EFFECT OF FLUTE ANGLE ON RING FRAME EFFICIENCY AND YARN CHARACTERISTICS

PROJECT REPORT

Submitted by

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Register No:0920201015

in partial fulfillment for the award of degree

of

MASTER OF TECHNOLOGY

in

TEXTILE TECHNOLOGY

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE – 641 049

(An Autonomous Institution Affiliated to Anna University of Technology: Coimbatore)

APRIL 2011

BONAFIDE CERTIFICATE

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ACKNOWLEDGEMENT

I express my sincere gratitude to our beloved Co-Chairman, **Dr. B.K. Krishnaraj Vanavarayar, Dr. J. Shanmugam**, Director, Kumaraguru College of Technology and **Dr. S. Ramachandran**, Principal for their support and allowing to use the facilities of the institution.

I express my whole hearted thanks to **Dr. K.Thangamani**, Head of Department, Kumaraguru College of Technology, for having been a source of encouragement and for instilling the vigor to do the project.

It gives me great pleasure to express my deep sense of gratitude for my supervisor, **Mr.P.Thangeswaran**, Assistant Professor, Department of Textile Technology, Kumaraguru College of Technology, for his innovative guidance, expert suggestions and constant encouragement at every step for the study.

I am overwhelmingly grateful to **Mr. Ashwin Venkatraman, M.Tech., MBA.,** Managing Director, Ashwin Industries, Coimbatore and **Mr. Sasidharan,** Managing Director, Nathan Industries, Coimbatore for their guidance and help.

I thank all the teaching and non-teaching staff for their help during this project.

Words fail to express my thanks to my beloved family members and friends who are my sounding board and pillar of strength.

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ABSTRACT

In the ring frame drafting system, the front roller flute angle is 5^0 to the horizontal axis of the roller. In the curiosity of knowing the effect of altering the front roller flute angle from 5^0 to 6^0,4^0 and 3^0 on important yarn characteristics and ring frame efficiency, this project work was carried out. For this purpose, 60^s combed yarn was produced. The important yarn characteristics taken into account for the mentioned trial were Imperfections / Km, Hairiness, Classimat faults, CSP, U%, Count and strength C.V.%, Elongation, RKM, Single yarn strength, Ring frame breakages/100 spindle hour.

When the front roller flute angle was increased from 5^0 to 6^0, the improvement was noted in CSP, Count and strength C.V.%, Hairiness, classimat faults and Breakages/100 spindle hour and deterioration in U%, Imperfections/Km, Elongation, single yarn strength and R.K.M of yarn.

But when the front roller flute angle was reduced below 5^0 as 4^0 and 3^0, the improvement was noted in CSP, U%, Count and strength C.V.%, Single yarn strength, Elongation, R.K.M., Breakages/100 spindle hour and deterioration in Imperfections/Km, Hairiness and classimat faults.

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LIST OF ABBREVIATIONS

1. ANOVA	Analysis of Variance
2. mpm	meters per minute
3. rpm	revolutions per minute
4. TPI	Twist per inch
5. TM	Twist Multiplier
6. DF	Degree of Freedom
7. SS	Sum of squares
8. MS	Mean sum of squares

CHAPTER 1

INTRODUCTION

Previously in ring frames, the front rollers flute angle is 0° such as straight flutes. To avoid top roller hunting and reduce the top roller wear and tear, helical flutes are introduced in ring frames. Flute angle is 5° in latest ring frames.

Normally ring frame fluted rollers are precisely made in thread rolling machine with opposite helix flutes for zero axial thrust. Rollers made of alloy steel and precisely manufactured to determine the quality of bottom rollers, precise concentricity of bottom rollers and top rollers. Rollers completely hard chrome plated which helps to reduce the lapping.

The effect of altering the front roller flute angle from 5^0 to 6^0,4^0 and 3^0 on important yarn characteristics and ring frame efficiency, this project work was carried out. For this purpose, 60^s combed yarn was produced. The important yarn characteristics taken into account for the mentioned trial were Imperfections / Km, Hairiness, Classimat faults, CSP, U%. Count and strength C.V.%, Elongation, RKM, Single yarn strength, Ring frame breakages/100 spindle hour.

1.1 OBJECTIVES

To study the effect of change in bottom roller flute angle from 5^0 to 3^0, 4^0 and 6^0 On

- Imperfections / Km
- Hairiness
- Classimat faults
- CSP
- U%
- Count and strength C.V.%
- Elongation
- RKM
- Single yarn strength
- Ring frame breakages/100 spindle hour

CHAPTER 2

LITERATURE REVIEW

2.1 FLUTED ROLLER

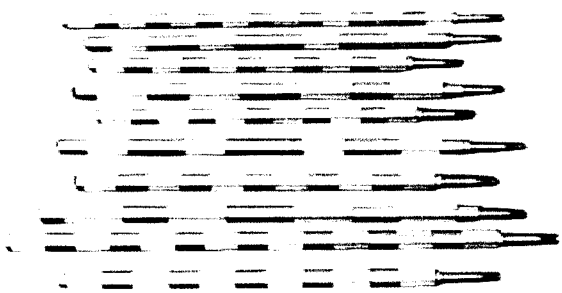


Fig. 2.1 Fluted roller

The lateral deflection of a drafting roller, which introduces eccentricity, is an important criterion in design of drafting rollers. Design against static load and torsionl rigidity (particularly for long rollers) can also be considered.

The process ability of fibres during drafting depends to a large extent on the roller-lapping tendency of the fibres being processed. The following discussion will highlight the importance of the use of large diameter drafting roller relating to controlling of the roller-lapping tendency of fibres, vibration forces on the bearings that support the drafting roller, and the roller-nip movement.

Fibres forced to bend over an element of small radius of curvature, (smaller diameter drafting roller) are subjected to more bending forces, and make large frictional contact with that element. As a result, they develop more frictional contacts with the drafting roller, which increase the tendency of roller lapping. The roller lapping will be severe with long, fine and less rigid fibres. Therefore, from the point of view of minimizing the roller-lapping tendency, the roller diameter has to be kept at maximum.

In the latest generation draw frame, the throughout speed has gone up to 600m/min and above from the present level of 250 m/min. At this high speed, the generation of negative air pressure around the surface of the drafting, roller would be high, and the roller lapping increases. Obviously, high drafting speed with smaller diameter of drafting roller further increases the roller – lapping tendency of the fibres. In addition, the loading on the rollers have been increased for the better drafting. All these lead to more bending stresses on the roller and fibres. To overcome these, the diameter of the drafting roller has to be increased. In the present day draw frame, the diameter of the front drafting rollers is increased to 52mm from 35 mm. The rotational speed has gone up to 3060 rpm from 2275 rpm.

If the diameter of the front drafting roller of the latest draw frame, were kept at 35mm, then the rpm of the roller would be 5460 rpm with a 2.4 fold increased from the level of 2275 rpm for the high delivery rate. For smooth running of drafting roller, the vibration of the drafting rollers measured at the support (bearings) should be less. Lack of roundness of rollers and the eccentricity due to fixing of the rollers in the bearings would result in vibrations at the bearings.

When drafting rollers are mounted on rolling contact bearings, there would be some eccentricity (e) between geometric center of rotation of roller(bearing axis) and the roller or journal axis due to non- roundness of rollers or inaccuracies in mounting/clearance. As a result, the drafting roller would be out of balance to a certain degree. The effect of this unbalance in terms of vibration forces or centrifugal forces on the bearings would depend on the diameter and rotational speed of drafting rollers, the effect of rotational speed is predominant than the diameter. The following illustration explains this.

The bearings would be subjected to this amount of force for every rotation of the roller. This force of vibration on the bearings can be calculated for a front roller delivery speed of 500 mm/ min with the roller diameters of 35mm and 52 mm using the above equation. When these rollers are mounted in rolling contact bearings with an eccentricity of 0.003 cm, they are subjected to a vibration force of 25.6 N. But the frequencies of the vibration are 76 and 51 cycles per second for the rollers with diameters of 35 mm and 52 mm respectively. It is clear that for smooth running of the drafting rollers, it is preferable to have large diameter. This is especially important for the front drafting roller which runs at higher rotational speed, compared to middle and back rollers. Otherwise, bearings life would come down. In addition, the deflection of the bearings due to centrifugal force of the unbalance of masses of the drafting roller would create certain amount of irregularity, in drafting the fibres due to roller nip movement.

For controlling the roller nip movement, the ratio of eccentricity to roller diameter (e/d) has to be kept low. For a given eccentricity, e/d is low for a large diameter roller than for small diameter rollers, as the eccentricity is only influenced by inaccuracies in mounting of the roller in the bearings. In addition, the radial run out of the drafting roller is also very important in controlling the drafting irregularity.

The bottom drafting rollers are made of steel. To improve their ability to carry the fibres along, they are formed with flutes of one of the following types.

- Axial flutes
- Spiral flutes
- Knurled flutes

Spiral fluting gives quieter running and more even clamping of the fibres compared to axial fluting. In addition, rolling of top rollers on spiral flutes takes place in a more even manner and with less jerking. Knurled fluting is used on rollers receiving aprons, to improve the transfer of drive to aprons. The diameters of bottom drafting rollers normally lie in the range of 25 to 50 mm. In long machines (e.g. ring spinning machines) the bottom rollers are made up by screwing together short segments of roller.

2.2 Bottom Roller Friction

When the top roller is driven through the cotton from the bottom roller, it is only the friction of the bottom roller on the cotton which is important. The top roller can be made to contribute to the roller grip by gearing it to the bottom one; the friction of the top roller surface is than added to that of the bottom roller. Another method is to use a 'metallic' top roller, the flutes of which mesh with those of the bottom roller. Both of these methods have been used, but do not seem to have become popular presumably because of their mechanical disadvantages. A simpler method of getting a better grip is to increase the friction of the bottom roller while retaining and ordinary top roller.

The friction of a bottom roller on the cotton depends on (1) The shape of the flutes and (2) the surface finish.

2.3 Flute Shape

The dimensions which determine the shape of the flutes are the angle between the flanks of the tooth and the width of the land at the top of the tooth. It will be seen that for the V-fluted roller of, the angle is reduced to 60^0 and the land to 0.007 inch. The idea behind this roller is that the teeth should penetrate into the sliver more than the ordinary teeth do, and so obtain a better grip even with a polished surface on the roller. The dimensions of the modified flutes are based on the observations that for the same land a 60 angle gives a lower critical weighting than a 90 angle, and that for the same angle the critical weighting decreases steadily as the land is reduced from 0.025 inch to 0.005 inch.

The performance of the V-fluted roller combined with a finger traverse guide is indicated in table 9, column (6) All the critical weightings are below 40 lb, but only with the finest sliver is there the required factor of safety. A further improvement is necessary. This is true for the first and second draw frame the critical weightings are half those in the table, and the combination of V-fluted rollers, finger guides and conventional draft distribution is satisfactory at this machine.

With regard to the other dimensions of the flutes, namely the depth and the pitch (the distance from one flute to the next), the depth of the V-flutes may be varied from 0.02 to 0.046 inch without affecting the critical weighting, and flutes, of I/32 – inch pitch have the same critical weighting at those of I/i6 – inch pitch.

2.4 Surface finish of bottom rollers

Many draw frame rollers exhibit fine circumferential scratches across the land of the teeth; these would be expected to encourage slip; and the friction of ordinary rollers can be increased by rubbing the roller lengthwise with pumice (or, for a case hardened roller, with carborundum) so as to replace that scratches across the teeth by scratches along the teeth. Such a pumiced roller has the same critical weighting as a V-fluted roller, and the pumicing is thus a useful temporary means of improving the grip. A pumiced plain roller without flutes has also the same critical weighting as a V-fluted roller. The critical weighting of a V-fluted roller is, however, practically unaffected by the surface finish. It is the same with scratches across or along the teeth or when highly polished.

It is remarkable that the critical weighting for pumiced rollers, V-fluted rollers and a bottom roller covered with rubber are all nearly the same. The critical weighting seems to be approaching a limit; possibly the friction between the roller and the cotton is approaching that between the fibres themselves, so that the bulk of each sliver is tending to slip over the layer of cotton in contact with the bottom roller.

2.5 Design of Bottom – drafting roller against torsional rigidity

The following example illustrates the calculation of diameter of a drafting roller (for a front bottom –drafting roller) of a single delivery draw frame running at a throughput speed of 500 m/min. The example is hypothetical only with assumption of power, distance between the bearings that support the roller, since the actual details are not available. Let us assume that power from motor goes to front drafting roller. From there, power is transmitted to other drafting rollers. The power transmitted to front drafting roller from motor is 4KW. The front drafting roller would be rotating at a speed of 3600 rpm, if its diameter were 52mm.

The torque on the front drafting roller is

M_t = Power in KW x 1000/ω= 4000/(2πx 3060/60) = 12.48 N-m or 12480 N –mm with the following assumptions:

- The modules of rigidity of material (steel) of bottom roller (G) is 79300 N/mm^2
- Span length of drafting roller l, in between the two bearing is 500mm.

If the allowable angle of twist (θ°) per metre length of the drafting roller is 1.

Then the allowable angle of twist for the span length of the roller in

degrees = 1 x 500 /1000

= 0.5

From Eg. 9.20

$$d^4 = 584M_tl/G\theta$$

$$= (584 \times 12480 \times 500)/(79300 \times 0.5)$$

$$d = 17.41 \text{ mm for } 1^\circ \text{ of twist per metre length of roller.}$$

Similarly, the diameters of the front bottom roller are 20.71 mm for 0.5° of twist per metre length of roller and 24.62mm for 0.25° of twist per metre length of roller.

2.6 Design of Bottom –drafting roller against lateral rigidity

Distributed load on bottom –drafting roller

The top roller weighting is distributed over the bottom roller along the axis of the roller with span length equal to the width of fibre spread during drafting of the slivers. The load is distributed around and mid-point between bearings spreading 20-25 cm across the roller, but not up to the bearings as shown in figure. This is for a single delivery draw frame.

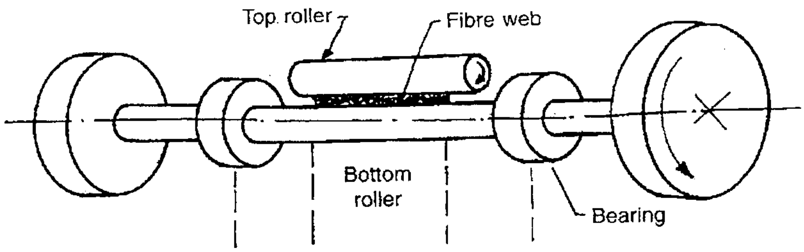


Fig.2.2 Front drafting rollers with supports and fibre web

Let us assume that the top roller weighting (load) acting on the bottom –drafting roller (P) is 60kgf or 588N. Referring to figure, The distributed load per unit length of the bottom roller (assuming the slivers spread is 200mm in the transverse direction) is

$$\Omega = (P/200)$$

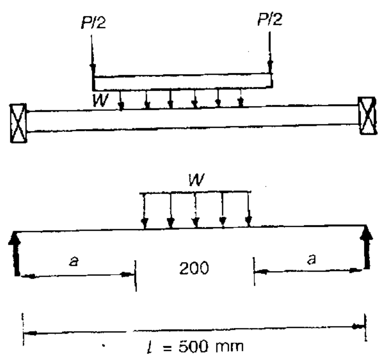


Fig. 2.3 Distributed load on bottom drafting roller

The maximum deflection of bottom drafting roller in this case is given by

$$(\delta_{max}) = \omega(5L_4 - 24L^2a^2 + 16a^4)/(384EI)$$

The value of ω is = 2.94 N/mm. (i.e. 588 N is distributed over 200mm at middle of the roller. The value of a = (500-200)/2 = 150mm. From this the diameters of roller at 60kgf load are: 40.9 mm for 0.05mm deflection; and 48.6 mm for 0.025 mm deflection.

The diameter of roller at 80kgf load are: 44mm for 0.05mm deflection; and 52.3mm for 0.025mm deflection.

A Simple Approach

As a simple approach, the normal load applied to the bottom roller through top roller is considered as a point load. Therefore, the calculated diameter of bottom drafting roller in this example would be higher than for a distributed load. Using the Equation.

$$d^4 = 16Pl3/(\pi.48x207000\ \delta_{max})$$

the diameter of the rollers can be calculated.

When the permissible lateral deflection of the bottom –drafting roller (δ_{max}) is kept at 0.05mm, then the diameter of that roller is, d=41.7mm for 60kgf load; and 44.8mm for 80kgf load. For the permissible lateral deflection of roller of 0.25mm, d= 49.6mm for 60kgf load; and 53.3mm for 80kgf load.

Similarly, the diameter of drafting roller against static load can be worked out, knowing the details of pulleys, belt tension ratio, gears and dimensions of elements etc. For the design of bottom –drafting rollers of ring and speed frames, the design against lateral rigidity may be used. Here the rotational speeds of front bottom rollers are around 125 to 250rpm for rollers of around 25mm diameter. The rollers are available in short length of around 50-60 mm, between bearings. The number of top arm in a ring frame is four per roller segment, that is eight drafting positions per segment of roller. Therefore, the number of point loads that may be considered, as acting on a segment of bottom –drafting roller between two bearing supports is 8, all equally spaced from each other (assuming that fibre spreading during drafting is very low).

The standard or "ordinary" drafting system universally used until quite a recent date. The roving or sliver enters the mechanism at a given rate through the pair of rollers C and comes out of the front pair several times faster and, of course, thinned down. The surface speed of the front rollers divided by that of the back rollers gives the total draft of the mechanism.

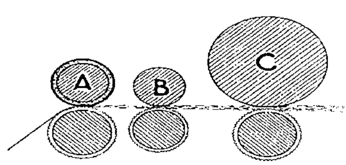


Fig 2.4 Fibre drafting

The work of these front and back pairs of rollers can be considered satisfactory as long as they compel the fibres which pass through them to travel at their speed. If this were not the case, the amount of draft would, of course, vary, and the counts of the yarn also would consequently vary.

To ensure a constant feed, the top back roller is often either extra heavy in itself or provided with pressure by means of a weighted saddle or hook. At the front more care is necessary as the strand is much thinner and the rollers travel faster; the work here must be very positive so that it can grip and pull along even, the individual fibres, end for this reason the front top rollers are always heavily weighted and besides are covered with a. soft material, which will yield and crush itself a little against the flutes of the bottom roller, thus forming a very effective nip.

But the real difficulty of the mechanism lies between the' front and back pairs of rollers and consists in how to make the fibres slide forward uniformly, so that they will not advance before their proper turn and yet will do so easily when required to. The difficulty of achieving this result by mechanical means will at once be realised, on considering the gentle and yet positive sort of control which is required and the nature of the material to be treated-a bunch of a large number of extremely delicate filaments of very different lengths and thicknesses, which must be controlled whilst in constant motion. This control, besides preventing any incorrect displacement of the fibres must at the same time allow them to slide forward freely, the moment they come under the grip of the drawing rollers. It must, therefore, be at once strong and gentle; it must restrain the movement of the fibres just sufficiently and no more.

The "ordinary" roller drafting arrangement has a pair of middle rollers B, for the purpose of effecting the said control. Their main drawback, however, is that owing to the fact that they must be set at a distance from the front rollers, at least that of the longest fibres, an enormous percentage of fibres are left between the front and middle rollers without control. Only if the fibres were all exactly alike in length and thickness, and further, if they were always nicely placed side by side , might it be possible to arrive at a satisfactory result with these rollers by setting them at a distance from the front rollers exactly equal to the length of the fibres. Then, all the fibres not yet nipped by the front rollers would be well held back by the middle ones, and only released by the latter just in time for them to be pulled forward by the former.

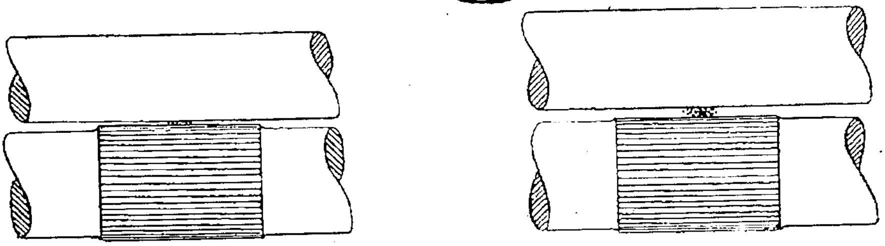


Fig. 2.5 Flute arrangements

The fibres, however, vary infinitely in length and thickness, and also they are bundled together so that the nip of the two middle rollers is not as in, but as in fig. The weight of the top middle roller presses on the mass of the fibres, holding with the maximum pressure those that happen to be right in the centre of the bunch and not at all those on the sides.

This inability to control all the fibres and yet allow free movement to all of them when required, becomes more pronounced when the difference in the speeds of the two pairs of rollers, that is, the draft, is greater. In practice, certain limits have been found beyond which the irregularities are so considerable that the product loses its commercial qualities altogether. These irregularities are due to the following frequent occurrence.

Suppose a strand of fibres which has subsequently to be drawn out by the drafting pair of rollers A, first passes between a pair of rollers B. The position is shown in Fig, where a fibre C has already left the pair B and is being gripped by A and, therefore, is

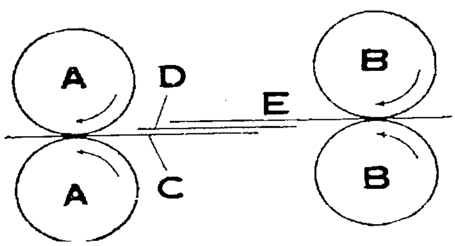
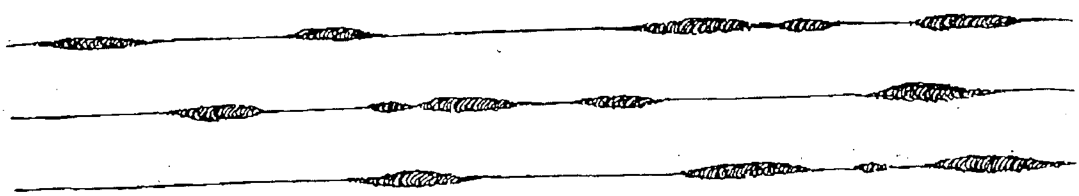


Fig. 2.6 Fibre drafting

travelling at the surface speed of the latter. Fibre E has not yet reached the drafting pair of rollers A, being still retained by B, and consequently is moving apace with these. In between the nips of B and A is a fibre D, which has already left the one pair and not yet arrived at the other. If the adherence between the fibres D and E is sufficient, fibre D will travel at the speed of the rollers B until it is gripped by the rollers A, in which case the drafting will have taken place satisfactorily. If, however, the fibre D has less adherence with fibre E than with C, the latter will drag D forward, and this will emerge from the rollers A in a position in front of that which it should have occupied. In practice, where the fibres are many, large numbers of them under the conditions of fibre D will similarly go forward before they ought to do so, the result being a thick place in the yarn or the roving followed by a thin place corresponding to the position these fibres should have filled. It may be noticed that even if fibre D were held back because of some very exceptional adherence with fibre E; this fibre E itself might subsequently be dragged along by D before its proper time, owing to the said adherence.

So much for what happens to those fibres which find themselves without positive control between the front and middle rollers. In the spinning mill, for the sake of minimising these "floating" fibres, the rollers B are sometimes set as near as practicable to the rollers A and then it may be the longer fibres which will give most trouble. Suppose a number of fibres are still under the grip of rollers B by the time their other end reaches the grip of rollers A; if such fibres are from the sides of the strand they will probably come forward quite easily, but if they are in the heart of if they will very likely



hesitate a moment or so before the rollers are able to pull them through. The effect of this is to retard a number of fibres which eventually come forward suddenly in a bunch, and this is known in cotton spinning as "plucking".

A familiar result of excess of retention by the middle rollers is the fault known as "crackers", which consists of one or more tense fibres in the centre of the yarn with all the other fibres slackly curled round them. In pulling the thread these central fibres easily break, making a characteristic 'sound which has given the name of crackers to this fault. Fig. shows plainly how it occurs. The fibre or fibres M are still under the

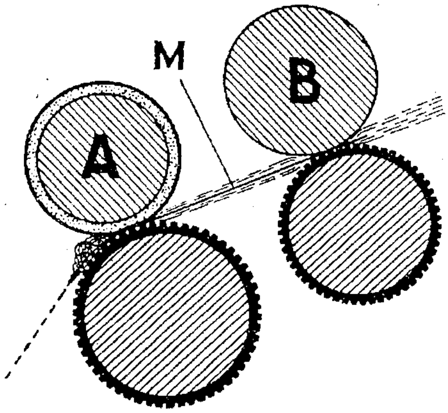


Fig. 2.7 Fibre drafting

grip of the middle rollers at one end while their other end has already passed through the nip of the front rollers. At the one end they are still so effectively held by the rollers B that they travel at their speed, whilst at the other end they are slipping through the nip of the front rollers. The front end has already been twisted round with the rest 0.£the fibres to form the yarn, and so holds the yarn back with it for a few moments during which the front rollers keep on delivering all the other fibres which are freer. Eventually the rollers B release fibres M and the drafting and the yarn immediately become normal again. The cracker produced will either give way at once under the tension of the yarn or cause a breakage when coming against the traveller. In many cases it will pass into the bobbin only to give trouble later on.

If the difference between the speeds of the front and middle pairs of rollers is high (that is, if the draft is high or long) the fibres will not only move more irregularly than when these pairs of rollers turn at a more similar speed, but also the result of the incorrect displacement of the fibres will be more disastrous to the yarn, since the fibres would be taken farther away from the positions which would have been correct. On the other hand, as has been mentioned before, the results of ordinary roller mechanisms are also better when the operation is performed at less speed as the fibres then have a little more time to disentangle amongst themselves and release those whose turn has already arrived for sliding forward several years ago Mr Fernando Casablancas, a prominent figure in the Spanish textile industry, made known to the world his famous spinning apparatus, and the expression "high drafting" came into use for the first time as a distinction for its drafting efficiency or capacity as compared with existing orthodox methods. Mr Casablancas was probably the first to devote to the drafting problem the thought it deserved, and he made a scientific and very thorough investigation into this process which had until then been much taken for granted and, consequently, very little understood.

The principle of the Casablancas method of drafting will be best appreciated by describing an interesting experiment which can be made by holding a small bunch of fibres lightly between the finger and thumb and P41ling these out with the other hand. If, for instance, one fibre only is taken and drawn out it will be observed that this fibre alone will come away. Again, if five fibres are pulled out at the same time, only five will come forward, the rest or bulk of them remaining safely held between finger and, thumb.

The effectiveness of this way of holding or retaining the cotton hairs is due to the softness of the tips of the fingers of the hand A which adapt themselves gently and yet firmly over the bunch of fibres.

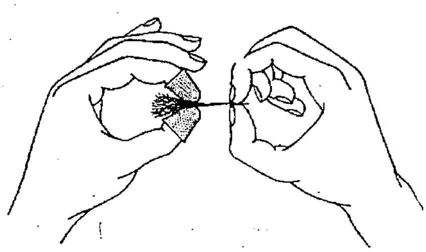


Fig. 2.8 Fibre control during drafting

The control thus exercised is very complete on account of the comparatively great surface of contact over the fibres. This theory can be easily corroborated by repeating the experiment, this time with both finger and, thumb covered with metal thimbles; then the

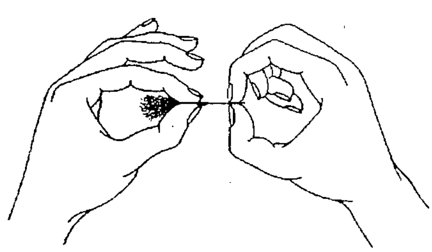


Fig. 2.9 Fibre control during drafting

defect explained before in connection with drafting between two pairs of rollers will appear again here very plainly.

The action of finger and thumb was reproduced with striking success in the first Casablanca's apparatus which is shown in Fig.

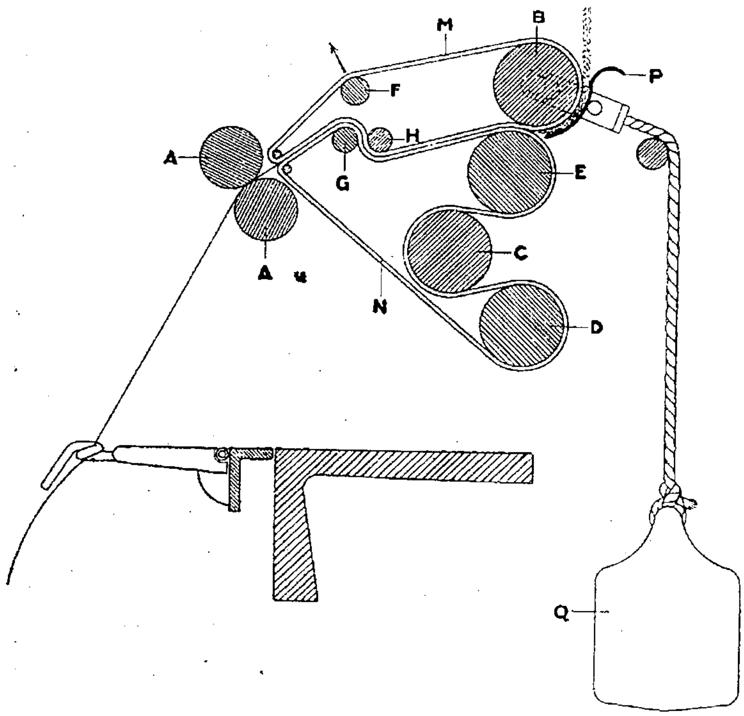


Fig. 2.10. Casablanca's apparatus

Its principle, which will be very clear from the illustration itself, was that of effecting as complete a control as possible over the cotton hairs, consistent with the soft and steady handling required for a material of such a delicate and flimsy nature.

A brief description of this first mechanism is as follows.

The drawing rollers A are of the usual kind. The roving is made to pass between two leather bands M, N, which are arranged in a zig-zag manner so as to increase the efficiency of the contact between them, thus avoiding any chance of slippage. Motion is imparted to the lower band by the rollers C and D, the roller E being free and acting only as a tensor. The top roller B is also free, and, by means of the weight Q, keeps the top band tense and pressed against the bottom one. A small roller F prevents any rubbing between the top and bottom parts of the band M.

This mechanism was first shown in 1913 in the School of Technology of Sabadell, near Barcelona, and was fitted to a small ring frame. Experts from many countries visited this machine at work, and the suitability of the way and means employed was at once acknowledged as excellent. The first samples spun were 60's and 80's counts from one hank roving, Egyptian cotton 1 t in. staple, and 26's and 34's counts, also from one hank roving, American cotton 1 t in. staple. The drafts were, therefore, very considerable. The apparatus was rather complicated for practical use in the cotton mills, and its handling and the attention it required also inadequate for ordinary industrial application. Notwithstanding this, however, its performance was so much more perfect than anything ever seen before that it was obvious it would make a unique success if the excellency of its features were maintained after it had been sufficiently simplified to meet practical requirements. To-day the Casablancas system is being installed in every spinning centre of the world, and it is already working on many millions of spindles. The efforts towards its improvement since the introduction of the first mechanism were very great, and the experiments carried out comprised a wealth of interesting experience.

2.7 Exhaustive experiments

Although the strikingly good results of the very first Casablancas apparatus were obviously due to the use of the two endless leather bands, the struggle which followed towards a simpler and more practical mechanism was certainly not prejudiced on that account. As a matter of fact, since the use of the bands was in part the cause of the complication of the original apparatus, there being the problems of imparting motion to them, guiding them, etc. Mr Casablancas naturally at once sought solutions with other more orthodox and manageable parts which would imitate the work of the bands. Most of the alternative arrangements thus contrived were tested and experimented upon under mill conditions, and patents were taken out for many of them. Most of the drawings illustrating the following brief notes have been copied from the actual Patent Specifications.

Use of one band only

One of the earliest attempts consisted in suppressing one of the two leather bands and replacing it by a polished metal plate A. In this arrangement, shown in Fig, use is already made of the existing front and back pairs of rollers, the lower band being driven by the back bottom roller. To keep the band tense and to help: in driving it, there was a special roller M inside. The stationary plate, whilst certainly exerting some control over the cotton strand, was not conducive to the required conditions for an even flow of fibres,

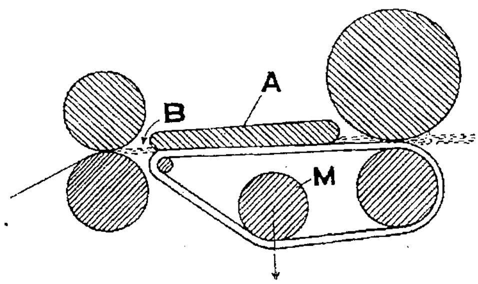


Fig. 2.11. Fibre guide In drafting zone

and also did not hold them satisfactorily at the delivery point B between the plate and the band. The results were poor. Experiments were also change with the band at the top and

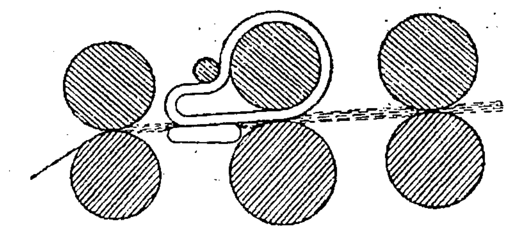


Fig. 2.12. Fibre guide In drafting zone

plate underneath. Results in this case were similar, apart from the increased difficulty in driving the band from the top roller.

2.8 Small light top rollers

To obviate the faults of the stationary plate the arrangement shown in Fig was then brought out, and in this the rollers A and B took the place of the plate. The peculiarity presented itself that if the roller A (which was set within the staple length) was too heavy, the requisite sliding of the fibres amongst themselves at the drafting

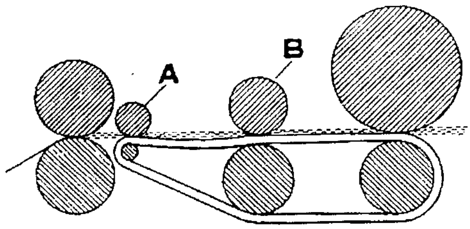


Fig. 2.13. Roller control in drafting zone

point could not occur. If, on the other hand, the roller was - too light, the cotton was easily snatched by the drawing rollers from the delivery nip, the roller A having a jerky instead of a regular motion.

So in either of these two cases the results were .very bad. By careful and long experimenting, however, the suitable weight of this roller for a predetermined cotton, hank of roving, and count, could be arrived at and actually better results obtained than with the stationary plate previously described. But the work of the roller A was always unreliable and unsteady, a very serious thing seeing that any failure at the one point of contact between this roller and the band .left the fibres entirely uncontrolled. Moreover, the method did not allow much freedom in changing the kind of cotton, counts, etc. and it never could be made to work satisfactorily for coarse counts. At its best the result of this method was not nearly comparable with that of the original two-band apparatus.

Therefore another attempt was made to further imitate the action of the bands on the cotton, and the contrivance shown in Fig. gave very remarkable results. In this it will be observed that the existing front and back rollers were also used; and by having the

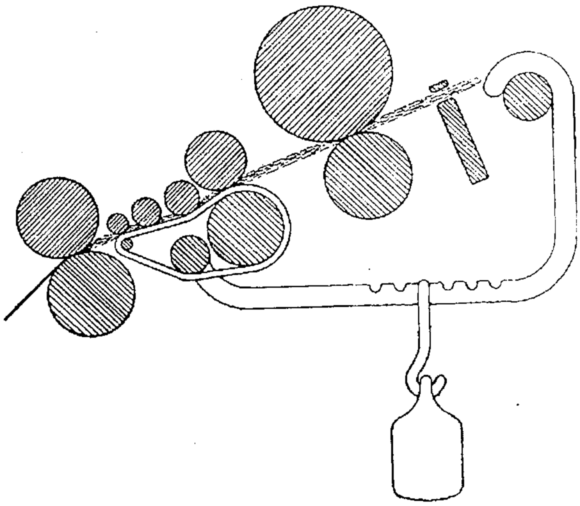
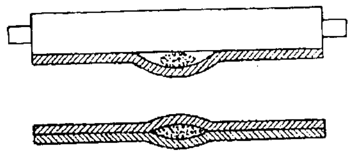


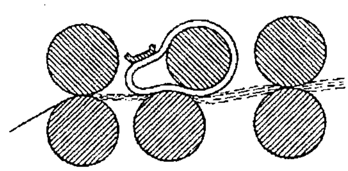
Fig. 2.14. Leather guide in drafting zone

leather band driven this time by the middle roller, a small draft was possible between the middle and back which was very helpful for straightening out the fibres and softening the twist of the roving. The uninterrupted control over the fibres exerted by the top band of the first mechanism leaning against the bottom Gne, was imitated as far as possible by a series of small rollers progressively smaller in diameter and also lighter from the middle to the front. These rollers acted by their own weight on the fibres and were also free and driven only by contact with the band. This arrangement never made quite so good a yarn, nor was it able to perform such high drafts as had been obtained with the two bands, but it was distinctly better than any other one-band method.

The main reasons accounting for the inferiority of the results from the arrangement, as compared with the original two-band apparatus were, in the first place, that the rigid nature of the top roller did not effect anything like the suitable control of the two bands pressed together. The difference is exaggeratedly shown *in* Fig. 21. Added to this, the points of control over the cotton strand were limited in number as



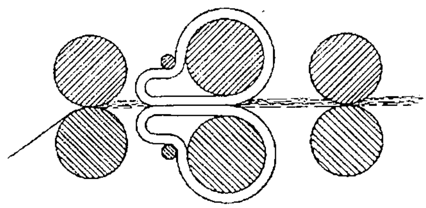
compared with the continuous contact between the bands. A third and very important reason was that the series of small rollers used for obtaining the necessary control over the fibres presented the same difficulties as the roller A in Fig. that is, the steadiness and continuity of their performance could not be relied upon. To this drawback, greater here because of the increased number of rollers, it must also be added that the smaller rollers had more tendency to gather waste and wind cotton fibres round themselves. Very careful investigations were made in this respect and it was found that not only did these rollers become very dirty, and therefore out of order, but also that it was very difficult to keep them clean because no clearer of any kind could be made to tough them or they would have stopped immediately. In conclusion, the very modest imitation of the soft and gentle action of the leather bands with metallic parts required the latter to be made very small and light, and thus apt to work in a haphazard manner. It was also necessary to use several of these so that an advantage from a simplicity point of view could not be claimed.



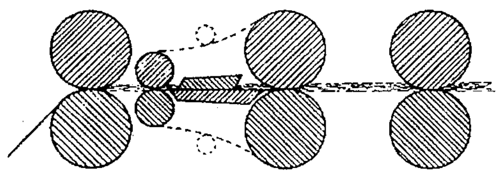
Above figure represents another method which was duly investigated without any important results.

The two-leather bands definitely the best

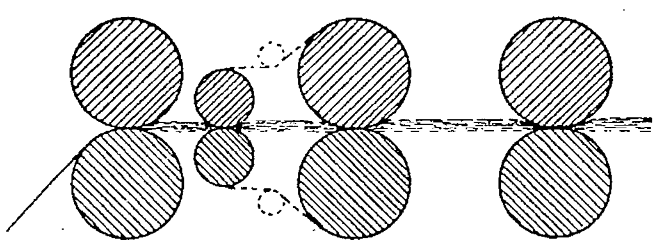
A subsequent reversion to a two-band method is shown in Fig. This at once reproduced the remarkable results obtained with the original apparatus, so obviously that the performance of the two bands had to be recognized as inimitable. The method in Fig. 23 was tried conjunctively with those, which, as can be readily seen, attempt to imitate it. The results were bad and those only very moderate, as against those of the two-band arrangement, which produced strikingly strong and even yarn, and could successfully perform very high drafts. This



latter arrangement was the first one to be used on thousands of spindles in the cotton mills, and met with great practical success, the one difficulty about it being that it required the two middle rollers to be rather strongly pressed together so that the two bands would travel without slipping.



An important and, under the circumstances, possibly decisive improvement was therefore made with the special patented fluting of the bottom middle roller. With this saw-tooth shape grooving, the bands were irresistibly driven along with the least effort and very little pressure was necessary. The bands could be relied upon to turn steadily and continuously, thus completely solving the one possible: difficulty which might have stood in the way of the apparatus's frank progress.



The experiments just described are, of course, only a few of very many, and they represent a sort of landmark or stage at which some conclusions were arrived at.

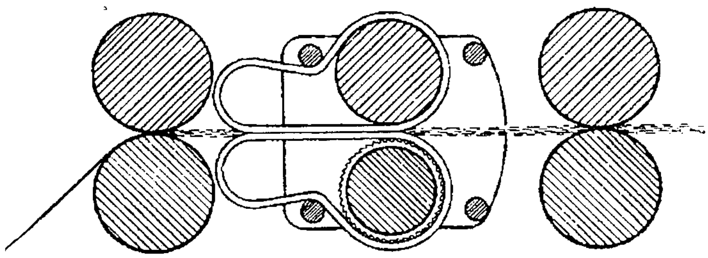


Fig. 2.15. Casablancas system

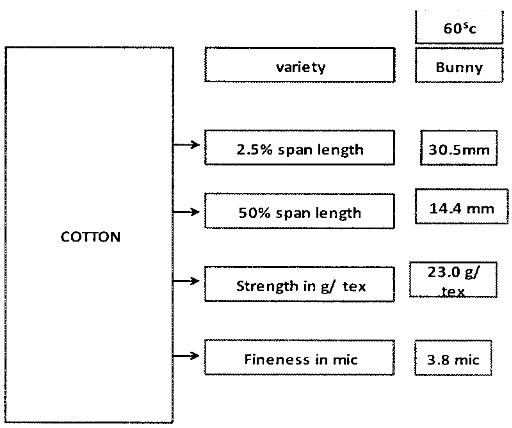
Once the Casablancas system had become a practical proposition and whole spinning plants were equipped with it, experience could be gained from the actual results in the mills, and the work of improving the apparatus was thus greatly assisted. Gradually different parts of the mechanism were improved, and the whole Casablancas arrangement evolved towards increased simplicity, cleanliness and reliability, not only preserving the original characteristics which had given such good results at the very first, but actually improving its drafting efficiency.

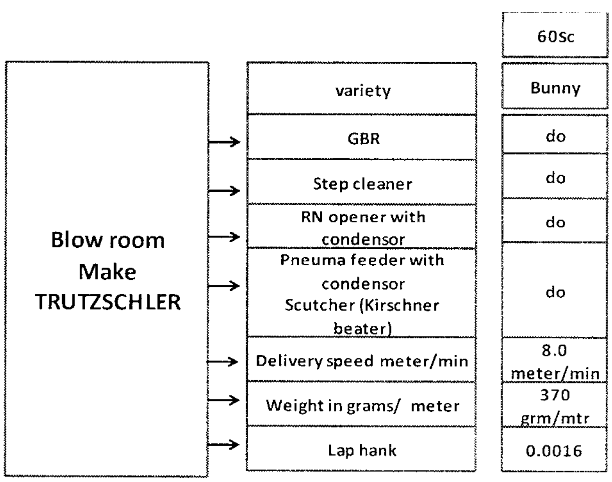
CHAPTER 3

MATERIALS AND METHODS

3.1 MATERIALS

The study is conducted in 60^s Ne combed yarn. Fibres specification and machinery details along with process parameter are listed in the flow chart. Three different flute angles 6^0,4^0 and 3^0 are selected and three fluted rollers are produced with mentioned flute angles.



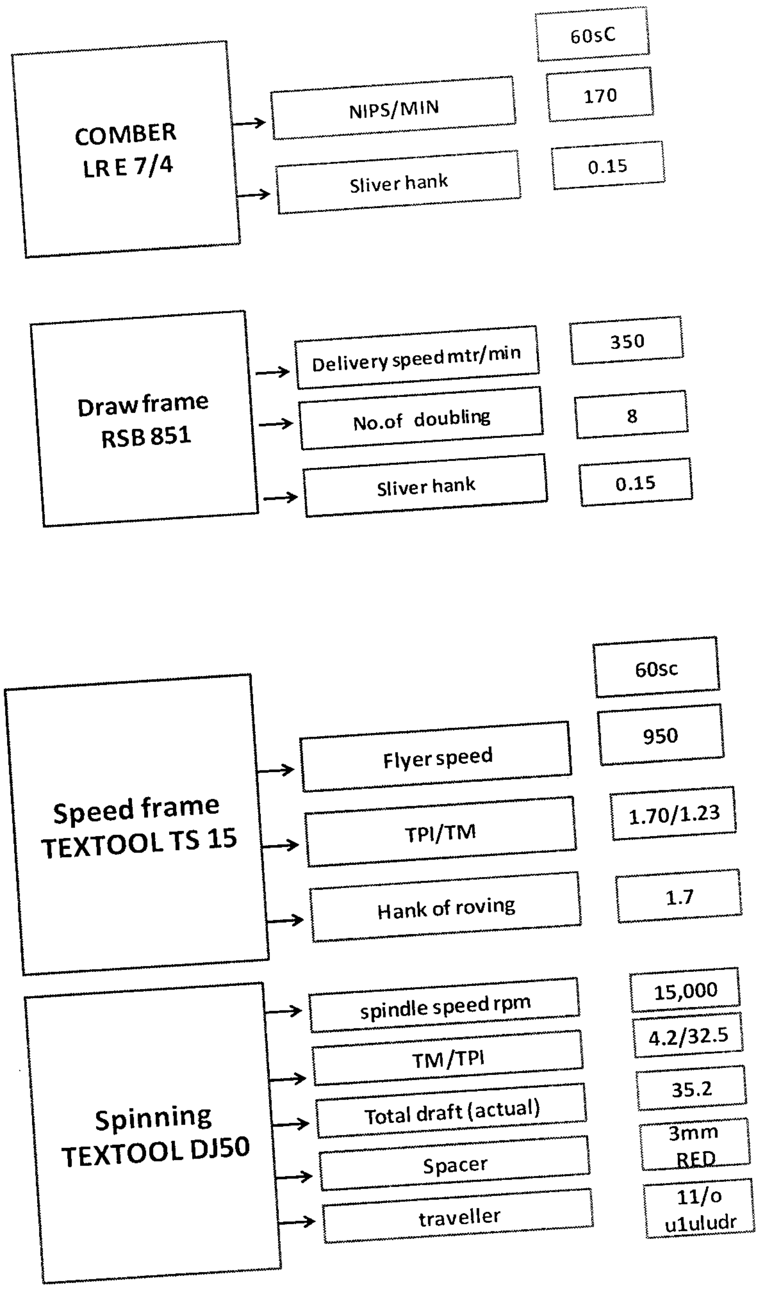


50sC

Machine	Parameter	Value
Carding Make CROSROL (MARK 5)	Delivery speed	**80 mpm**
	Sliver hank	**0.15**

Machine	Parameter	Value
SLIVER LAP LAKSHMI RIETER	DELIVERY SPEED	50 mpm
	LAP WEIGHT	50 g/m
	No. OF DOUBLINGS	16

Machine	Parameter	Value
RIBBON LAP LAKSHMI RIETER	DELIVERY SPEED	50 mpm
	LAP WEIGHT	50 g/m
	No. OF DOUBLINGS	6


COMBER
LR E 7/4
NIPS/MIN
Sliver hank
60sC
170
0.15
Draw frame
RSB 851
Delivery speed mtr/min
No.of doubling
Sliver hank
350
8
0.15
Speed frame
TEXTOOL TS 15
Flyer speed
TPI/TM
Hank of roving
60sc
950
1.70/1.23
1.7
Spinning
TEXTOOL DJ50
spindle speed rpm
TM/TPI
Total draft (actual)
Spacer
traveller
15,000
4.2/32.5
35.2
3mm
RED
11/o
u1uludr

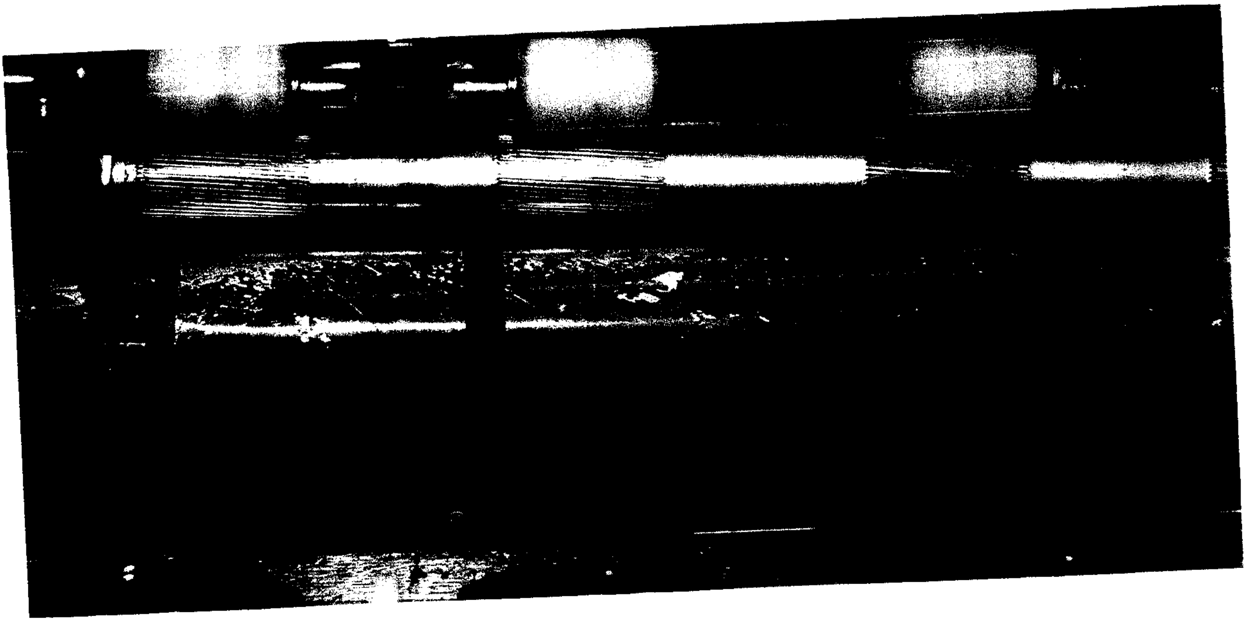


Fig.3.1. 5^0 Fluted Roller

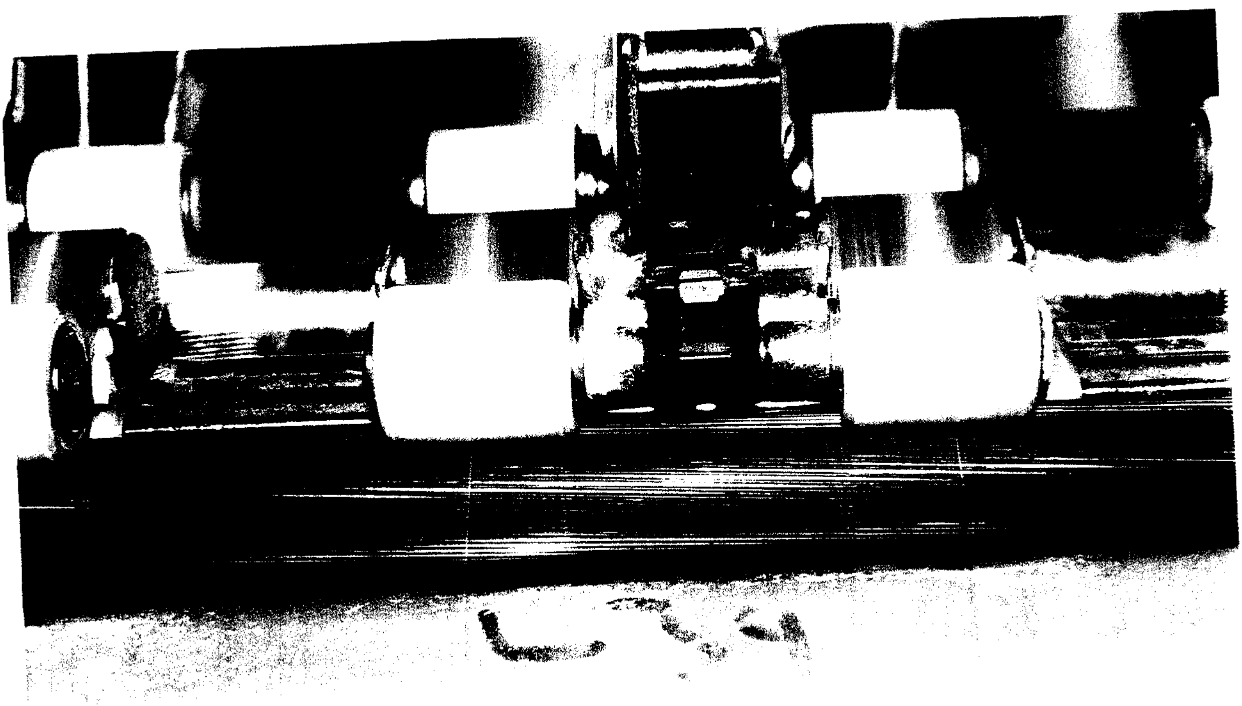


Fig.3.2. 6^0 Fluted Roller

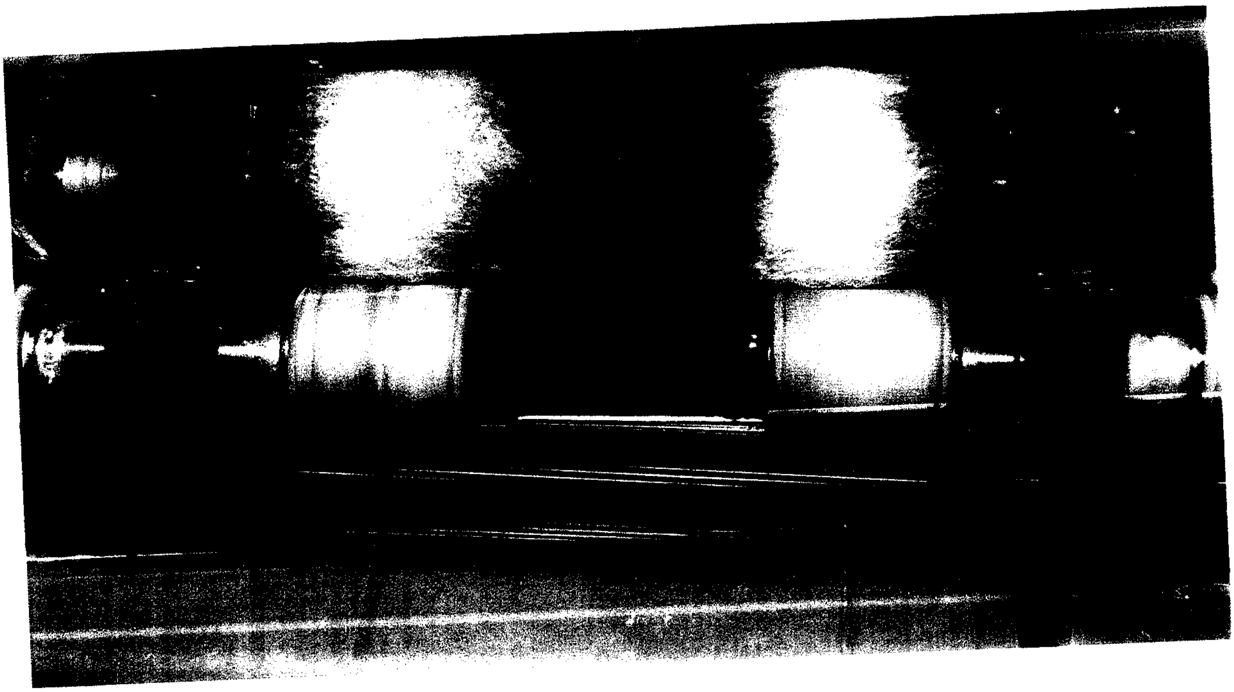


Fig.3.3. 4^0 Fluted Roller

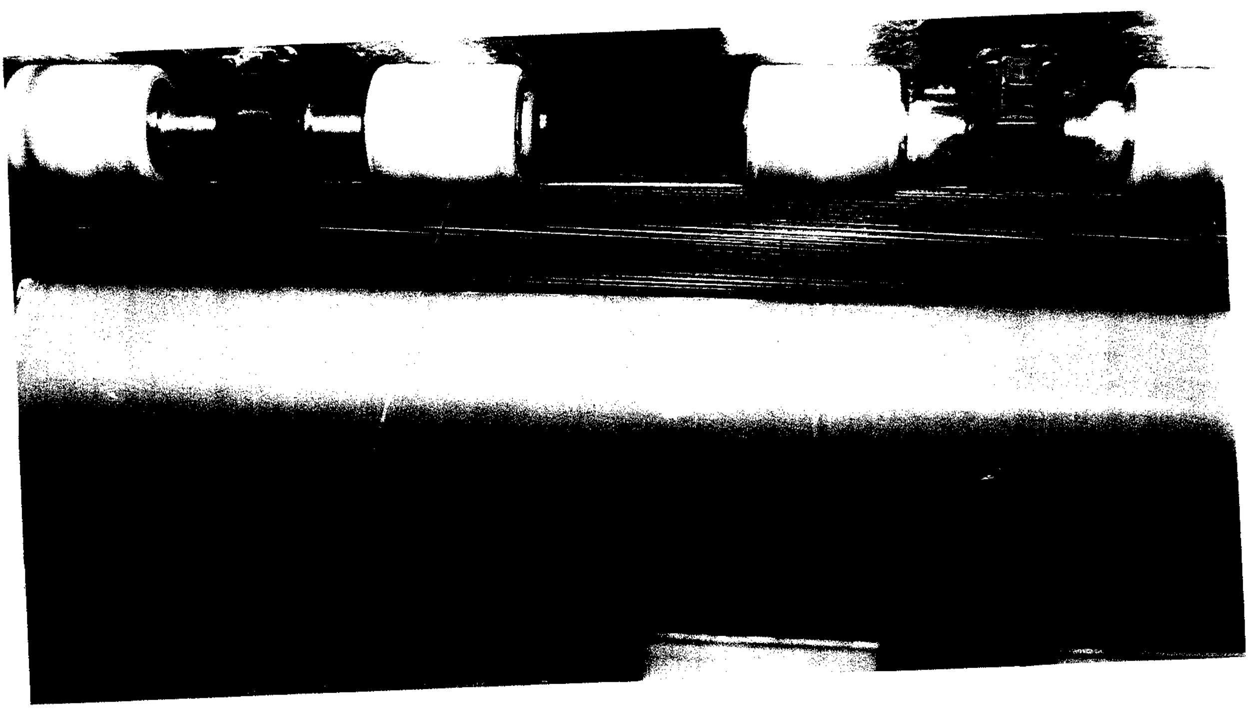


Fig.3.4. 3^0 Fluted Roller

3.2 METHODOLOGY

- The ring frame flute angle is fixed as 5^0 by all the ring frame manufacturers.
- The flute angle to be reduced from 5^0 to 4^0 and 3^0.
- The flute angle to be increased from 5^0 to 6^0.
- To study the effect of change in bottom roller flute angle from 5^0 to 3^0, 4^0 and 6^0 On
    - Imperfections / Km
    - Hairiness
    - Classimat faults
    - CSP
    - U%
    - Count and strength C.V.%
    - Elongation
    - RKM
    - Single yarn strength
    - Ring frame breakages/100 spindle hour

3.3 TESTING METHODOLOGY

- Eveness and Imperfections testing – **UT 4.** The testing speed is 400 mpm and the specimen length is 1000 meters.
- Classimat faults – **USTER CLASSIMAT 3.** The testing speed is 650 mpm and the specimen length is 125 Kilometers.
- Hairiness testing – **ZWEIGLE HAIRINESS TESTER.** The testing speed is 50 mpm and the specimen length is 100 meters.
- CSP comparison – **STATEX CSP LAB**
- Single yarn strength, R.K.M. and elongation – **TENSORAPID.** The testing speed is 5000 mm/m and the specimen length is 50 cm.
- Breaks per 100 spindle hour – **SNAP STUDY IN THE INDUSTRY**

CHAPTER 4

RESULTS AND DISCUSSION

PARAMETER \ FLUTE ANGLE		5^0	6^0	4^0	3^0
COUNT		60^s Ne	60^s Ne	60^s Ne	60^s Ne
CSP		2461	2518	2572	2584
U %		11.82	11.95	11.66	11.79
C.V. %	COUNT	2	1.3	1.9	1.8
	STRENGTH	5.6	4.2	4.3	4.1
IMPERFECTIONS/ KM	THIN	22	25	14	19
	THICK	143	160	139	149
	NEPS	256	250	288	270
	TOTAL	421	435	441	438

FLUTE ANGLE / PARAMETER		5^0	6^0	4^0	3^0
COUNT		60s Ne	60s Ne	60s Ne	60s Ne
HAIRINESS	INDEX	30.3	28.7	38.0	45.0
	S3	775.5	770.5	880.0	919.0
SINGLE YARN STRENGTH		165.5	164	169.1	168.6
ELONGATION		5.0	4.77	5.31	5.26
RKM		16.81	16.66	17.18	17.12
BREAKS/100 SPINDLE HOUR		6.5	5.2	4.8	5.0

CLASSIMAT FAULTS

FLUTE ANGLE / PARAMETER	5^0	6^0	4^0	3^0
SHORT THICK	1582	1411	2093	1528
LONG THICK	17	8	24	18
LONG THIN	125	51	311	55
OBJECTIONAL	39	55	56	70
TOTAL	1763	1525	2484	1671

Table. 01. Yarn parameters results for various flute angles

CLASSIMAT FAULTS COMPARISION CHART

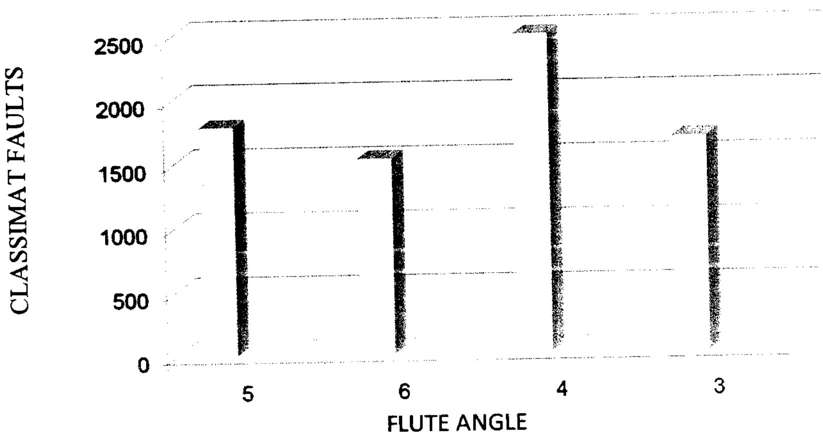


Fig.4.1. COMPARISION CHART FOR CLASSIMAT FAULTS

The above figure shows that the total classimat fauls are getting reduced as the flute angle increases from 5^0 to 6^0. And at the same time it is getting increased as the flute angle decreases from 5^0 to 4^0. In the case of 3^0 flutes there is not much difference in the total classimat faults against 5^0 flutes.

HAIRINESS INDEX COMPARISION CHART

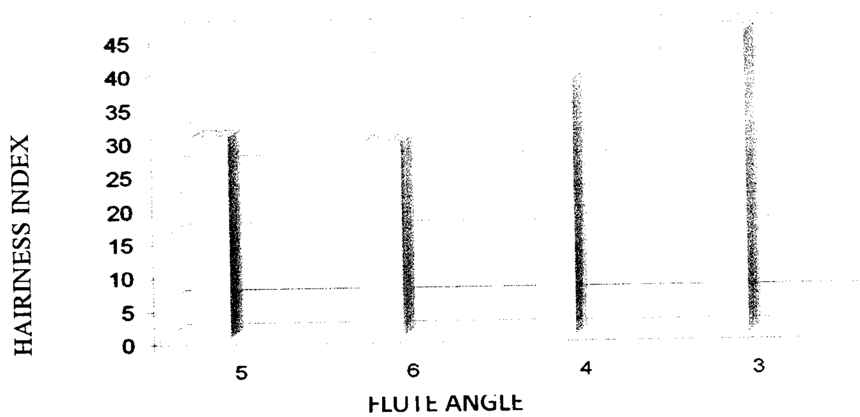


Fig.4.2. COMPARISION CHART FOR HAIRINESS INDEX

The above figure shows that the hairiness is getting reduced as the flute angle increases from 5^0 to 6^0. And at the same time it is getting increased as the flute angle decreases from 5^0 to 4^0 and 3^0. Here the 5^0 flute is displaying better result than 4^0 and 3^0.

IMPERFECTIONS/Km COMPARISION CHART

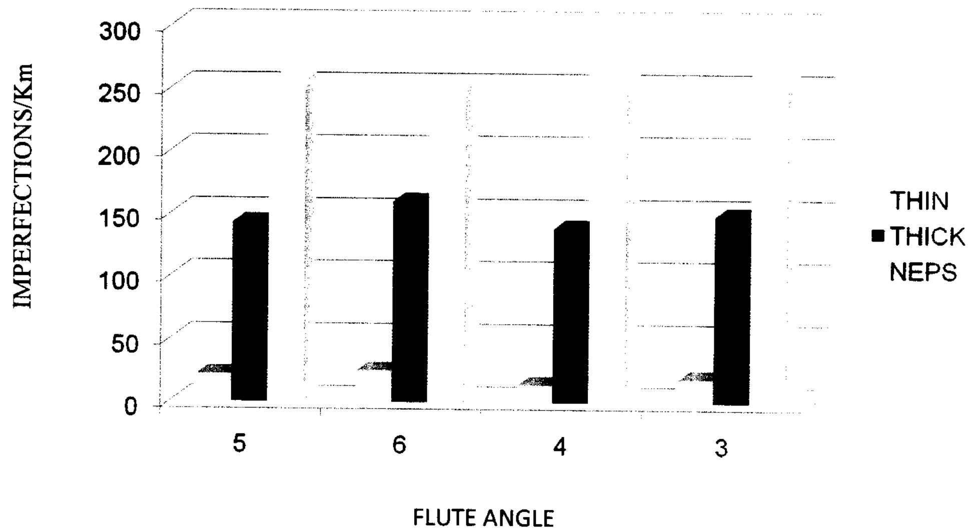


Fig.4.3. COMPARISION CHART FOR IMPERFECTIONS/Km

From the above figure it was understood that there was not much difference found as for as the total imperfections/Km is concerned.

CSP COMPARISION CHART

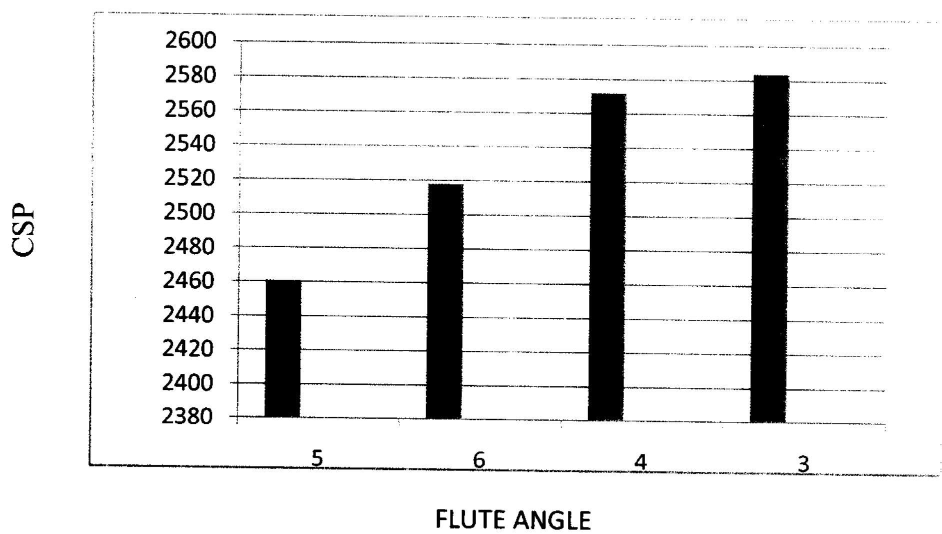


Fig.4.4. COMPARISION CHART FOR CSP

The above figure shows that the CSP is in the upward trend if the flute angle increases from 5^0 to 6^0. It shows even better result when the flute angle is 4^0 than 5^0. The 3^0 flute angle is displaying very good CSP values when compared with all the other flute angles.

U % COMPARISION CHART

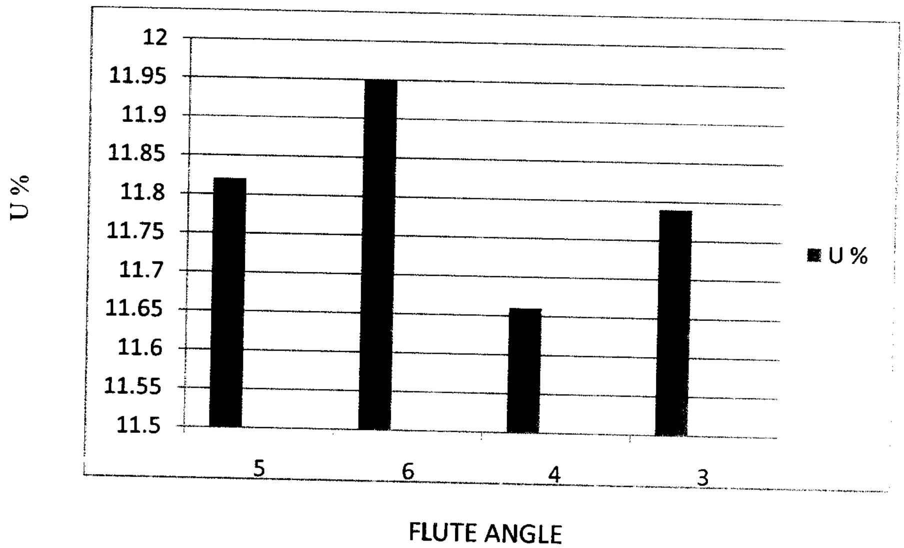


Fig.4.5. COMPARISION CHART FOR U%

The above figure shows that the U% of the yarn is increasing as the flute angle increases from 5^0 to 6^0. But very good result had been achieved when the flute angle is reduced from 5^0 to 4^0. And 3^0 flute displays intermediate result between 4^0 and 5^0 as for as the U% is concerned.

COUNT & STRENGTH C.V.% COMPARISION CHART

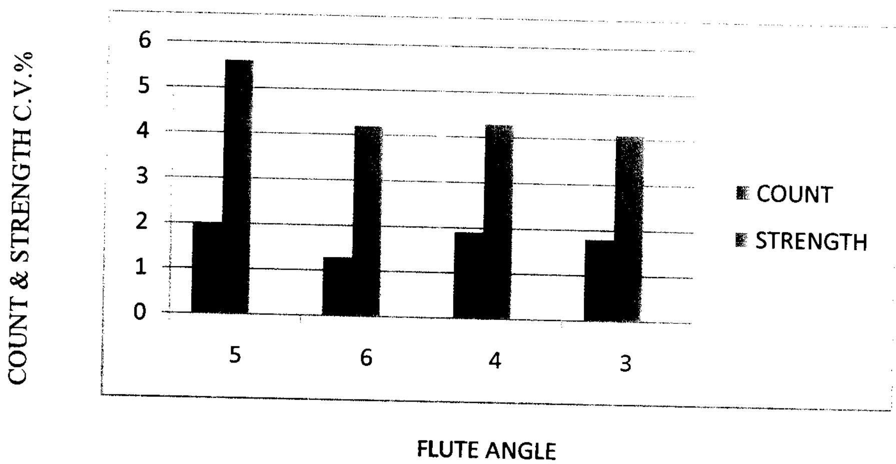


Fig.4.6. COMPARISION CHART FOR COUNT&STRENGTH C.V.%

It is visible that the count C.V.% is lower for 6^0 flute angle than 5^0 flute angle. It is lower for 4^0 and 3^0 flutes also but slightly higher than 6^0 flutes. Overall, 6^0 flute is giving better result than all the three mentioned flute angles. As for as strength C.V.% is concerned, 6^0, 4^0 and 3^0 flute angles are displaying better result than 5^0.

SINGLE YARN STREGTH COMPARISION CHART

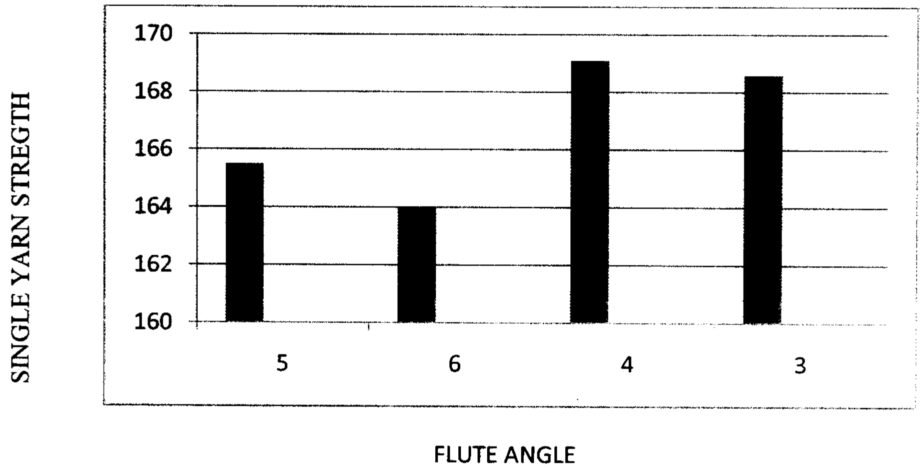


Fig.4.7. COMPARISION CHART FOR SINGLE YARN STRENGTH

It is visible that the single yarn strength is lower for 6^0 flute angle than 5^0 flute angle. It is higher for 4^0 and 3^0 than 5^0 flutes. Overall, 4^0 flute is giving better result than all the three mentioned flute angles.

ELONGATION COMPARISION CHART

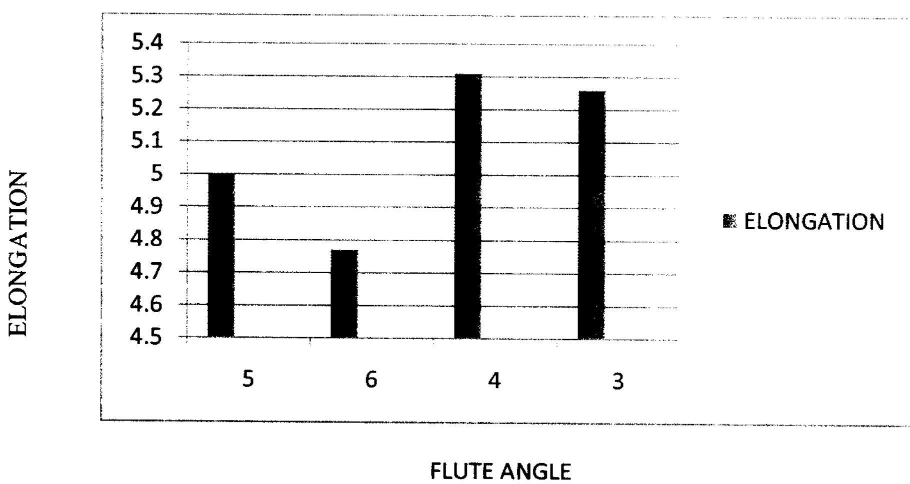


Fig.4.8. COMPARISION CHART FOR ELONGATION

The above figure shows the comparision yarn elongation for the different flute angles. It is seen that 4^0 flute angle is giving better result than all the other flute angles. The 6^0 flute angle is giving lowest yarn elongation than all the other flute angles. The 5^0 flute angle is displaying optimum elongation values.

RKM COMPARISION CHART

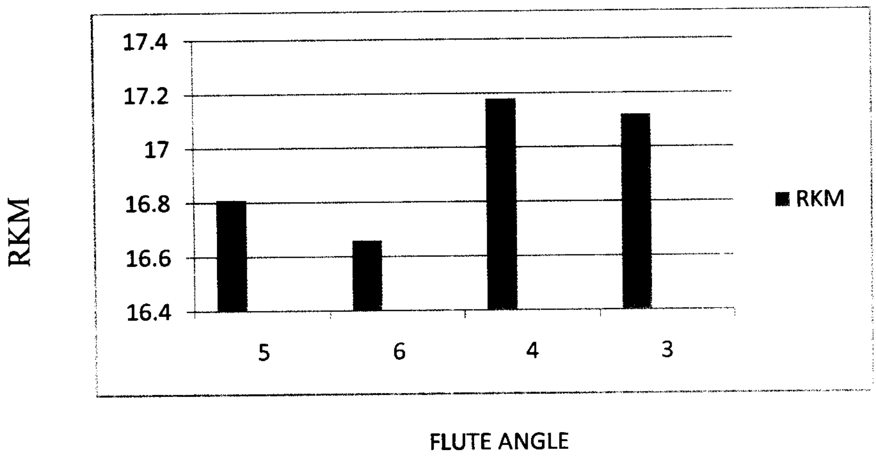


Fig.4.9. COMPARISION CHART FOR R.K.M.

Since the RKM and the elongation are having inter relationship with each other, the elongation results will be reflected in the RKM values.The above figure shows the comparision yarn RKM for the different flute angles. It is seen that 4^0 flute angle is giving better result than all the other flute angles. The 6^0 flute angle is giving lowest yarn RKM than all the other flute angles. The 5^0 flute angle is displaying optimum RKM values.

BREAKS/100 SPINDLE HOUR COMPARISION CHART

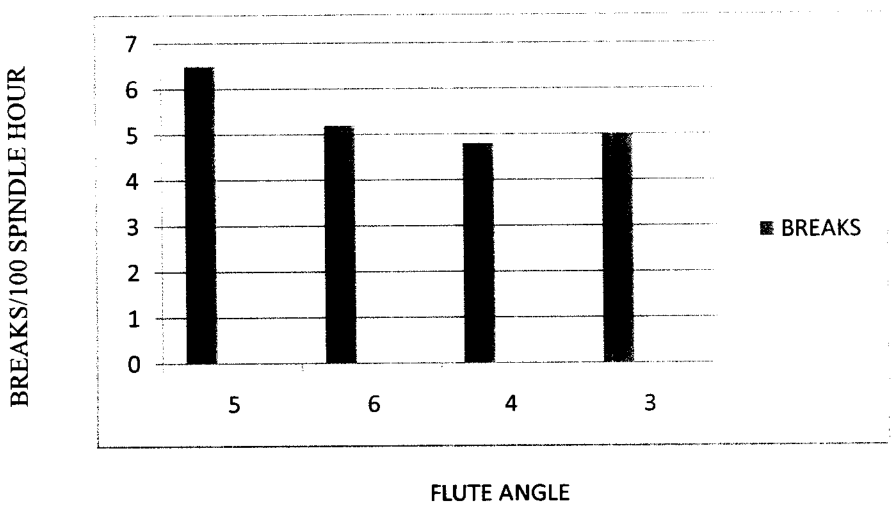


Fig.4.10. COMPARISION CHART FOR BREAKS/100 SPINDLE HOUR

From the above figure it is observed that the 5^0 flute angle is giving more end breaks than all the other three flute angles.

4.1. STATISTICAL ANALYSIS

ANOVA ANALYSIS TABLES

THIN PLACES					
Source	DF	SS	MS	F	P
Flute angles	3	683.5	227.8	2.50	0.075
Error	36	3284.0	91.2		
Total	39	3967.5			

THICK PLACES					
Source	DF	SS	MS	F	P
Flute angles	3	2589	863	0.96	
Error	36	32311	898		
Total	39	34900			

NEPS					
Source	DF	SS	MS	F	P
Flute angles	3	8255	2752	1.11	0.360
Error	36	89607	2489		
Total	39	97862			

For DF ^{3}**V** $_{36,}$ the table value F_b = 2.872 @ 5% significant level

So difference is not significant with respect to Thin places and Thick places and

TENACITY					
Source	DF	SS	MS	F	P
Flute angles	3	182.1	60.7	1.39	0.261
Error	36	1570.9	43.6		
Total	39	1753.0			

ELONGATION					
Source	DF	SS	MS	F	P
40^{S}c RDP offsets	3	1.8421	0.6140	15.87	0.000
Error	36	1.3931	0.0387		
Total	39	3.2352			

HAIRINESS INDEX					
Source	DF	SS	MS	F	P
Flute angles	3	1713	571	3.84	0.017
Error	36	5350	149		
Total	39	7064			

For DF ^{3}**V** $_{36,}$ the table value $F_b = 2.872$ @ 5% significant level

So difference is significant for elongation and hairiness index

Not significant with respect to tenacity.

CLASSIMAT FAULTS					
Source	DF	SS	MS	F	P
Flute angles	3	172248	57416	0.06	0.980
Error	36	11642440	970203		
Total	39	11814687			

For DF $^{3}V_{36}$, the table value $F_b = 2.872$ @ 5% significant level

So difference is not significant with respect to classimat faults

TABLE 02. STATISTICAL ANOVA TABLES

CHAPTER 5

CONCLUSION

- The total classimat fauls are getting reduced as the flute angle increases from 5^0 to 6^0. And at the same time it is getting increased as the flute angle decreases from 5^0 to 4^0. In the case of 3^0 flutes there is not much difference in the total classimat faults against 5^0 flutes.
- The hairiness is getting reduced as the flute angle increases from 5^0 to 6^0. And at the same time it is getting increased as the flute angle decreases from 5^0 to 4^0 and 3^0. Here the 5^0 flute is displaying better result than 4^0 and 3^0.
- It was understood that there was not much difference found as for as the total imperfections/Km is concerned.
- The the CSP is in the upward trend if the flute angle increases from 5^0 to 6^0. It shows even better result when the flute angle is 4^0 than 5^0. The 3^0 flute angle is displaying very good CSP values when compared with all the other flute angles.
- The the U% of the yarn is increasing as the flute angle increases from 5^0 to 6^0. But very good result had been achieved when the flute angle is reduced from 5^0 to 4^0. And 3^0 flute displays intermediate result between 4^0 and 5^0 as for as the U% is concerned.
- The count C.V.% is lower for 6^0 flute angle than 5^0 flute angle. It is lower for 4^0 and 3^0 flutes also but slightly higher than 6^0 flutes. Overall, 6^0 flute is giving better result than all the three mentioned flute angles. As for as strength C.V.% is concerned, 6^0, 4^0 and 3^0 flute angles are displaying better result than 5^0.
- The single yarn strength is lower for 6^0 flute angle than 5^0 flute angle. It is higher for 4^0 and 3^0 than 5^0 flutes. Overall, 4^0 flute is giving better result than all the three mentioned flute angles.
- It is seen that 4^0 flute angle is giving better elongation result than all the other flute angles. The 6^0 flute angle is giving lowest yarn elongation than all the other flute angles. The 5^0 flute angle is displaying optimum elongation values.
- It is seen that 4^0 flute angle is giving better result than all the other flute angles. The 6^0 flute angle is giving lowest yarn RKM than all the other flute angles. The 5^0 flute angle is displaying optimum RKM values.
- It is observed that the 5^0 flute angle is giving more end breaks than all the other three flute

CHAPTER 6

REFERENCES

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H INDIA TEXTILE RESEARCH ASSN. PO BOX NO : 3205 COIMBATORE - 641014

SITRA Sample ID 08519 Nom. count Nec 60 Nom. twist 0 T/m
10 / 1 v= 400 m/min t= 1 min Meas. slot 4 Short staple

Imperfections

Y-9747 Material class Yarn Mach. Nr.

60 COPS

	U% %	CVm %	Thin -50% /km	Thick +50% /km	Neps +200% /km
	12.35	15.60	23	153	210
	11.55	14.64	13	148	273
	12.20	15.50	43	168	275
	11.70	14.90	35	155	273
	11.61	14.79	18	143	310
	11.60	14.73	23	108	275
	11.71	14.95	13	125	258
	12.46	15.79	25	173	245
	11.57	14.63	15	115	210
0	11.45	14.51	10	140	233
an	11.82	15.00	22	143	256
V	3.1	3.0	48.8	15.0	12.4
	0.37	0.46	10	21	32
95	0.26	0.33	8	15	23
ax	12.46	15.79	43	173	310
in	11.45	14.51	10	108	210

ER 4 - SX R 2.0 Sun 02.01.11 14:15 Operator RM Page 1

NDIA TEXTILE RESEARCH ASSN. PO BOX NO : 3205 COIMBATORE - 641014

TRA Sample ID 08529 Nom. count Nec 60 Nom. twist 0 T/m

/ 1 v= 400 m/min t= 1 min Meas. slot 4 Short staple

perfections

Y-9781 Material class Yarn Mach. Nr.

LE-B 57 COPS

	U% %	CVm %	Thin -50% /km	Thick +50% /km	Neps +200% /km
	11.84	14.99	25	123	250
	11.97	15.20	33	155	215
	11.52	14.64	20	155	240
	12.24	15.50	23	195	210
	11.76	14.95	8	165	315
	12.16	15.36	33	143	235
	11.60	14.68	18	140	278
	12.32	15.65	43	193	288
	12.20	15.44	38	195	223
	11.85	14.98	15	138	250
	11.95	15.14	25	160	250
	2.3	2.3	43.1	16.4	13.5
	0.28	0.35	11	26	34
	0.20	0.25	8	19	24
	12.32	15.65	43	195	315
	11.52	14.64	8	123	210

INDIA TEXTILE RESEARCH ASSOCIATION

	60s		Length:	125 km
er:	Y_9747-0015		Weight:	1.23 kg
	60.0 Nec		Speed:	650 m/min
	60s,SAMPLE-A			
	60 COPS			
	BM			

lts: Cumulative/Absolute/All (Actual/Machine)

[%]	0.1 – 1	1 – 2	2 – 4	4 – 8	8 – 32	32 – 64 [cm]
00	A4 8	B4 16	C4 4	D4 4	E 7	
00	A3 53	B3 40	C3 10	D3 8		
250	A2 356	B2 89	C2 23	D2 12		
150	A1 1817	B1 115	C1 27	D1 17		
100	A0 19352	B0 1018	C0 153	D0 36	F 12	G 1
-45						
30		TB1 83079	TC1 29181	TD1 2997	H1 82	I1 1
45		TB2 5799	TC2 5684	TD2 1233	H2 71	I2 1
75						

ults: Cumulative/Per 100 km/All (Actual/Machine)

[%]	0.1 – 1	1 – 2	2 – 4	4 – 8	8 – 32	32 – 64 [cm]
600	A4 6.4	B4 12.8	C4 3.2	D4 3.2	E 5.6	
400	A3 42.4	B3 32.0	C3 8.0	D3 6.4		
250	A2 284.8	B2 71.2	C2 18.4	D2 9.6		
150	A1 1453.6	B1 92.0	C1 21.6	D1 13.6		
100	A0 15481.6	B0 814.4	C0 122.4	D0 28.8	F 9.6	G 0.8
0/45						
- 30		TB1 66463.2	TC1 23344.8	TD1 2397.6	H1 65.6	I1 0.8
- 45		TB2 4639.2	TC2 4547.2	TD2 986.4	H2 56.8	I2 0.8
- 75						

UTH INDIA TEXTILE RESEARCH ASSOCIATION

icle:	60s	Length:	125 km
t Number:	Y_9781-0016	Weight:	1.23 kg
n count:	60.0 Nec	Speed:	650 m/min
terial:	60s,SAMPLE-B		
mment:	57 COPS		
erator:	BM		

MT Results: Cumulative/Absolute/All (Actual/Machine)

[%]	0.1–1	1–2	2–4	4–8	8–32	32–64 [cm]
600–400	A4 11	B4 17	C4 10	D4 3	E 2	
400–250	A3 41	B3 35	C3 20	D3 8		
250–150	A2 363	B2 86	C2 33	D2 15		
150–100	A1 1586	B1 123	C1 36	D1 16		
100–70/45	A0 16608	B0 833	C0 149	D0 28	F 7	G 0
- 30		TB1 73253	TC1 25182	TD1 2202	H1 40	I1 0
- 45		TB2 3817	TC2 3814	TD2 754	H2 24	I2 0
- 75						

MT Results: Cumulative/Per 100 km/All (Actual/Machine)

[%]	0.1–1	1–2	2–4	4–8	8–32	32–64 [cm]
600–400	A4 8.8	B4 13.6	C4 8.0	D4 2.4	E 1.6	
400–250	A3 32.8	B3 28.0	C3 16.0	D3 6.4		
250–150	A2 290.6	B2 68.9	C2 26.4	D2 12.0		
150–100	A1 1269.8	B1 98.5	C1 28.8	D1 12.8		
100–70/45	A0 13297.0	B0 666.9	C0 119.3	D0 22.4	F 5.6	G 0.0
- 30		TB1 58649.3	TC1 20161.7	TD1 1763.0	H1 32.0	I1 0.0
- 45		TB2 3056.0	TC2 3053.6	TD2 603.7	H2 19.2	I2 0.0
- 75						

USTER TENSORAPID 3 V7.0 WE 3-01-11 9:49 Operator: M.K

Article number:SITRA Test number:Y-9747 Mean count: 60.00 Nec
60s C ; SAMPLE:A 10 COPS
Tests: 10/20 v = 5000 mm/min. FV = 5.0 gf LH = 500 mm P_{ci} = 112 N/cm² (10%)
Limits: F: 0.00 / 0.50 kgf E: 0.00 / 10.00 %

OVERALL REPORT:

	Time to Br. (s)	B-Force (gf)	Elongation (%)	Rkm (kgf*Nm)	B-Wor (gf.cm
Test 1:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	165.9	4.93	16.85	217.
Test 2:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	165.5	4.83	16.82	215.
Test 3:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	174.0	5.07	17.68	228.
Test 4:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	172.6	5.19	17.53	236
Test 5:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	159.6	4.96	16.22	210
Test 6:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	166.7	5.19	16.94	226
Test 7:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	166.3	5.13	16.89	223
Test 8:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	163.5	4.84	16.60	211
Test 9:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	154.6	4.91	15.70	201
Test 10:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	165.9	5.00	16.85	220
Overall results: (total)					
10 Test(s)/	200 Single test(s)		(Outside limit values:		0)
Mean value	0.3	165.5	5.00	16.81	219
s +/-		15.2	0.47	1.54	35
CV%		9.17	9.43	9.17	16
Q95% +/-		2.1	0.07	0.21	4
Min. value		119.3	3.38	12.12	110
Max. value		204.1	6.32	20.73	302

USTER TENSORAPID 3 V7.0 WE 3-01-11 9:24 Operator: M.K P

Article number:SITRA Test number:Y-9781 Mean count: 60.00 Nec
60s C ; SAMPLE:B 10 COPS
Tests: 10/20 v = 5000 mm/min. FV = 5.0 gf LH = 500 mm p_{c1} = 112 N/cm² (10%)
Limits: F: 0.00 / 0.50 kgf E: 0.00 / 10.00 %

OVERALL REPORT:

	Time to Br.	B-Force	Elongation	Rkm	B-Work
	(s)	(gf)	(%)	(kgf*Nm)	(gf.cm)
Test 1:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	164.5	4.83	16.71	211.7
Test 2:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	161.9	4.57	16.44	198.6
Test 3:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	177.4	5.18	18.03	233.4
Test 4:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	168.1	4.63	17.07	205.5
Test 5:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	164.3	4.70	16.69	203.5
Test 6:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	156.1	4.55	15.86	192.5
Test 7:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	165.9	5.16	16.85	223.3
Test 8:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	151.9	4.51	15.44	185.8
Test 9:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	158.6	4.85	16.11	202.4
Test 10:	20 Single test(s)		(Outside limit values:		0)
Mean value	0.3	171.4	4.73	17.41	218.1
Overall results: (total)					
10 Test(s)/	200 Single test(s)		(Outside limit values:		0)
Mean value	0.3	164.0	4.77	16.66	207.5
s +/-		17.7	0.53	1.80	38.4
CV%		10.82	11.06	10.82	18.5
Q95% +/-		2.5	0.07	0.25	5.4
Min. value		117.2	3.38	11.90	114.7
Max. value		201.0	6.19	20.42	291.0

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION
SITRA PHYSICAL LABORATORY
13/37, Avanashi Road, Aerodrome P.O., Coimbatore - 641 014, INDIA.
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E-mail : sitraindia@dataone.in sitra@vsnl.com Website : http://www.sitra.org.in
Address all correspondence to the Director
ISO/IEC 17025 : 2005 NABL ACCREDITED
Cert. Number : T-358

Yarn Test Report No.:4828 V.R.Textiles

Samples Tested at : R.H. 65% +/- 2% and Temp. 21 Degree C +/- 1 Degree C

Lab Code No.	Y_10143	Y_10144
Sample Particulars.:	60s C SAMPLE-C 60 COPS	60s C SAMPLE-D 60 COPS
U% Imperfection (As per ASTM D 1425-96)		
Mean U%	11.66	11.79
Mean CV%	14.85	14.96
Imperfections/1000 m		
Thin Places (-50%)	14	19
Thick Places (+50%)	139	149
Neps (+200%)	288	270
Hairiness (Zweigle) (As per ASTM D-5647-07)		
No. of Protruding Hairs per 100 Mtrs (3mm and above)	880	919
Hairiness Index	38	45

End of Report

R. Ganapathy

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION
SITRA PHYSICAL LABORATORY

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Address all correspondence to the Director ISO/IEC 17025 : 2005 NABL ACCREDITED
Cert. Number : T-358

Yarn Test Report No.:4828 V.R.Textiles

Samples Tested at : R.H. 65% +/- 2% and Temp. 21 Degree C +/- 1 Degree C

Lab Code No.	Y_10143	Y_10144
Sample Particulars.:	60s C SAMPLE-C 60 COPS	60s C SAMPLE-D 60 COPS

Single Yarn Tenacity and Elongation (UTR)
(As per Uster Standard Method ASTM D 2256-02)

Actual Strength (g)	169.1	168.6
CV% of Strength	9.23	9.88
% Elongation	5.31	5.26
CV% of Elongation	9.55	9.31
RKm (g/tex)	17.18	17.12

R. Rampathy

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Address all correspondence to the Director ISO/IEC 17025 : 2005 NABL ACCREDITED

Cert. Number : T-358

Yarn Test Report No.:4828 V.R.Textiles

Samples Tested at : R.H. 65% +/- 2% and Temp. 21 Degree C +/- 1 Degree C

Lab Code No.	Y_10143	Y_10144
Sample Particulars.:	60s C SAMPLE-C 60 COPS	60s C SAMPLE-D 60 COPS

Yarn Faults (CMT-III) : Cummulative/100 Km
(As per ASTM-D-6197-99) (Reapproved 2005)

Fault Length (cm)	Fault Cross Sectional Size%	Type of Fault	Y_10143	Y_10144
0.1 - 1	+100 to +150	A1	1935 ✓	1378 ✓
0.1 - 1	+150 to +250	A2	398	317
0.1 - 1	+250 to +400	A3	44	53
0.1 - 1	Above +400	A4	13	16
1 - 2	+100 to +150	B1	109 ✓	109 ✓
1 - 2	+150 to +250	B2	74	83
1 - 2	+250 to +400	B3	30	38
1 - 2	Above +400	B4	11	18
2 - 4	+100 to +150	C1	39 ✓	30 ✓
2 - 4	+150 to +250	C2	30	23
2 - 4	+250 to +400	C3	18	14
2 - 4	Above +400	C4	8	8
4 - 8	+100 to +150	D1	10 ✓	11 ✓
4 - 8	+150 to +250	D2	8	10
4 - 8	+250 to +400	D3	4	9
4 - 8	Above +400	D4	2	5
Above 8	Above +100	E	2	6
8 - 32	+45 to +100	F	18	10
Above 32	+45 to +100	G	4	2
8 - 32	-30 to -45	H1	167	30
Above 32	-30 to -45	I1	5	2
8 - 32	-45 to -75	H2	134	21
Above 32	-45 to -75	I2	5	2

Short
Long -> 24

Lea Count & Strength with CV%
(As per ASTM D1907-07 & ASTM D 1578-93 Reapp.2006)

Actual Count (Ne)	57.7	58.5
Actual Strength (lb)	45.1	44.5
Corrected CSP (Ne x lb) / Uncorrected CSP	2572	2584
CV% of Count	1.9	1.8
CV% of Strength	4.3	4.1

R. Ramprathy

Statex Lab data Spinning Wrapping Test Report

The South India Textile Research Association,
Post Box No: 3205,
Civil Aerodrome Post,
Coimbatore - 14.

Supplier : Y-9747	Test Time : 15:45.27	operater : SB
Yarn Count : 60s	Test No : 2261	
Description : 10 COPS	Count Unit : Nec	
Test Date : 03-Jan-2011	Sample Length 120 Yards	

Readings

	1	2	3	4	5	Avg. Value	CV%
Cnt	60.84	58.54	58.33	60.00	58.22	58.53	2.03
Str	40.18	40.09	41.16	40.38	43.69	42.39	5.56
CSP	2445	2347	2400	2423	2543	2480	4.62
	60.00	58.59	59.45	58.80	55.81		
	41.16	42.42	41.64	41.94	45.83		
	2469	2485	2476	2466	2558		
	58.75	58.91	56.30	57.70	57.29		
	41.25	41.55	46.61	40.28	44.17		
	2424	2447	2624	2324	2531		
	59.45	57.09	56.01	58.96	59.02		
	42.42	46.12	48.16	41.06	42.32		
	2522	2633	2697	2421	2498		
	59.67	60.62	58.96	59.83	57.29		
	38.92	42.42	44.08	39.60	36.10		
	2322	2571	2599	2369	2068		
	58.70	57.24	58.33	57.65	57.09		
	40.67	42.81	43.30	45.05	43.10		
	2387	2451	2525	2597	2461		
	59.34	59.23	60.17	58.96	58.75		
	41.64	41.25	39.89	41.45	43.78		
	2471	2444	2400	2444	2572		
	58.96	57.19	58.43	58.17	58.70		
	45.83	44.85	43.30	44.17	40.96		
	2702	2565	2530	2569	2404		

Avg count → 58.5
Avg strength → 42.4
2480.4
19.5
2460.9
Corrected csp → 24
avg
count → 2
strength → 5

Statistical Report

	Avg.	Min.	Max.	CV%	Q95
Count	58.53	55.81	60.84	2.03	0.38
Strength	42.39	36.10	48.16	5.56	0.75
CSP	2480	2068	2702	4.62	36.62

CSP : In Units of Nec.lbs

Remarks:- 60s,SAMPLE-A,10 COPS.

Operator QCM FM

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION,
Post Box No.3205,Coimbatore Aerodrome Post,Coimbatore - 641014.

Ring Frame Department - CSP

Supplier	:Y=10144	Test Date	:29 Jan 2011
Yarn Count	:60s	Test Time	:10:44:39 AM
Yarn Type	:C	Report Type	:Test
Description	:10 COPS	Operator	:AVK

Sample	TestNo	Count	Strength lbs	CSP
Average		58.46	44.48	2599
C.V.%		1.79	4.11	3.13
S.D.%		1.05	1.83	81.42

Comment: 60s C SAMPLE-D 10 COPS

Prepared by Q C F.M. M.D.

Avgct: 58.5
Avgst: 44.5

2603.3
19.5

2583.8

corrcsp: 2584

cv%
ct: 1.8

SITRA

COIMBATORE-14

G 566

INDIVIDUAL RESULTS
1/3/2011 PAGE 1 (1)

DESIGN. : Y-9781

DATE	1/3/2011	MACHINECODE	G566 NR210	60s
TIME	4:14:19 PM	MATERIALCODE	TEST	SAMPLE-B
MATERIAL	10 COPS	BOBBINS	10	
FINENESS	60s	TESTS	1	
PRETENSION	5 cN	LENGTH	100 m	

BOBBIN	TEST	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
1	1	11632	1719	712	186	12	2	0	0	0	0	0	0	912	30
2	1	12499	1638	778	246	19	0	0	0	0	0	0	0	1043	44
3	1	9744	1269	461	108	7	0	0	0	0	0	0	0	576	18
4	1	10789	1418	582	155	12	1	0	0	0	0	0	0	750	30
5	1	10904	1440	483	148	10	1	0	0	0	0	0	0	642	25
6	1	10306	1174	463	108	8	0	0	0	0	0	0	0	579	20
7	1	13625	1752	956	277	18	1	0	0	0	0	0	0	1252	43
8	1	9689	1269	473	104	7	0	0	0	0	0	0	0	584	18
9	1	10797	1429	630	159	11	0	0	0	0	0	0	0	800	27
10	1	9798	1234	453	100	13	0	0	0	0	0	0	0	566	32

OVERALL

	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
MEAN	10978.30	1434.20	599.10	159.10	11.70	0.50	0.00	0.00	0.00	0.00	0.00	0.00	770.40	28.70
MEAN/100m	10978.30	1434.20	599.10	159.10	11.70	0.50	0.00	0.00	0.00	0.00	0.00	0.00	770.40	0.00
S	1284.52	207.19	170.52	61.52	4.16	0.71	0.00	0.00	0.00	0.00	0.00	0.00	234.53	9.27
CV%	11.70	14.45	28.46	38.67	35.60	141.42	0.00	0.00	0.00	0.00	0.00	0.00	30.44	32.31
MAX	13625.00	1752.00	956.00	277.00	19.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1252.00	44.00
MIN	9689.00	1174.00	453.00	100.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	566.00	18.00

SITRA

COIMBATORE-14

G 566

INDIVIDUAL RESULTS

1/19/2011 PAGE 1 (1)

DESIGN. : Y-10143

DATE	1/19/2011	MACHINECODE	G566 NR210	60s C
TIME	2:53:59 PM	MATERIALCODE	TEST	COPS
MATERIAL	10 COPS	BOBBINS	10	SAMPLE-C
FINENESS	60s C	TESTS	1	
PRETENSION	5 cN	LENGTH	100 m	

BOBBIN	TEST	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
1	1	13105	1945	818	233	20	2	0	0	0	0	0	0	1073	47
2	1	13156	1962	691	202	17	1	0	0	0	0	0	0	911	41
3	1	11087	1689	590	166	13	1	0	0	0	0	0	0	770	32
4	1	11129	1558	518	160	15	2	0	0	0	0	0	0	695	36
5	1	11076	1530	666	178	12	5	0	0	0	0	0	0	861	30
6	1	11394	1641	600	141	8	0	0	0	0	0	0	0	749	21
7	1	13253	1913	724	205	16	0	0	0	0	0	0	0	945	39
8	1	10984	1520	541	135	16	1	0	0	0	0	0	0	693	39
9	1	14803	2585	1052	266	31	4	0	0	0	0	0	0	1353	72
10	1	10847	1602	596	142	10	0	0	0	0	0	0	0	748	26

OVERALL

	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
MEAN	12083.40	1794.50	679.60	182.80	15.80	1.60	0.00	0.00	0.00	0.00	0.00	0.00	879.80	38.30
MEAN/100m	12083.40	1794.50	679.60	182.80	15.80	1.60	0.00	0.00	0.00	0.00	0.00	0.00	879.80	0.00
S	1377.98	327.05	158.75	43.24	6.39	1.71	0.00	0.00	0.00	0.00	0.00	0.00	206.13	14.08
CV%	11.40	18.22	23.36	23.65	40.45	107.04	0.00	0.00	0.00	0.00	0.00	0.00	23.43	36.76
MAX	14803.00	2585.00	1052.00	266.00	31.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	1353.00	72.00
MIN	10847.00	1520.00	518.00	135.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	693.00	21.00

SITRA

COIMBATORE-14

G 566

INDIVIDUAL RESULTS

1/?0/2011 PAGE 1 (1)

DESIGN. : Y-10144

DATE	1/20/2011	MACHINECODE	G566 NR210	60s C SAMPLE=D	
TIME	2:13:23 PM	MATERIALCODE	TEST	6 COPS	
MATERIAL	60 COPS	BOBBINS	10		
FINENESS	60s C	TESTS	1		
PRETENSION	5 cN	LENGTH	100 m		

BOBBIN	TEST	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
1	1	12085	1782	648	200	17	0	0	0	0	0	0	0	865	41
2	1	11850	1738	749	223	30	3	0	0	0	0	0	0	1005	68
3	1	13862	2123	778	242	21	4	0	0	0	0	0	0	1045	50
4	1	11795	1856	720	239	21	4	0	0	0	0	0	0	984	50
5	1	11284	1519	530	143	17	0	0	0	0	0	0	0	690	41
6	1	11536	1700	678	196	14	0	0	0	0	0	0	0	888	34
7	1	13392	2036	901	241	33	2	0	0	0	0	0	0	1177	75
8	1	11317	1792	655	160	9	0	0	0	0	0	0	0	824	23
9	1	11983	1782	702	193	18	0	0	0	0	0	0	0	913	43
10	1	11248	1574	629	160	10	0	0	0	0	0	0	0	799	25

OVERALL

	1mm*	2mm*	3mm*	4mm*	6mm*	8mm	10mm	12mm	15mm	18mm	21mm	25mm	S3	Index
MEAN	12035.20	1790.20	699.00	199.70	19.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	919.00	45.00
MEAN/100m	12035.20	1790.20	699.00	199.70	19.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	919.00	0.00
S	895.94	184.63	99.13	36.53	7.75	1.77	0.00	0.00	0.00	0.00	0.00	0.00	138.98	16.73
CV%	7.44	10.31	14.18	18.29	40.77	135.92	0.00	0.00	0.00	0.00	0.00	0.00	15.12	37.18
MAX	13862.00	2123.00	901.00	242.00	33.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1177.00	75.00
MIN	11248.00	1519.00	530.00	143.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	690.00	23.00
F	[illegible]	[illegible]	[illegible]											

[illegible]

COUNT;60SCCbd

FLUTE ANGLE VERSES HAIRINESS INDEX

One-way ANOVA: HAIRINESS INDEX versus FLUTE ANGLE

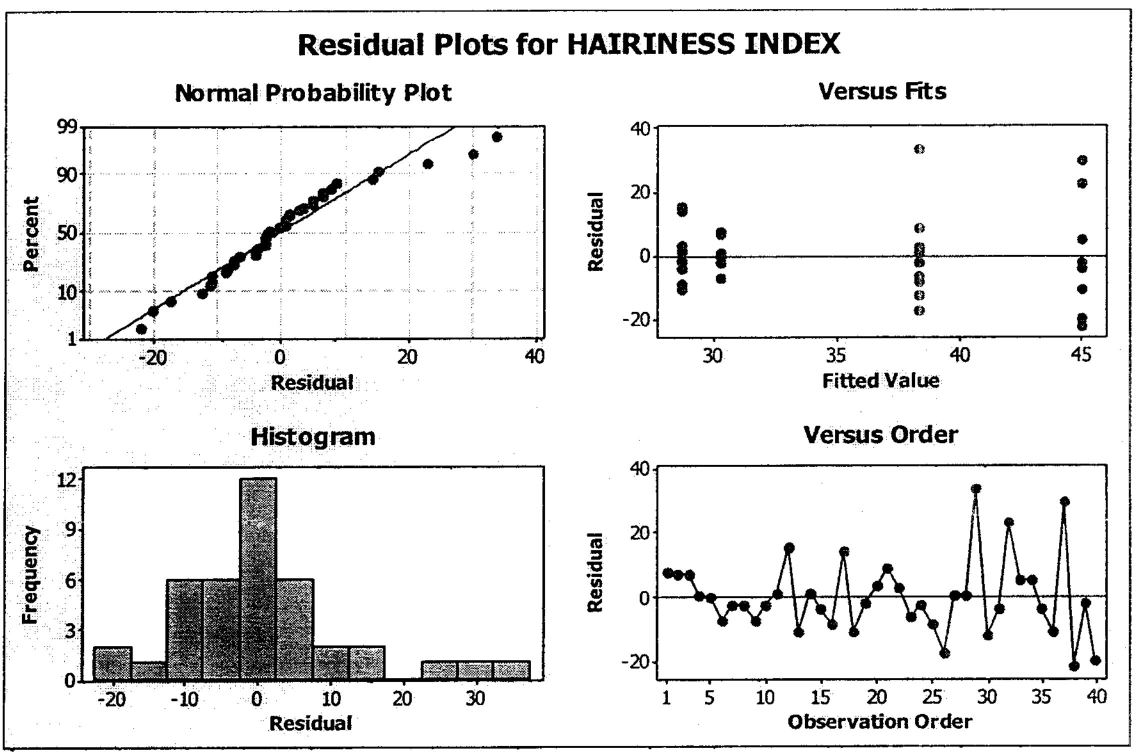
Source	DF	SS	MS	F	P
FLUTE ANGLE	3	1713	571	3.84	0.017
Error	36	5350	149		
Total	39	7064			

S = 12.19 R-Sq = 24.26% R-Sq(adj) = 17.95%

```
                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level   N   Mean  StDev  ----+---------+---------+---------+-----
1      10  30.30   5.50    (---------*---------)
2      10  28.70   9.27  (---------*---------)
3      10  38.30  14.08             (---------*---------)
4      10  45.00  16.73                     (---------*---------)
                         ----+---------+---------+---------+-----
                          24.0      32.0      40.0      48.0
```

Pooled StDev = 12.19

Residual Plots for HAIRINESS INDEX



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COUNT;60SC Cbd

FLUTE ANGLE VERSES HAIRINESS VALUE(S3)

One-way ANOVA: hairiness versus Flute angle

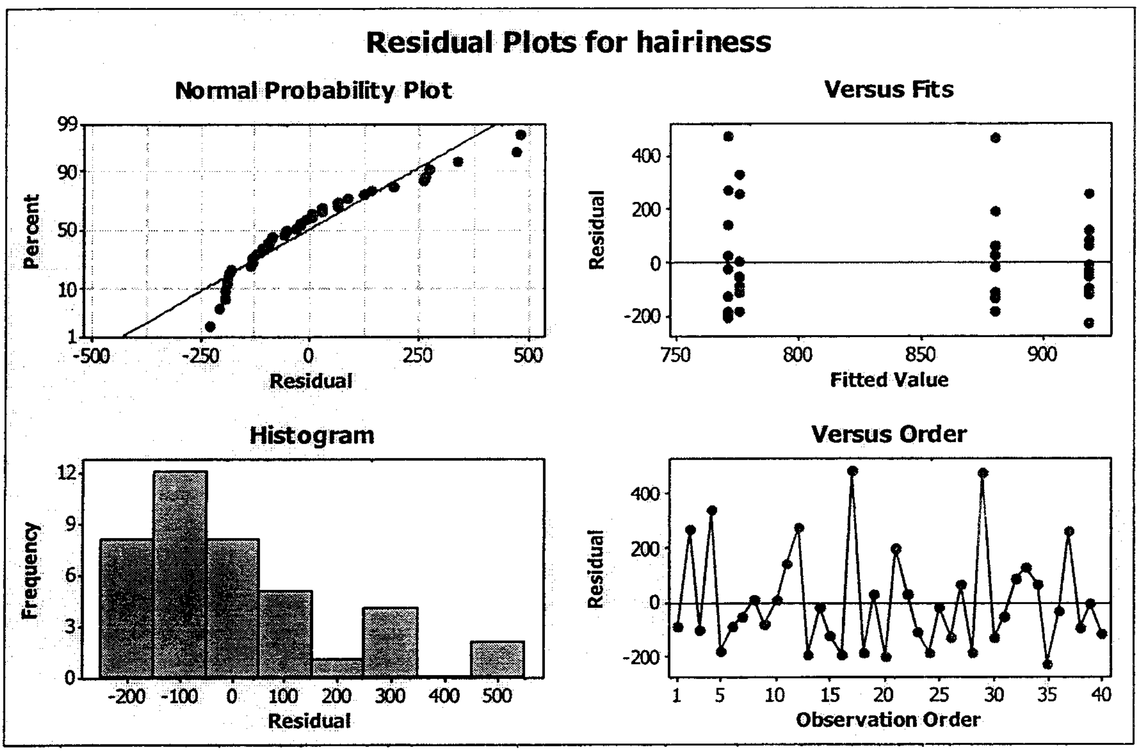
Source	DF	SS	MS	F	P
Flute angle	3	167709	55903	1.54	0.221
Error	36	1305685	36269		
Total	39	1473394			

S = 190.4   R-Sq = 11.38%   R-Sq(adj) = 4.00%

```
                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level   N   Mean  StDev  -----+---------+---------+---------+----
1      10  775.5  168.1  (------------*-----------)
2      10  770.4  234.5  (-----------*-----------)
3      10  879.8  206.1            (-----------*-----------)
4      10  919.0  139.0               (-----------*-----------)
                         -----+---------+---------+---------+----
                            700       800       900      1000
```

Pooled StDev = 190.4

Residual Plots for hairiness



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COUNT;60SC Cbd
FLUTE ANGLE VERSES ELONGATION

One-way ANOVA: elongation versus Flute angle

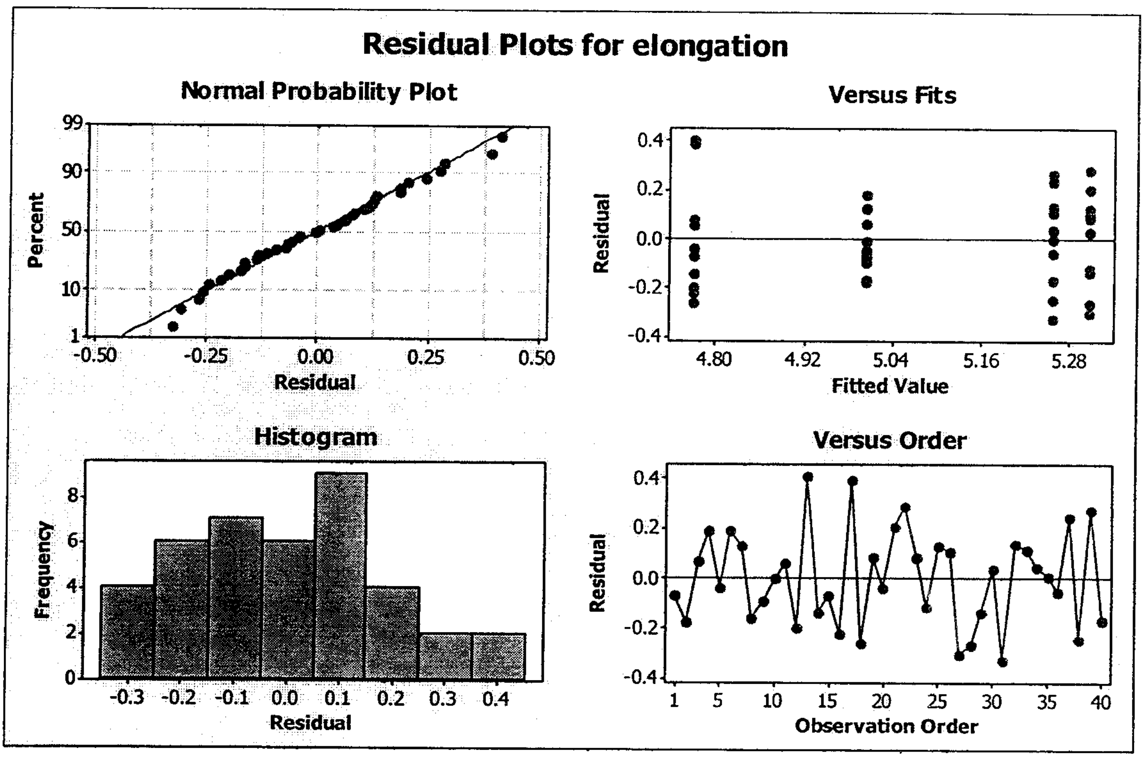
Source	DF	SS	MS	F	P
Flute angle	3	1.8421	0.6140	15.87	0.000
Error	36	1.3931	0.0387		
Total	39	3.2352			

S = 0.1967   R-Sq = 56.94%   R-Sq(adj) = 53.35%

```
                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level   N    Mean   StDev  --------+---------+---------+---------+-
1      10  5.0050  0.1345              (-----*------)
2      10  4.7710  0.2386  (------*-----)
3      10  5.3070  0.1980                               (-----*------)
4      10  5.2580  0.2014                            (-----*-----)
                           --------+---------+---------+---------+-
                                4.80      5.00      5.20      5.40
```

Pooled StDev = 0.1967

Residual Plots for elongation



```
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```
COUNT;60SC CBD

FLUTE ANGLE VERSES TENACITY

One-way ANOVA: tenacity versus flute angle

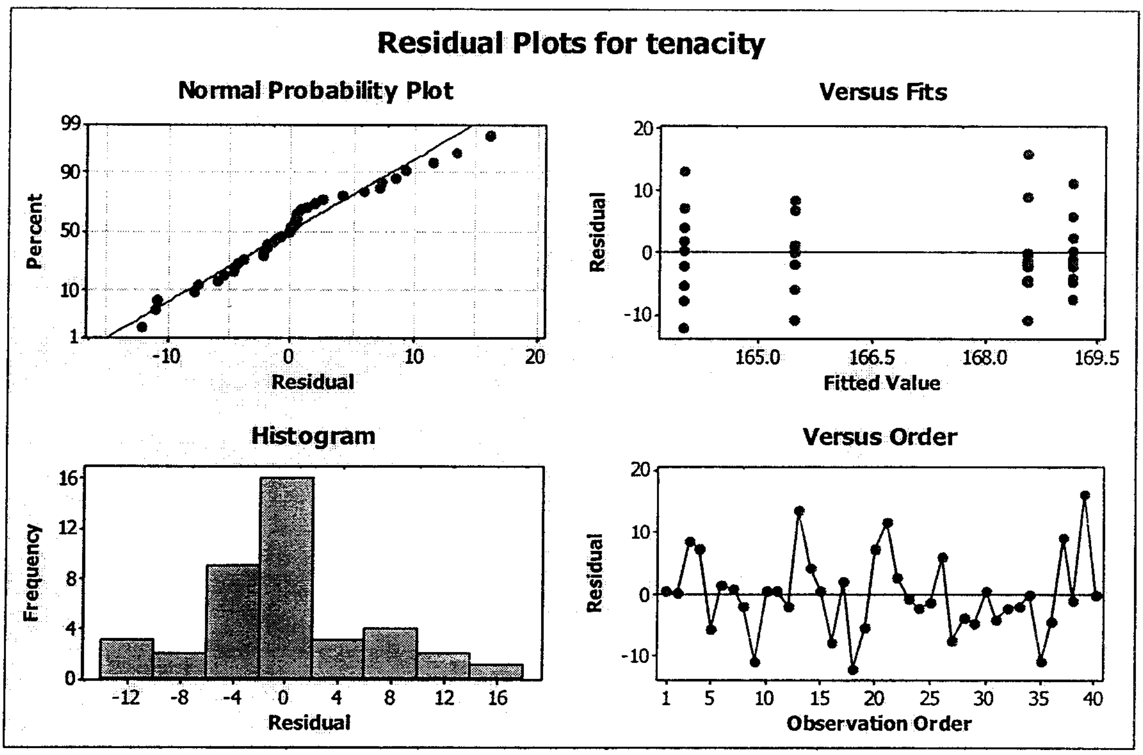
Source	DF	SS	MS	F	P
flute angle	3	183.2	61.1	1.40	0.259
Error	36	1570.7	43.6		
Total	39	1754.0			

```
S = 6.605   R-Sq = 10.45%   R-Sq(adj) = 2.98%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level   N    Mean  StDev  ----+---------+---------+---------+-----
1      10  165.46   5.60       (-----------*-----------)
2      10  163.99   7.43  (------------*-----------)
3      10  169.16   5.50              (------------*-----------)
4      10  168.55   7.59            (------------*-----------)
                          ----+---------+---------+---------+-----
                          161.0     164.5     168.0     171.5

Pooled StDev = 6.61
```

Residual Plots for tenacity



```
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```

COUNT;60SC Cbd

FLUTE ANGLE VERSES NEPS

One-way ANOVA: neps versus flute angle

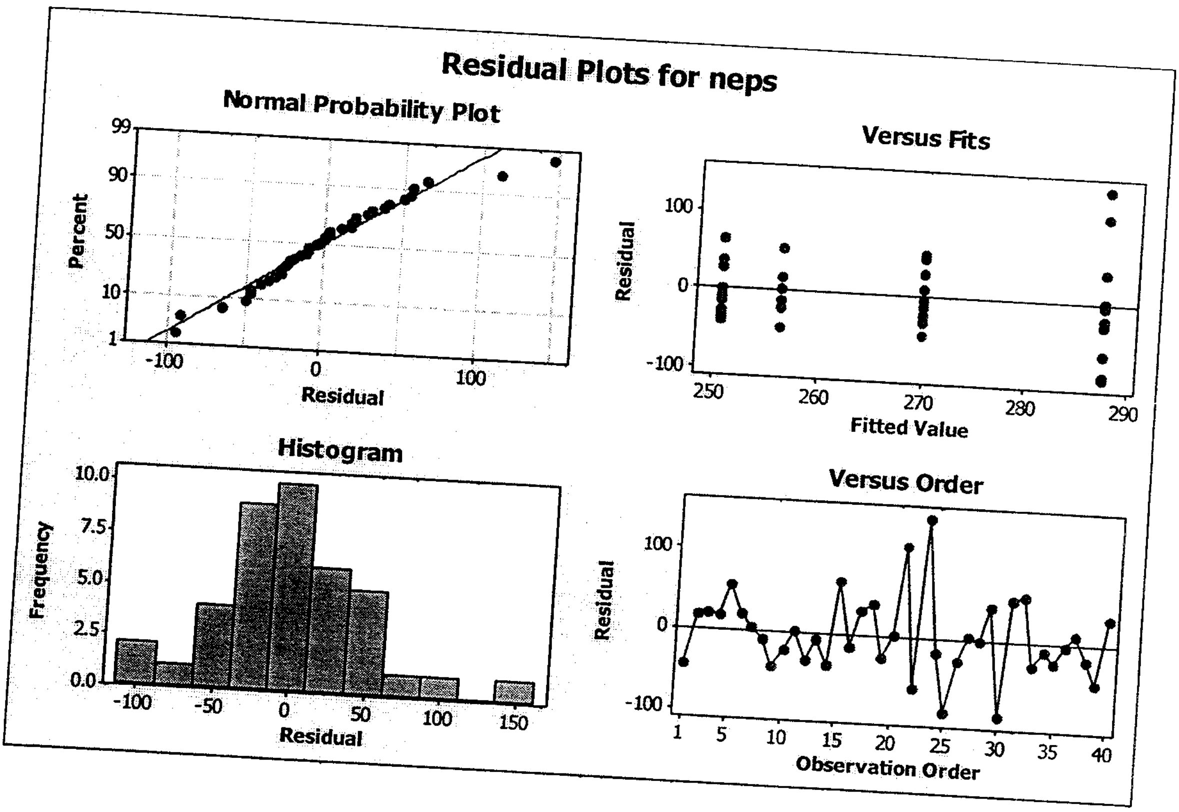
```
Source         DF     SS    MS     F      P
flute angle     3   8255  2752  1.11  0.360
Error          36  89607  2489
Total          39  97862

S = 49.89   R-Sq = 8.44%   R-Sq(adj) = 0.80%


                              Individual 95% CIs For Mean Based on
                              Pooled StDev
Level   N    Mean  StDev  -------+---------+---------+---------+--
1      10  256.20  31.80     (---------*----------)
2      10  250.40  33.88  (---------*----------)
3      10  287.70  80.86              (----------*----------)
4      10  269.90  35.48         (----------*----------)
                          -------+---------+---------+---------+--
                               240       270       300       330

Pooled StDev = 49.89
```

Residual Plots for neps



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COUNT;60SC Cbd

FLUTE ANGLE VERSES THICK PLACE

One-way ANOVA: thickplaces versus flute angle

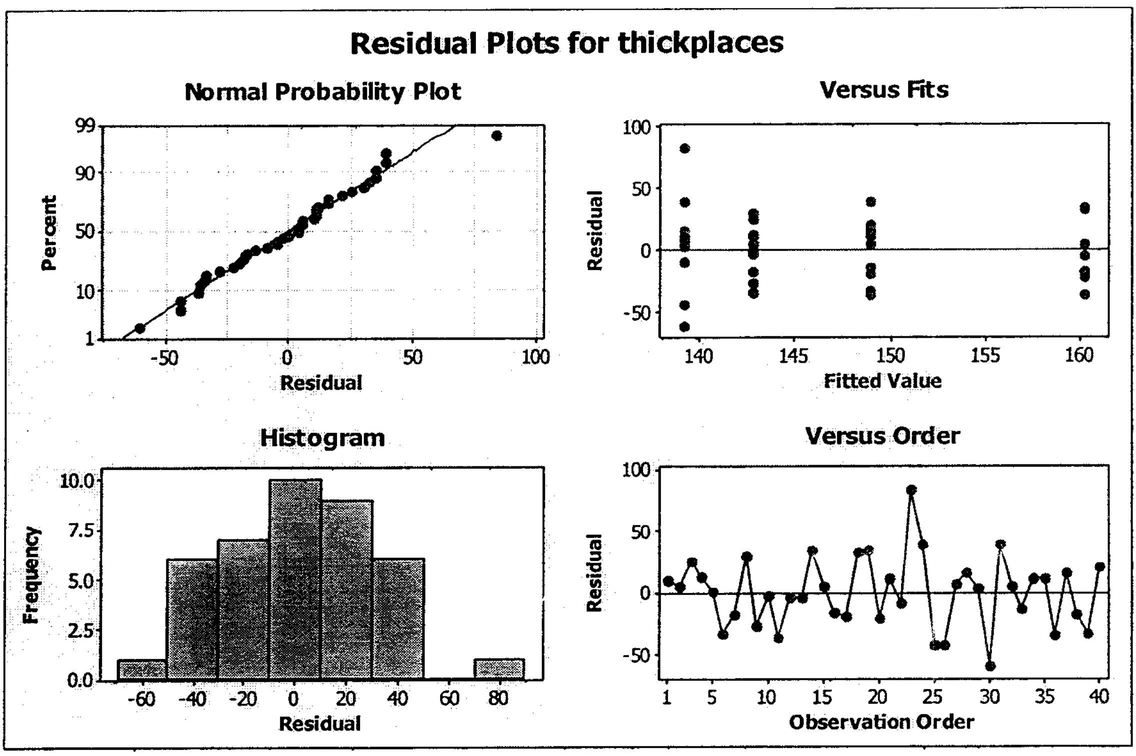
Source	DF	SS	MS	F	P
flute angle	3	2539	846	0.94	0.432
Error	36	32456	902		
Total	39	34995			

S = 30.03   R-Sq = 7.26%   R-Sq(adj) = 0.00%

```
                               Individual 95% CIs For Mean Based on Pooled StDev
Level   N    Mean  StDev  +---------+---------+---------+---------
1      10  142.80  21.44    (------------*------------)
2      10  160.20  26.15                (------------*------------)
3      10  139.20  43.05  (------------*------------)
4      10  148.90  24.69        (------------*------------)
                          +---------+---------+---------+---------
                        120       135       150       165
```

Pooled StDev = 30.03

Residual Plots for thickplaces



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COUNT;60S Cbd
FLUTES ANGLE VERSES THIN PLACES

One-way ANOVA: THIN PLACES versus FLUTE ANGLE

Source	DF	SS	MS	F	P
FLUTE ANGLE	3	683.5	227.8	2.50	0.075
Error	36	3284.0	91.2		
Total	39	3967.5			

S = 9.551   R-Sq = 17.23%   R-Sq(adj) = 10.33%

```
                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level   N    Mean   StDev  -------+---------+---------+---------+--
1      10  21.800  10.497                (---------*----------)
2      10  25.600  10.977                      (----------*---------)
3      10  14.200   7.223  (----------*---------)
4      10  19.400   9.058           (---------*----------)
                           -------+---------+---------+---------+--
                               12.0      18.0      24.0      30.0
```

Pooled StDev = 9.551

Residual Plots for THIN PLACES