (A).

If an enlarged yarn profile is projected on to screen, it is easy to verify that hairiness is formed by,

a) The protruding fibre ends.

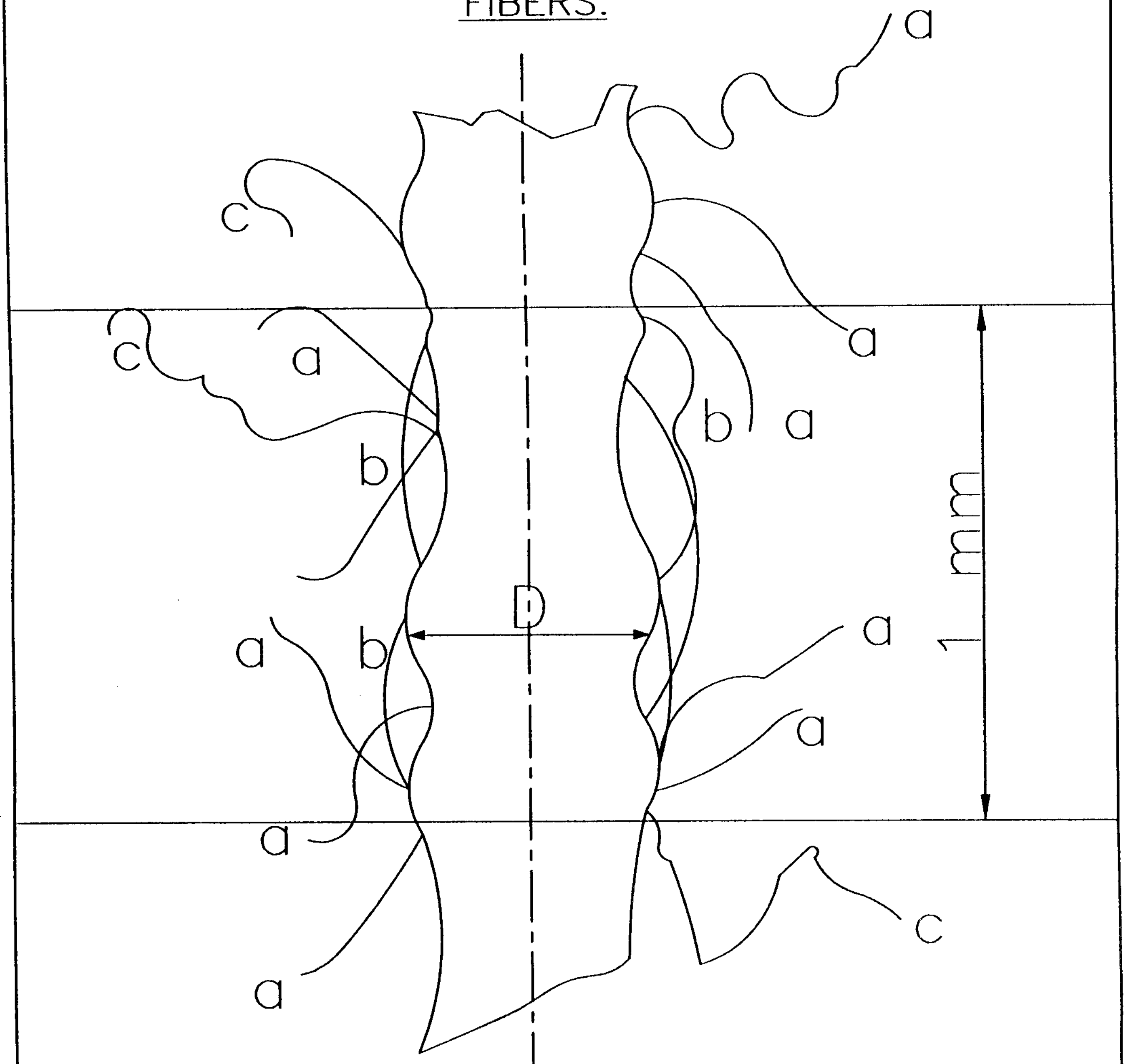
b) The looped fibres arched out of the yarn surface.

c) The fibres called by Morton fibres.

Protruding fibres as shown in fig (A) covering the yarn surface are termed as hairs. When the ribbon shaped flat strand of fibres comes out of the drafting zone of the ring frame and gets twisted into the yarn form, the fibres as well as loops emerge out of the main yarn body. The degree of yarn hairiness is dependent on the number of these fibre ends and loops protruding out of the yarn body as well as their lengths, this characteristics of hairiness is existent to some extent in all yarns spun from staple fibres. Therefore some amount of hairiness in yarn is unavoidable as well as acceptable, however excessive hairiness is undesirable.

A comprehensive survey of the literature on the hairiness of yarns is presented by A.Barella (7). The techniques used in the measurement of hairiness are classified and discussed in detail. The parameters used to express hairiness and to drive the theory of hairiness are considered. The effects on hairiness are discussed of fibre and yarn characteristics, different spinning processes and process subsequent to spinning (winding, singeing, bleaching, dyeing and sizing).

YARN SHOWING PROTRUDING FIBER ENDS, LOOPS, AND WILD FIBERS.



a= PROTRUDING FIBRE ENDS
b= FIBER LOOPS
c= WILD FIBERS

FIGURE:A

1.4 MEASURING TECHNIQUE:

1.4.1 OPTICAL METHOD:

In optical methods discussed by A.Barella (5), the magnified yarn profile on a large screen, the enlargement being 80 to 100X (Though in some instances a magnification of 200X has been reached) and in determining hairiness by counting in a unit length (1mm).

1.4.2 PHOTOGRAPHIC METHOD:

In photographic methods discussed by A.Barella, sample is selected at random 36 yarn length and photographed then by means of a microphotography device the magnification being 8X immediately afterwards the negatives were examined by means of a microfilm reader, so that the actual magnification was 45X. The longitudinal image of yarn of a screen was divided to two eight parts of which extremes were discarded because of the difficulty experienced in determining number of fibres they contained (6).

1.4.3 PHOTOELECTRIC METHOD:

In photoelectric and related methods discussed by A.Barella based on the measurement of yarn diameters projected on to a screen, the diameter of the yarn core being determined by a photoelectric device. When the diameter is photometrically computed the values of this parameter are affected by the hairiness. The ratio of the two diameters is a measure of hairiness (the coefficient of hairiness) (7).

1.4.4 METHOD BASED ON ELECTRICAL CONDUCTIVITY:

Electrical conductivity method is based essentially on raising hairs on end by means of a high voltage electric field. The yarn is passed through two electrodes and the hairiness is measured by the intensity of curving by which the protruding hairs touch the wall. The result is given as an index of hairiness proportion to the current in yarn.

1.4.5 WEIGHING TECHNIQUE:

In weighing technique the difference in the weight of the given length of yarn before and after the elimination of hairiness is by means of singeing (8).

1.4.6 YARN HAIRINESS METER:

W.Walton (16) narrated a procedure to be used in yarn hairiness meter and discussed the effect of spinning conditions on the hairiness yarns spun from cotton and man-made fibres. He found the difference in yarn hairiness between bobbins of nominally identical yarns. He suggested systematic sampling procedure for reliable results. Also we revealed that the eccentricity of spindles at the ring frame led to increased yarn hairiness and spindle speed had little effect on the yarn hairiness.

1.5 CONTROL OF YARN HAIRINESS:

1.5.1 PRESSURE SPINNING:

In the present investigation, the main method of suppressing hairiness is by the application of a higher air pressure and under this condition spinning is allowed to progress (13).

The yarn from the nip of the front roller is taken through a small jacket which has an inner jacket. Compressed air fed into the outer jacket escapes into the inner jacket through four holes.

The spinning yarn passes through the tube as it reaches the ballooning area through a lappet, the schematic drawing in figure shows the set up, the compressed air passes through the air passage and escapes through the yarn passage holes provided in the top and bottom covers of the tubes and indicated as the yarn inlet and outlet in the figure (B).

The spinning was done on a SKF spin tester and PK 225 top arm drafting system.

The pressure jacket was kept at a distance of about 4cm from the front roller nip. Better results could be possible if the experimental arrangement were closer to the front roller nip.

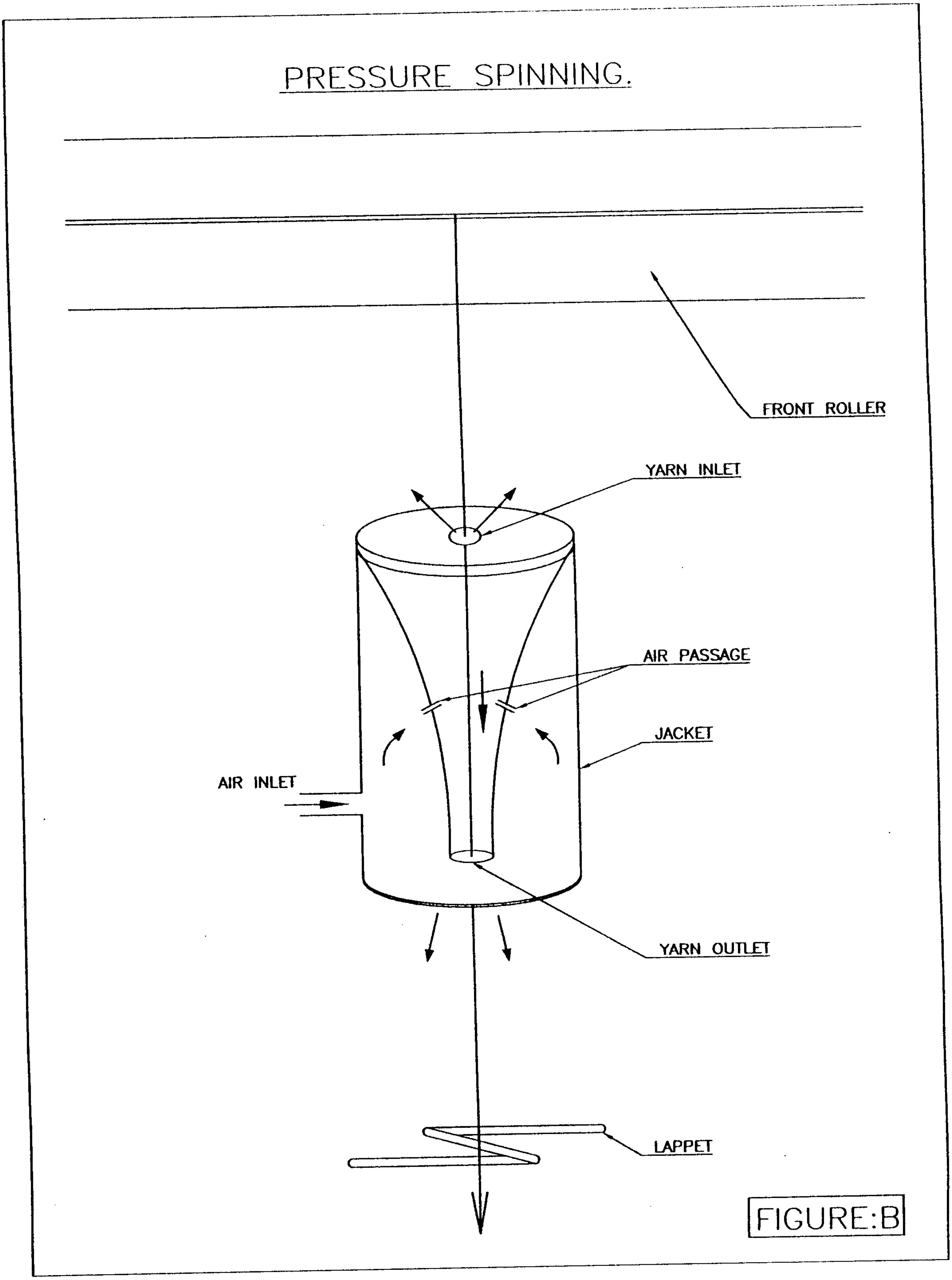

PRESSURE SPINNING.
FRONT ROLLER
YARN INLET
AIR PASSAGE
JACKET
AIR INLET
YARN OUTLET
LAPPET

FIGURE:B

With the set up used end breakage mending is difficult and piecing was achieved by inserting a wire through the yarn inlet and outlet. In the present design the yarn received twist under high pressure conditions inside a chamber made from a trumpet.

This arrangement may not perhaps be the best solution for commercial usage and engineering solutions have to be sought to make the piecing faster (13).

1.5.2 AIR JET ATTACHMENT IN WINDING:

The winding process tends to promote yarn hairiness a determental effect that can be significantly reduced by adding a air jet nozzle.

The yarn hairiness can be reduced if the air flow spirals along the yarn in a general direction opposite that of the yarn traverse to suppress the majority of protruding fibre ends.

Wrapping of protruding fibre ends around the yarn and removal of wild fibres by the swirling air current are believed to be responsible for the reduction in yarn hairiness and tucking of fibre ends into the yarn structure.

The schematic diagram of the winding process is shown in figure (C).

The air jet attachment is positioned about 2cm in front of the Uster Classimate sensor between the yarn tensioners on a Mettler type SPE grooved drum winder the pressure of compressed air supplied to the jet nozzle was kept constant at 0.5 bar.

The yarn hairiness reduction may be most efficient if the air vortex induces an axial air flow that suppresses the majority of protruding fibre ends, bearing in mind that there is a majority of trailing ends for ring spun yarn during spinning (14).

The false twisting air vortex should be reduced the twist level just before the yarn enters the jet, so there is a loosening and tightening up of yarn structure as the yarn traverses a jet which may help to tuck the fibre ends into the yarn structure, we must admit though that these arguments are somewhat hypothetical and warrant further investigation (15).

That study also revealed that the following winding process parameters also having the major contribution in determining the yarn characteristics:

1. Variation in tension during unwinding of bobbin.
2. Alignment of bobbin.
3. Soft nose and base.
4. Yarn sloughs.
5. Unwinding accelerator.
6. Optimum tension.

A SCHEMATIC DIAGRAM OF THE WINDING PROCESS WITH AN AIR JET ATTACHMENT.

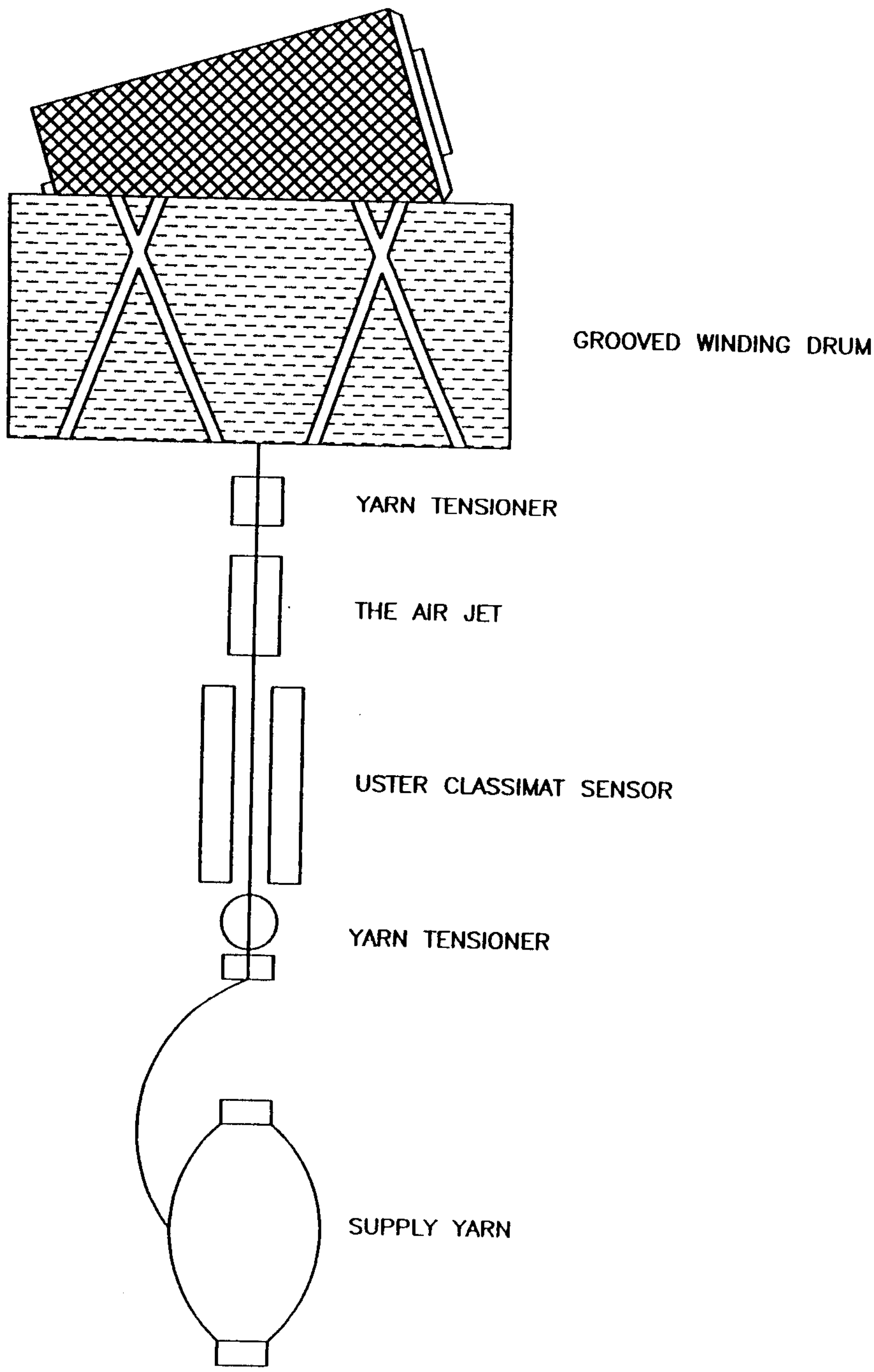


FIGURE:C

1.6 OTHER PUBLISHED LITERATURE:

A.Barella (17) investigated the sources of hairiness of cotton and their blends. For his work, the vidicon tube (18,19,20) yarn hairiness meter based on scanning the yarn through a vidicon tube was used. In his work, by influence of fibre parameters on hairiness in spinning process and yarn parameters on hairiness were studied and he concluded that

a. Fibre length influences hairiness, the longer the fibre, the smaller the total hairiness and the length of the protruding ends.
b. When the micronaire index increases, both total hairiness and length of the protruding ends decrease the more rigid the fibre, the greater the yarn hairiness.
c. Spindle speed does not influence yarn hairiness to a large extent; as the speed increases, there is a slight increase in the total hairiness and in the length of the ends
d. Travellers that are light or too heavy increase yarn hairiness. Traveller type has less influence than traveller weight, but some shapes tend to yield a greater hairiness than others.

In a study of the hairiness of cotton yarn K.P.R.Pillay (21) adopted a combined technique of singeing and microscopic technique to find out the relationship between yarn hairiness and various fibre properties. He investigated in detail about the factors that influence the preferential protruding of fibre ends towards the yarn surface by a tracer technique.

The results indicated that torsional and flexural rigidity, fibre length and fineness of cotton are significantly correlated with yarn hairiness. Further he stated that the length of protruding fibre ends and loops was influenced not only by the fibre properties of the cotton used but also by processing technique and factors of yarn quality.

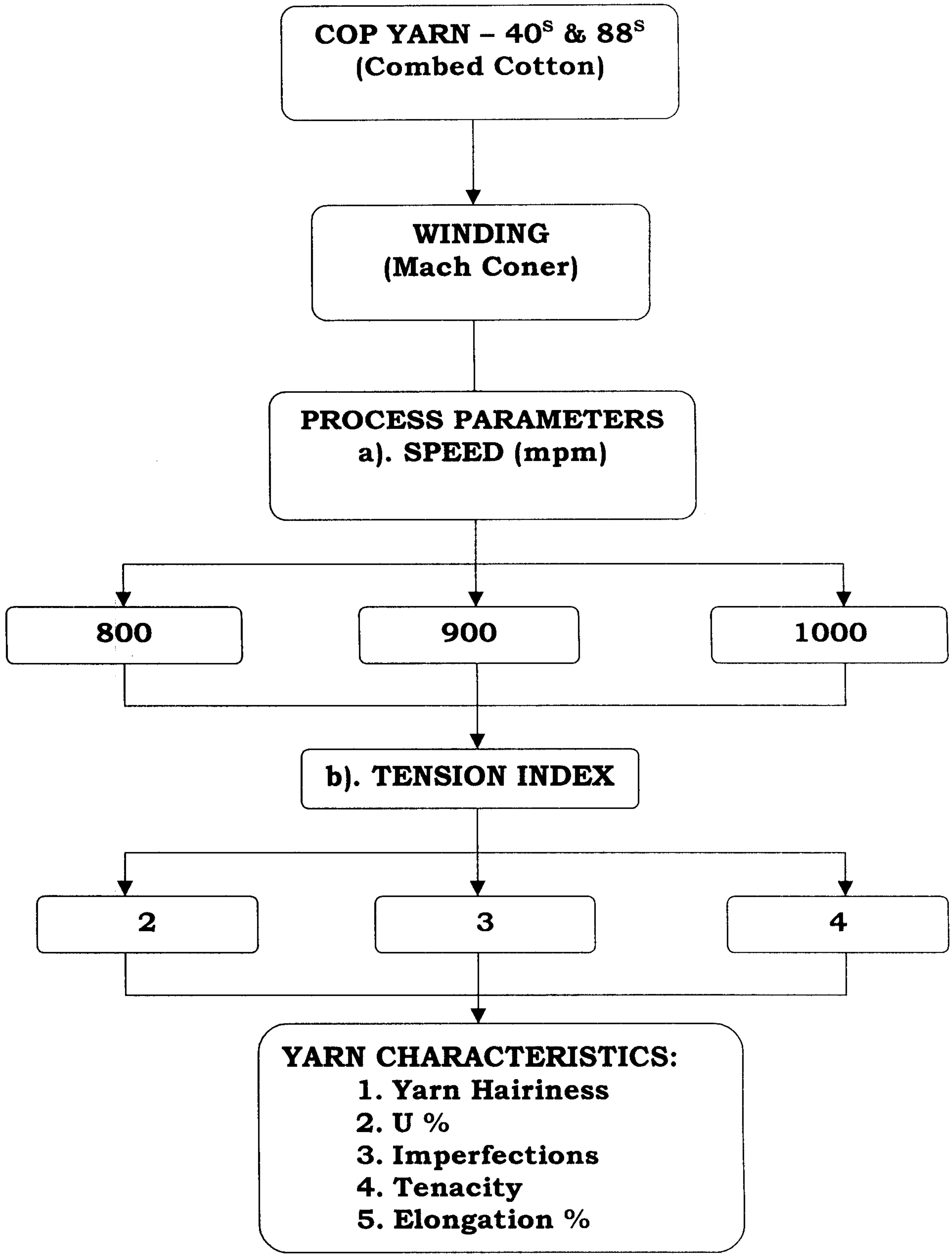
M.A.Mark (3) summarised the influence of the various ring spinning process (Appendix-3) and open-end process (Appendix-4) on yarn hairiness, and he revealed that the hairiness in yarn reduces as the weight of the traveller used increases.

2. METHODOLOGY

2.1 MATERIALS AND METHODS

For this study 40^s and 88^s combed cotton which were running in 00the mill were chosen. Murata Mach Coner machine having versatility to run at 800 to 1000 mpm was selected to carry out the project. For each count 30 ring cops from one particular doff was chosen and the ring cops were wound in Murata Mach Coner with speeds varying from 800 to 1000 mpm. The tension index was kept at 2, 3 & 4 for the above speeds and the cone samples were tested.

A comparative study was also made in the properties at ring cop and cone stage.



COP YARN – 40^s & 88^s
(Combed Cotton)
WINDING
(Mach Coner)
PROCESS PARAMETERS
a). SPEED (mpm)
800
900
1000
b). TENSION INDEX
2
3
4
YARN CHARACTERISTICS:
1. Yarn Hairiness
2. U %
3. Imperfections
4. Tenacity
5. Elongation %

2.2 TESTING INSTRUMENTS

2.2.1 STAR EVENNESS TESTER:

By using Star Evenness Tester [Model-ST-1 PC-3] (Appendix No.1) the surface characteristics of yarns like U%, hairiness and imperfections were tested out at the test speed of 200 mpm. Three samples were selected for each yarn characteristics.

The sensitivity range selected was 100% for the evaluation time of 10 min. The hairiness count measured was the fibres protruding beyond 3mm from the staple fibre yarn body.

The mean values of the imperfections per kilometer, hair count per 100m were noted at 95% confidence range. For measuring the hairiness the hairiness sensor was clamped to the monitor in such a way that the yarn passed normally without any appreciable deviation. The regular material feed mechanism of yarn evenness tester had drawn the test material through hairiness sensor.

2.2.2 TEXTECHNO STATIMAT – M TESTER:

To find out the tenacity and elongation at break Textechno Statimat – M Tester (Appendix No: 2). Thirty tests were carried out for yarn tenacity and elongation at the test speed of 500 mpm. The Statimat-M had an automatic package changer for 20 yarns and which can be extended upto 50 stations using additional models.

3. RESULTS AND DISCUSSIONS

3.1 INFLUENCE OF SPEED ON YARN QUALITY

3.1.1 Influence of Speed on Imperfections:

From the table No. 5.1 & 5.3 and graph No. 5.5 & 5.10 it could be inferred that for the 40^s count increase in speed from 800 to 1000 mpm, In the step of 100 mpm result in increase in tendency for total imperfections (sum of thick, thin and Neps) for the various level of tension studied [10, 15, 20 gms]

The total imperfections / km were in the range 303 to 432 / km for 800 mpm and 375 to 535 / km for 1000 mpm.

For 88^s Ne increase in imperfections was predominant at lower tension level (10 gms) for the increase in speed from 800 to 1000 mpm.

At higher tension level the same speed increase did not show any significant increase in the imperfections.

3.1.2. Influence of speed on U%

From the table No. 5.1 & 5.3 and graph No. 5.6 & 5.11 it could be inferred that in the case of U% also there was a trend of deterioration at high speed for 40^s Ne.

In going from 800 to 900 mpm the U% at various the tension level deteriorated from 12.17 to 12.62 and 12.53 to 12.76.

For further increase in speed the deterioration was not significantly seen.

In the case of 88^s count there was a significant level of deterioration in U% seen in going from 800 – 1000 mpm at various level of tension Viz. 14.69 to 14.95 for 800 mpm against 14.92 to 15.17 for 1000 mpm.

3.1.3 Influence of speed on yarn Tenacity:

From the table No. 5.2 & 5.4 and graph 5.7 & 5.12 it could be seen that in the case of 40^s counts if the odd reading i.e. 16,59 was omitted then there is no significant change noticed in the tenacity, at various levels of speed and tension.

In the case of 88^s count if the odd reading in tenacity i.e 20.16 is omitted then there is a trend of reduction in tenacity in comparison with supply yarn noticed for increase in speed but it was more pronounced with the increase in Tension.

3.1.4 Influence of Speed on Elongation:

From the table No. 5.2 & 5.4 and graph No. 5.8 & 5.13 it could be inferred that in the case of 40^s Ne. The significant loss was noticed in breaking elongation, in going from 800 to 1000 mpm with the omission of odd reading. The loss in elongation was noticed Viz. 4.49 to 4.81 and 4.3 to 4.55.

But as in the case of finer count 88^S Ne the reduction in elongation with the increase in speed was not high compared to the influence of tension on the breaking elongation loss.

3.1.5 Influence of Speed on Yarn Hairiness:

From the table No. 5.2 & 5.4 and graph No. 5.9 & 5.14 it could be inferred that in the case of 40^s Ne, the hairiness count / 100 m shows a lower value at higher speed (i.e 1000 mpm). However the coefficient of variation on hairiness was being very high and due to the small number of samples trend was not clear with respect to speed.

The trend was also not clear for 88^s count.

3.2 INFLUENCE OF WINDING TENSION ON YARN QUALITY

3.2.1 Influence of tension on imperfection:

From the table No. 5.1 & 5.3 and graph No. 5.5 & 5.10 it could be inferred that in the case of 40^s at lower level of speed i.e. 800 mpm, the increase in tension results in the trend of increase in imperfections. But there was no trend at higher speeds.

Similarly for 88^s count at lower speeds there was an increase in imperfections with the increase in tension for 800, 900 m/min, but at 1000 mpm this trend was not reflected.

3.2.2. Influence of tension on U%:

From the table No.5.1 & 5.3 and graph No. 5.6 & 5.11 it could be inferred that in the case of 40^s at 800 m/min only increase in tension shows a deterioration in U%. At higher speed with the increase in tension there was no change noticed in the U% of yarn for the same count.

In the case of 88^s Ne. there was no significant changes in U% absorbed with the increase in tension.

3.2.3 Influence of Tension on yarn tenacity:

From the table No. 5.2 & 5.4 and graph No. 5.7 & 5.12 it could be seen that in the case of 40^s count, if the odd reading i.e 16.59 is omitted, then there was no significant change noticed in the tenacity, at various level of tensions.

But in the case of 88^s Ne. there was a marked reduction in tenacity with the increase in tension, when odd reading i.e 20.16 is omitted.

3.2.4 Influence of tension on Yarn Elongation:

From the table No. 5.2 & 5.4 and graph No. 5.8 & 5.13 it could be inferred in the case of 40^s there was a significant reduction in breaking elongation at higher speeds i.e. 1000 mpm but at lower speeds no specific trend was noticed with the omission of odd reading i.e. 5.16.

In the case of 88^s Ne. there was a marked reduction noticed in the breaking elongation with the increase in tension at all speeds.

3.2.5 Influence of Tension on Yarn Hairiness:

From the table No. 5.2 & 5.4 and graph No. 5.9 & 5.14 it could be inferred that there was no trend noticed for the various tension on the yarn hairiness for 40^s & 88^s count.

3.3 – COMPARISION OF QUALITY OF COP YARN AND CONE YARN

From the table 5.4.a. and 5.1 to 5.4 one can conclude that there is a significant increase in hairiness of cone yarn in comparison with the cop yarn for both the counts (40^s & 88^s) irrespective of winding parameters like speed and tension.

In the case of breaking elongation the difference is more between cop and cone for higher speed and tension for both the counts.

In the case of yarn tenacity the loss is more pronounced in wound yarn for finer counts.

CONCLUSIONS

4. CONCLUSIONS

From the study and subsequent discussions the following conclusions have been drawn.

1. Increase in speed results in increase in the imperfections level for the medium and fine count studied. In the case of finer count the influence is more pronounced at lower tension level.
2. The influence of tension on imperfections is more at lower winding speed for medium and fine count.
3. The U% deteriorates with the increase in speed for both the counts. The influence of tension of U% is predominantly noticed at low speed for medium count i.e. 40^s and no trend for finer count.
4. There is no influence of tenacity due to charge in speed and tension for medium count. There is a reduction in tenacity with increase in tension.
5. In the medium count, as the speed increases there is a loss in breaking elongation where as for finer count the loss in breaking elongation is more due to increase in tension rather than on increase in speed.
6. Winding increases the hairiness of yarn significantly. However, the hairiness co-efficient of variation being observed very high, no specific conclusions could be drawn on the trend of this parameter with respect to changes in speed and tension.

LEVEL OF U% AND IMPERFECTIONS

Count: 40^s Combed

Table No: 5.1

S.No.	Winding Speed in (mpm)	Tension Dial Reading	No.of Samples Tested	U%	Thin	Thick	Neps	Total Imperfections
1.	800	2	3	**12.17**	28.3	106.7	168.3	**303.3**
		3	3	**12.41**	38.3	158.3	235.0	**431.7**
		4	3	**12.62**	45.0	155.0	223.3	**423.3**
2.	900	2	3	**12.53**	48.3	166.7	273.3	**488.3**
		3	3	**12.77**	33.3	181.7	250.0	**465.0**
		4	3	**12.76**	50.0	201.7	210.0	**461.7**
3.	1000	2	3	**12.34**	48.3	145.0	271.7	**465.0**
		3	3	**12.52**	43.3	123.3	208.3	**375.0**
		4	3	**12.77**	60.00	198.3	278.3	**536.7**

LEVEL OF HAIRINESS, TENACITY & ELONGATION

Count: 40^s Combed | **Table No: 5.2**

S.No.	Winding Speed in (mpm)	Tension Dial Reading	Hair Count	Tenacity	Elongation %
1.	800	2	6967	15.19	4.9
		3	4984	15.04	4.49
		4	5865	15.07	4.81
2.	900	2	6096	15.88	4.6
		3	5721	15.48	4.73
		4	6602	16.59	5.16
3.	1000	2	4886	15.41	4.54
		3	4287	16.09	4.55
		4	4395	15.19	4.3

LEVEL OF U% AND IMPERFECTIONS

Count: 88^s Combed **Table No: 5.3**

S.No.	Winding Speed in (mpm)	Tension Dial Reading	No. Of Samples Tested	U %	Thin	Thick	Neps	Total Imperfections
1.	800	2	3	14.76	186.7	495.0	1115.0	1796.7
		3	3	14.69	193.3	600.0	1341.7	2135.0
		4	3	14.95	205.0	640.0	1230.0	2075.0
2.	900	2	3	14.31	143.3	488.3	1116.7	1748.3
		3	3	15.08	255.0	595.0	1310.0	2160.0
		4	3	14.85	166.7	546.7	1433.3	2146.7
3.	1000	2	3	14.92	238.3	601.7	1283.3	2123.3
		3	3	15.31	285.0	633.3	1153.3	2071.7
		4	3	15.17	263.3	536.7	1193.3	1993.3

LEVEL OF HAIRINESS, TENACITY & ELONGATION

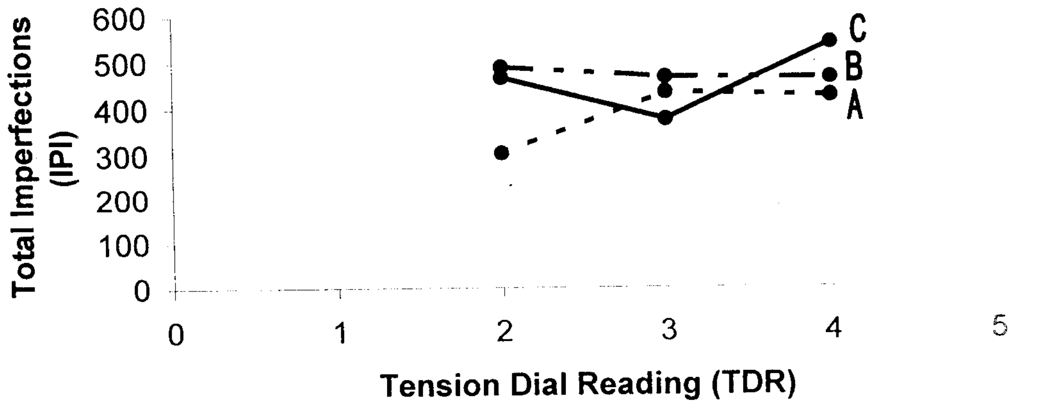
Count: 88^s Combed | **Table No: 5.4**

S.No.	Winding Speed in (mpm)	Tension Dial Reading	Hair Count	Tenacity	Elongation %
1.	800	2	2113	19.25	4.63
		3	2115	16.82	4.33
		4	1937	17.19	4.18
2.	900	2	2442	17.56	4.74
		3	2289	18.25	4.31
		4	2047	16.92	4.02
3.	1000	2	2120	17.93	4.52
		3	2119	18.0	4.34
		4	2008	20.16	4.07

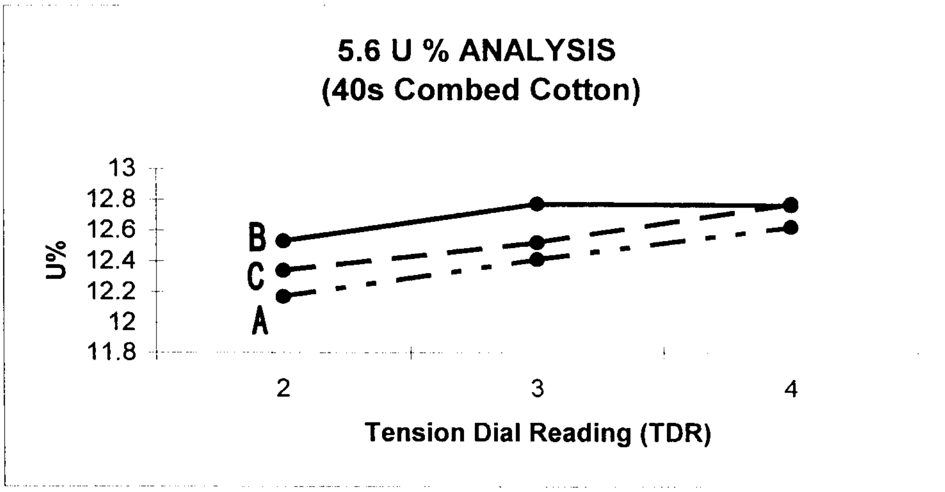
TABLE 5.4.a COP YARN TEST RESULTS

S.No.	Count	U %	Total Imperfections	Hair Count	Tenacity	Elongation %
1.	40^s	13.39	540	3030.3	15.36	4.79
2.	88^s	14.71	2565	488.3	19.22	4.54

5.5 IMPERFECTION LEVEL ANALYSIS (40s Combed Cotton)

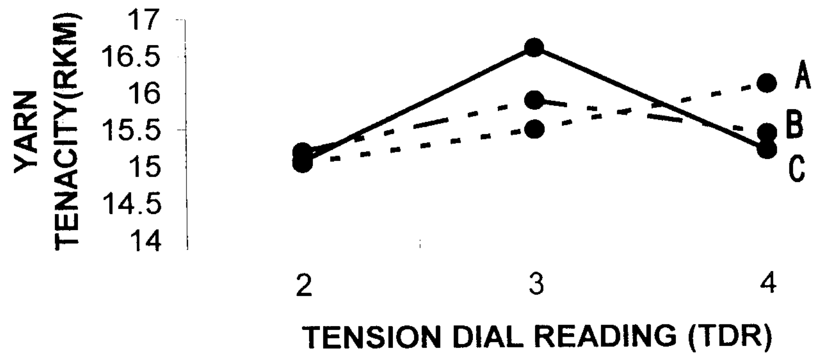


TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	303	488	465
3	432	465	375
4	423	462	537

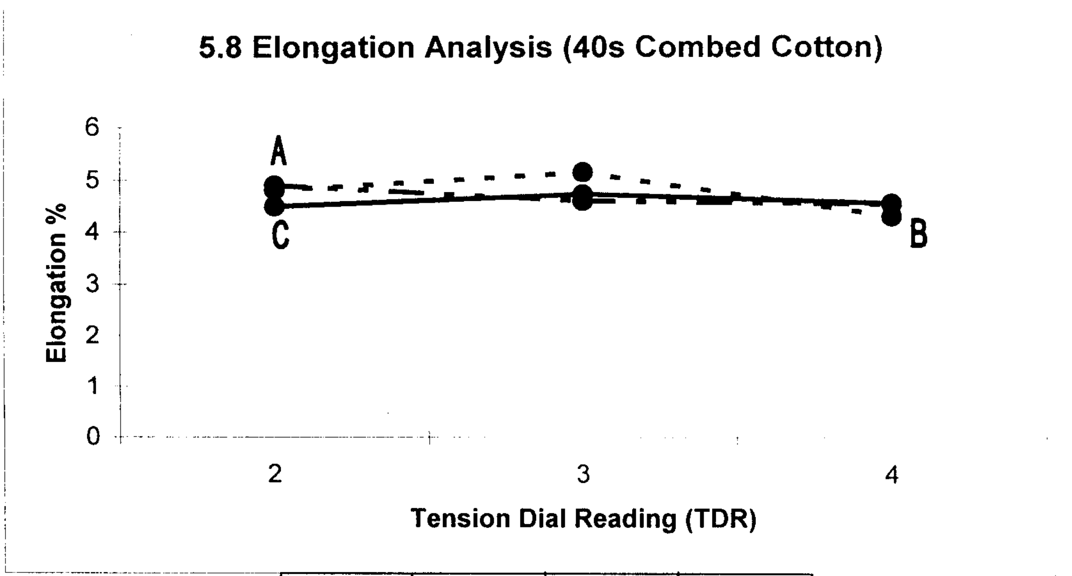


TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	12.17	12.53	12.34
3	12.41	12.77	12.52
4	12.62	12.76	12.77

5.7 YARN TENACITY ANALYSIS
(40 S Combed Cotton)

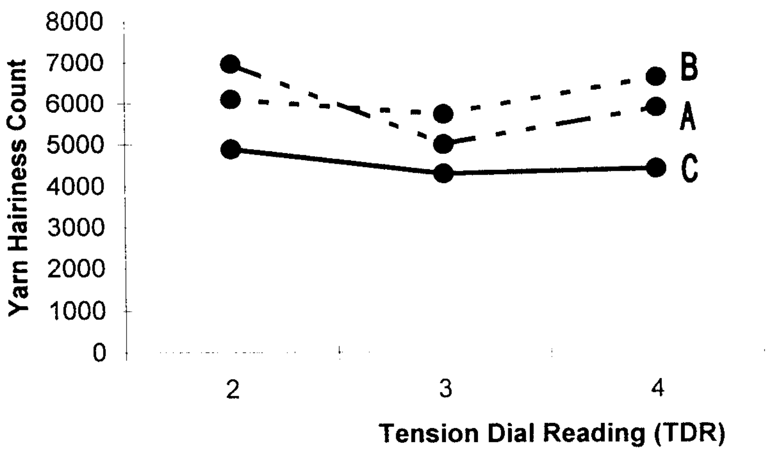


TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	15.19	15.88	15.41
3	15.04	15.48	16.09
4	15.07	16.59	15.19



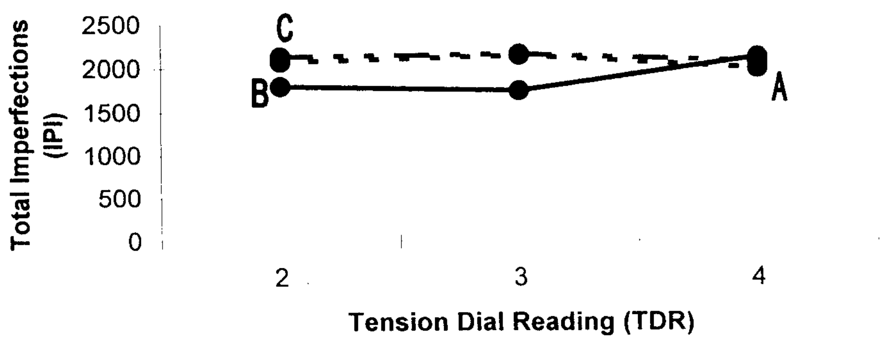
TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	4.9	4.6	4.54
3	4.49	4.73	4.55
4	4.81	5.16	4.3

5.9 YARN HAIRINESS ANALYSIS (40s COMBED COTTON)



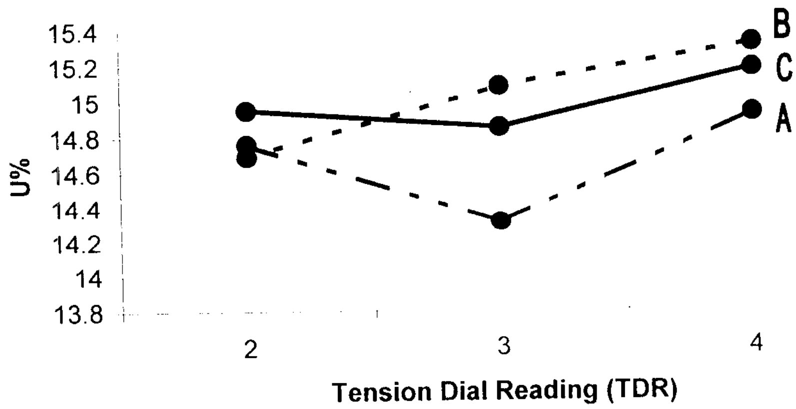
TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	6967	6096	4886
3	4984	5721	4287
4	5865	6602	4395

5.10 IMPERFECTION ANALYSIS
(88s Combed Cotton)



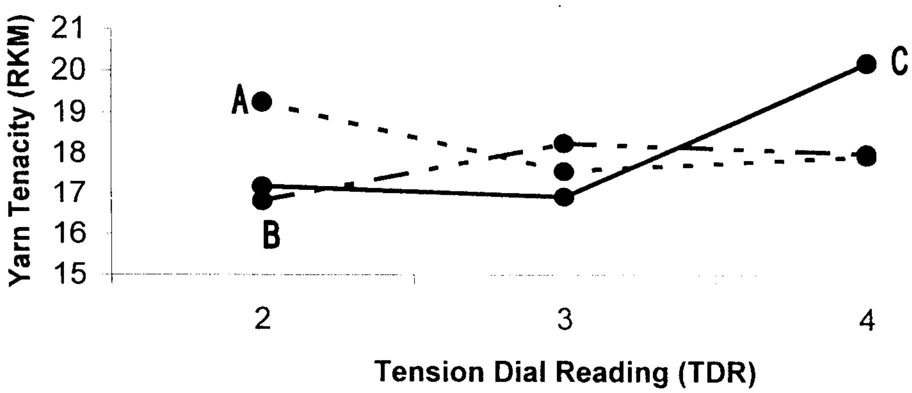
TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	1797	1748	2123
3	2135	2160	2071
4	2075	2147	1993

5.11 U% ANALYSIS (88s Combed Cotton)



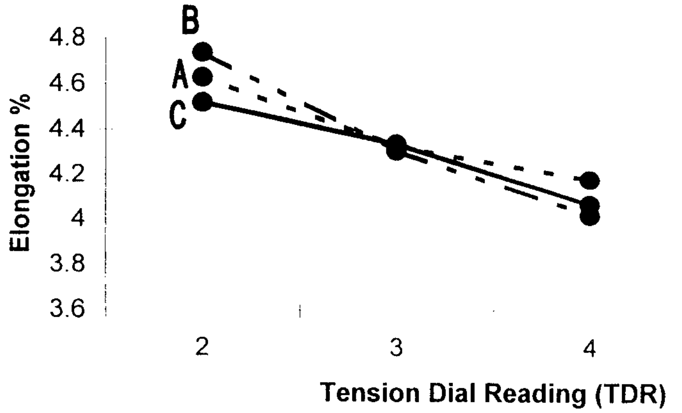
TI	A ([illegible])	B (900 mpm)	C (1000 mpm)
2	14.76	14.31	14.92
3	14.69	15.08	15.31
4	14.95	14.85	15.17

5.12 YARN TENACITY ANALYSIS
(88 s Combed Cotton)



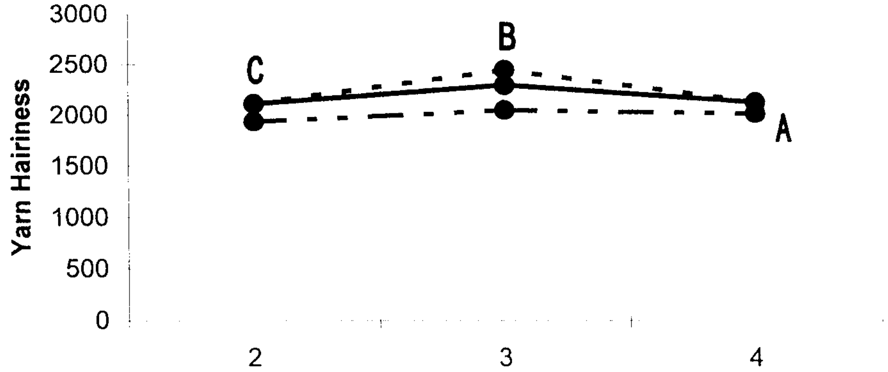
TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	19.25	17.56	17.93
3	16.82	18.25	18.00
4	17.19	16.95	20.16

5.13 ELONGATION ANALYSIS
(88s Combed Cotton)



TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	4.63	4.74	4.52
3	4.33	4.31	4.34
4	4.18	4.02	4.07

5.14 YARN HAIRINESS ANALYSIS
(88s Combed Cotton)



TI	A (800 mpm)	B (900 mpm)	C (1000 mpm)
2	2113	2442	2120
3	2115	2289	2119
4	1937	2047	2008

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APPENDIX - 1

Star Yarn Evenness Tester

Model	:	St -1 PC - 3.
Test Type	:	Normal
Slot No	:	5
Imperfections	:	-50 / 50 /200%
Speed	:	200 m/min
Range	:	100%
Time	:	1.0 min
Liner density	:	3.1 mg/ inch
Hairiness Measurement	:	Measurement, Indication and Printout of Hair count for fibres protruding beyond 3mm from the staple fibre yarn body.

Hairiness Measurement

Test speed	:	50 m/mm
Duration	:	1 min

APPENDIX - 2

TEXTECHNO STATIMAT - M TEST

Gauge Length	:	500(mm)
Load Cell	:	10 (N)
Test speed	:	500 (mm/min)
Pre-load	:	0.5 (CN/Tex)
Auto count	:	109 (m)

Limits

Elongation	Min-E	2%	Max-E	15.%
Force	Min-F	50g	Max-F	500g
Count	Min-C	30Ne	Max-C	50Ne

APPENDIX - 3

THE EFFECT OF DIFFERENT STAGES IN THE COTTON SPINNING PROCESS ON HAIRINESS

Process step	Feature of process	Influence of yarn hairiness
Draw frame	Number of drawing passages Reversal of sliver spinning from draw frame sliver.	The greater the number of passages, less hairiness. Reversal of sliver leads to less hairiness Direct spinning from draw frame sliver leads to greater hairiness.
Roving frame	Influence of roving twist	More roving twists leads to less yarn hairiness
Combing	Influence of combing	Combed yarns are less hairy than carded ones. The greater the amount of waste the less the hairiness.

	Influence of roving linear density	The greater the proportion of short fibres, the greater the hairiness. Hairiness increases with the roving linear density A double roving feed leads to more hairiness. In come cases, the influence is only slight.
Spinning	Influence of double roving	The higher the draft the greater the hairiness
	Influence of drafting system	Double-apron drafting system lead to less hairiness than roller system

		Pendulum arm systems lead to more hairy yarn than OM super draft system
	Influence of fibre control condensers in the main drafting system	The greater the fibre control during drafting (condensers)the less the hairiness. The use of condensers decrease yarn hairiness. If a condenser is placed before the delivery rollers, there is a noticeable decrease in yarn hairiness.
	Influence of spindle speed	A higher spindle speed increases hairiness. If the spinning tension is increased then hairiness decreases with increase in spindle speed.

	Influence of thread guide	Thread guide eccentricity increases hairiness
	Influence of balloon suppressor	Balloon suppressor devices greatly increases yarn hairiness.
	Influence of balloon-control rings	It reduces hairiness.

APPENDIX - 4

PROCESS FEATURES INFLUENCING THE HARINESS OF OPEN - SPUN YARNS

Process step	Features of process	Influence of yarn hairiness
Preparatory process	Four preparatory process were investigated Tandem card +two drawing passages Tandem Card Crosrol+Two drawing passages. Tandem Card+Tex control Tandem Card+Uster card control	The nature of preparatory process can influence yarn hairiness.
Drawing process	Different draw frame combinations and open end spinning machines.	Hair count level is dependent on the open end spinning machines itself.

Rotor machines	Type of machine	Type of machine can influence yarn hairiness.
	Presence or absence of combing during the pre spinning process.	There is a small difference in the hairiness of carded and combed sliver.
	Rotor feeding system	Feeding rotor by means of an open end system tends to produce less hairy yarns than the opening roller system.
	Opening roller speed	It can influence yarn hairiness slightly .Faster speed produce less hairiness.
	Rotor geometry	Rotor geometry influences yarn hairiness. Hairiness is increased when yarn friction against the rotor parts increases.

	Rotor diameter	Hairiness increases when rotor diameter increases.
	Rotor speed	Hair length increases when the rotor speed increases.
	Rotor cleaning	Trash accumulation in the rotor groove increases yarn hairiness slightly.
	Influence of twist	The influence of twist depends on the fibre ;a twist increases tends to decrease yarn hairiness but for man made fibres the difference is very small.
	Doffing tube	Grooved or fluted doffing tubes increase yarn hairiness.

	Cop building	The cop formation and winding do not influence yarn hairiness.
	Variation in relative humidity	Hairiness decreases when RH increases.