Mansoura Engineering Journal, (MEJ), Vol. 26, No. 3, September 2001. T. 20

EFFECT OF FRONT TOP ROLL ECCENTRICITY IN RING SPINNING ON YARN REGULARITY AND IMPERFECTIONS

دراسة تأثير لامركزية الدرفيل الأمامي العلوى فى ماكينة الغزل على انتظامية وعيوب الخيوط المنتجة

by

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خلاصة:

الهدف من البحث هو دراسة تأثير لامركزية الدرفيل الأمامي العلوى فى جهاز السحب بماكينة الغزل على انتظامية الخيوط والعيوب الموجودة بها من أماكن رفيعة وسميكة ونبس وذلك فى وجود متغيرات أخرى . حيث تم انتاج خيط ٤٠ انجليزى عند سبع مستويات لمركزية الدرفيل العلوى ، ثلاث مستويات للضغط على الدرافيل العلوية ، ثلاث مستويات لتوزيع الضغط على الدرافيل العلوية وذلك عند سرعتى انتاج مختلفتين. وقد أوضحت النتائج أن : بزيادة لامركزية الدرفيل العلوى تزداد العيوب وتسوء انتظامية الخيوط ، يزداد تأثير اللامركزية على خواص الخيوط بزيادة سرعة الانتاج . كما وجد أن الضغط على الدرافيل العلوية و توزيع الضغط يؤثران على المناطق الرفيعة والسميكة والنبس عند سرعة الانتاج العالية .

ABSTRACT

The study reported in this paper concerns the influences of front top roll eccentricity (in ring spinning machine), loading the top arm, pressure distribution on top arm through changing pin position and delivery speed on yarn irregularity and imperfections (thin, thick places and neps). The results show that: roll eccentricity has a positive effect on yarn irregularity and imperfections. This effect increases by increasing delivery speed. Loading the top arm of 2.3 bar with first pin position or 1.7 bar at third pin position reduced thin, thick places and neps at the higher delivery speed. Also pressure distribution (or pin position) influences yarn irregularity and imperfections at the higher delivery speed.

1-INTRODUCTION

In an earlier paper Gregory and Tyson (1) showed that the primary cause of the irregularity due to defective front top drafting roller is movement of front roller nip along the line of draft, and that there are three main causes of nip movement which are: (a) roller eccentricity, (b) varying compressibility of the roller covering, (c) interaction between the bosses of double- boss roller. Eccentricity of the roller causes the contact between top and bottom to move forward and backward across the surface of the bottom roller, but varying compressibility and interaction cause variation in width of the area of contact, and, hence movement of the rear fibre edge of the contact at which the fibers are taken up by the rollers.

Accepted September 16, 2001

For bottom roll in addation to the nip movement caused by eccentric roll, there is another factor, which is variation in surface speed. Top roll eccentricity does not cause any variation in surface speed, since it is driven by contact with the bottom roll.

The movement of the back roller nip has no effect (2); it is the front roller nip, which is important. During the rotation of the roller it moves forward and backward, the forward movement of the nip makes the fibres ends further apart and therefore to make the drafted sliver thinner than normal, while the backward movement makes fibres ends closer together than they should be, so that the drafted sliver would be thicker than normal.

Periodic variation in surface speed, due to bottom roller eccentricity, produces thin and thick places as a result of periodic decreases and increases in draft.

Lawerence (6) stated that increasing bottom roll run-out up to 0.010 inch decreased yarn break factor by 11%, single end strength by 15% and single end elongation by 14% and increased yarn irregularity by 12%

Gregory and Tyson (1) stated that the additional variation introduced to the yarn by eccentric roll is proportional to some parameters as given by the following formula: eccentricity x draft / roller circumference, the draft being the draft in the zone just prior to the eccentric roll. So roller eccentricity is more effective on higher drafting systems; since higher draft means higher front zone draft.

Foster (3) discussed the ealier formula and stated that the defective drafting with eccentric bottom roll arises in the same manner as with eccentric top roll.

Keyser et.al (4) stated that as run-out of front bottom roll increases yarn irregularity and decreases strength, while back and middle roll run-out have no influence on yarn regularity and strength. Also as the amount of draft in spinning increases the effect of bottom roll run-out on yarn quality increases.

Foster and Tyson (5) measured the amplitude of the wave produced by pure eccentricity and compared it with the theoretical amplitude and found that there is agreement between the two amplitudes. They also stated that the amplitude of the wave produced, in cotton yarn by an eccentric top front roll, is proportional to the eccentricity of the roller and the draft minus one. They also stated that as the amplitude of the wave increases yarn strength decreases slowly at first, and then very rapidly, when the amplitude exceeds 8% a fall of 5% in yarn strength takes place.

The main object of this work is to investigate the effect of front top roller eccentricity different top roller pressure, different pressure distribution in the top arm and delivery speed on yarn irregularity and imperfections (thin, thick places and neps).

2-EXPERIMENTAL DETAILS

2-1-EXPRIMENTAL VARIABLES

The following four parameter were chosen to study their effect on yarn regularity and imperfections:

2-1-1-Front top roller eccentricity (e: 7 levels)

In order to investigate the effect of eccentric front top roll, actual eccentricity of top roll in 24 spinning unit, in spinning frame, was measured and mean values were calculated. Measurements showed that the 24 unit contain 7 values for front top roll eccentricity, which are: 1, 2, 3, 4, 5, 6 and 8 x 10^{-3} inch

2-1-2-Loading the top arm (p: 3 levels)

Three values of top roller pressure were chosen according to experimental limits as follows: 1.7, 2 and 2.3 bar

2-1-3-Pressure distribution in top arm (d: 3 levels)

In Rieter spinning machine G5/1 there are two pins (pin1 and pin2) in the top arm. Each pin has three position or holes and must be inserted in the recommended positions according to cradle length to obtain approximately indentical pressure condition with all cradle lengths. For example, with the cradle used in experiments (36mm), first position is recommended for pin1 and pin2 at normal setting. Changing pin position redistribute top roller pressure, where pressure distribution of the front top roll changes by changing the position of pin1 from 1st to 2nd to 3rd position and the same effect of pin2 on back roller. In this work trails are carried out to study the effect of changing pressure distribution of front top roller by using different three positions for pin1 at the same cradle length which lead to have three different pressure distributions of front top roller at 1st position, at 2nd and at 3rd pin' position.

2-1-4- Delivery speed (v_r: 2 levels)

Experiments were carried out at spindle speed of 11000 and 12000 r/min. and accordingly two values of delivery speed were included, which are 13 and 14.2 m/min. since yarn twist is constant

2-2-PLAN OF EXPERIMENTS

Complete plan of experiments was carried out including the previous four variables at the shown levels ie, 126 yarn were produced at the levels 7 x 3 x 3 x 2 for the parameters e x p x d x v

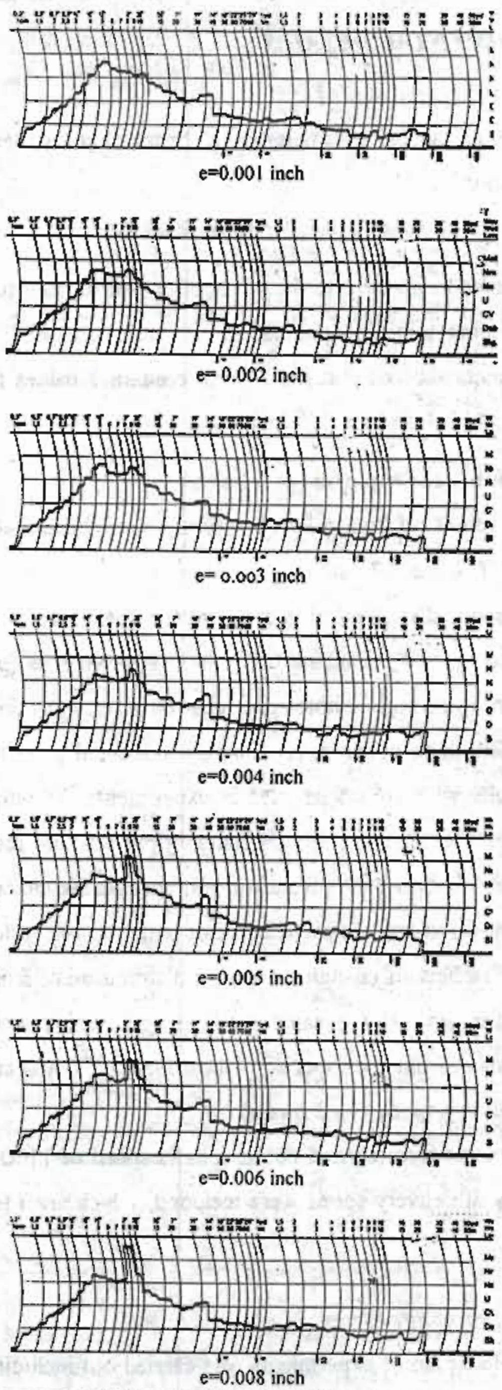


FIG (1-a) SET OF SPECTROGEAMS OF TOP ROLL ECCENTRICITIES

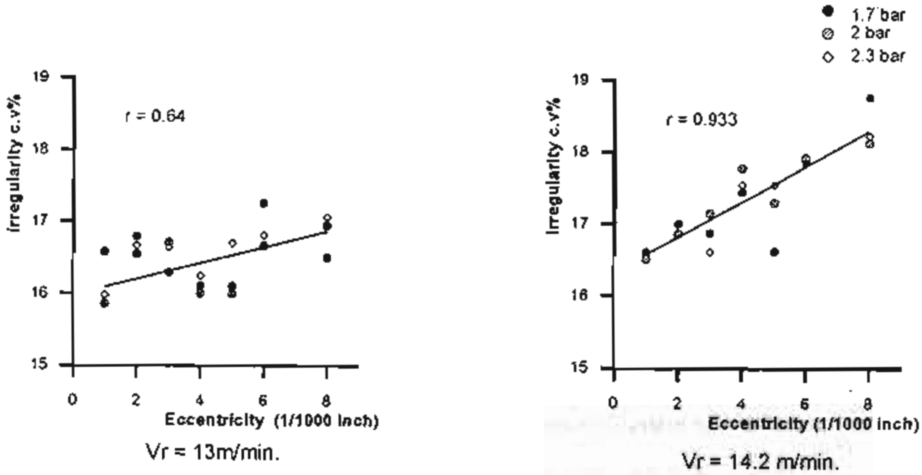


FIG. (1-1) AT FIRST PIN POSITION

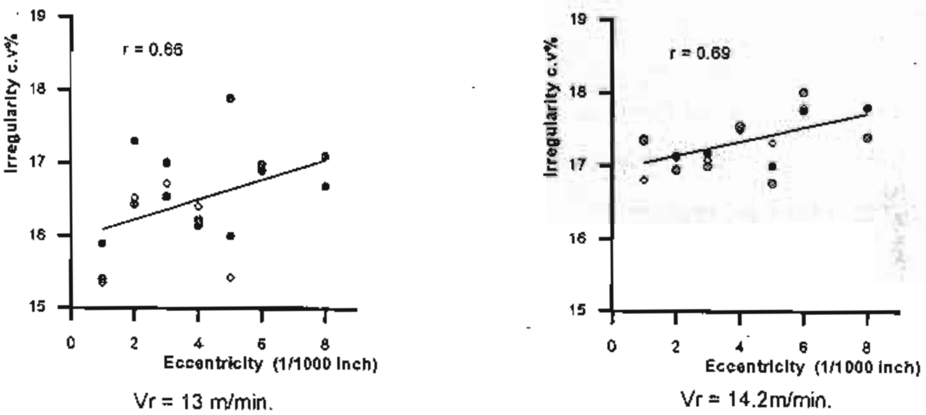


FIG. (1-2) AT SECOND PIN POSITION

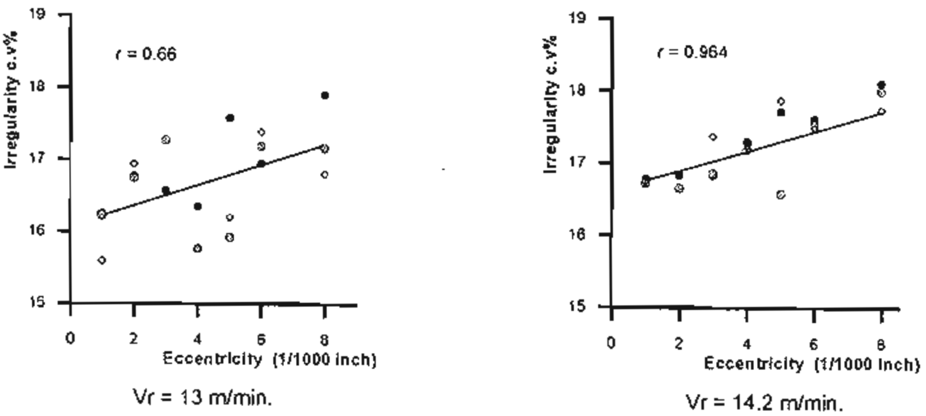


FIG. (1-3) AT THIRD PIN POSITION

FIG. (1) INFLUENCE OF TOP ROLLER ECCENTRICITY ON YARN IRREGULARITY

2-3- YARN PRODUCTION AND MEASUREMENTS

Egyptian cotton fibres (G 75) was processed to roving of 1.2 Ne which spun to carded yarn 40 Ne for knitting with twist factor α_e = 3.4, using Rieter (G5/1) spinning machine and considering the following variables:

break draft = 1.14, front top roller dia. = 30 mm, front bottom roller dia. = 27 mm, cradle type (R 2 P 36) , and length =36 mm, traveller number 3/0 and spindle speed 11000 and 12000 r/min.

Irregularity (c.v%) and imperfections per 1000 m (thin, thick places and neps) were measured for the produced yarns using Uster Tester III.

2-3-1-Measurement of top roller eccentricity

Top roller eccentricity was measured using roller eccentricity instrument (Shirley).

2-4-Evaluation of results

Measured yarn properties (y as dependent variables) were plotted against front top roller eccentricity (x as independent variable). Also the regression equation between the two variables was calculated and shown in tables I, III, and IV. Regression equations are plotted and correlation coefficients were calculated.

3-RESULTS AND DISCUSSION

3-1-YARN IRREGULARITY

Fig. (1) shows the influence of top roller eccentricity on yarn irregularity and table (I) shows regression equations of yarn irregularity. As top roller eccentricity increases yarn irregularity increases, this is because amplitude of weight variation caused by eccentricity is proportional to roller eccentricity and this is in agreement with previous studies (1), (4), (5).

TABLE (I) REGRESSION EQUATIONS AND CORRALATION COEFFICANTS (r) FOR YARN IRREGULARITY

Delivery speed		13 m/ min.		14.2 m/min.	
		Regression equation	r	Regression equation	r
Pin position	1	Y = 15.98 + 0.11X	0.64	Y = 16.33 + 0.245 X	0.933
	2	Y = 15.95 + 0.137 X	0.66	Y = 16.94 + 0.097 X	0.69
	3	Y = 16.07 + 0.142 X	0.66	Y = 16.61 + 0.137X	0.964

Fig (1-a) shows set of spectrograms for various eccentricities (at 1.7 bar and third pin position) and table (II) shows calculated amplitudes of the faults caused by different values of top roller eccentricity according to the formula introduced by (7)

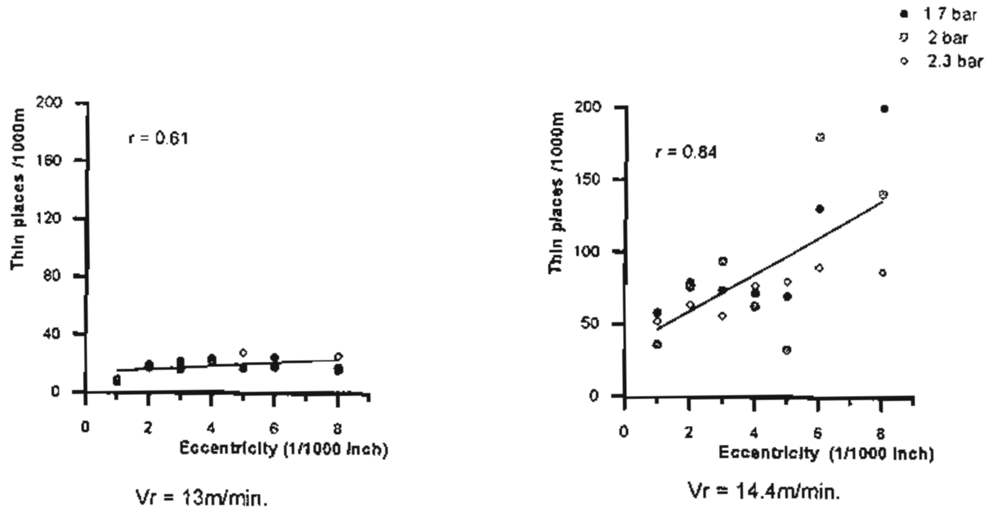


FIG. (2-1) AT FIRST PIN POSITION

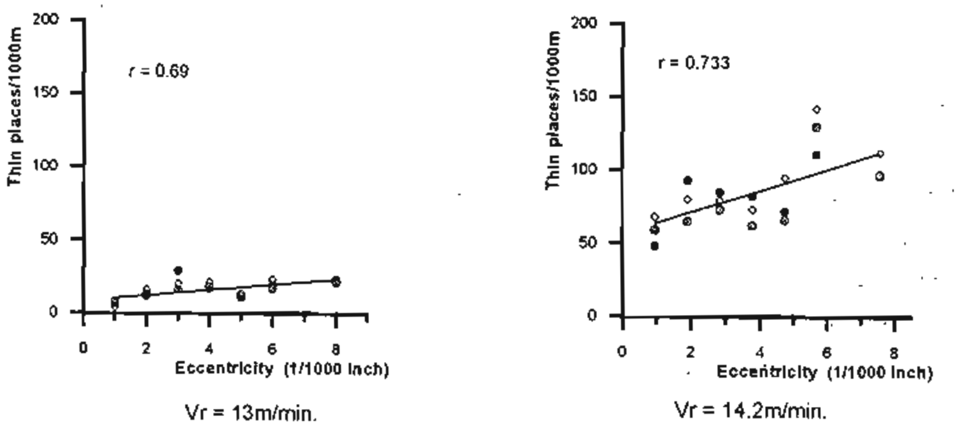


FIG. (2-2) AT SECOND PIN POSITION

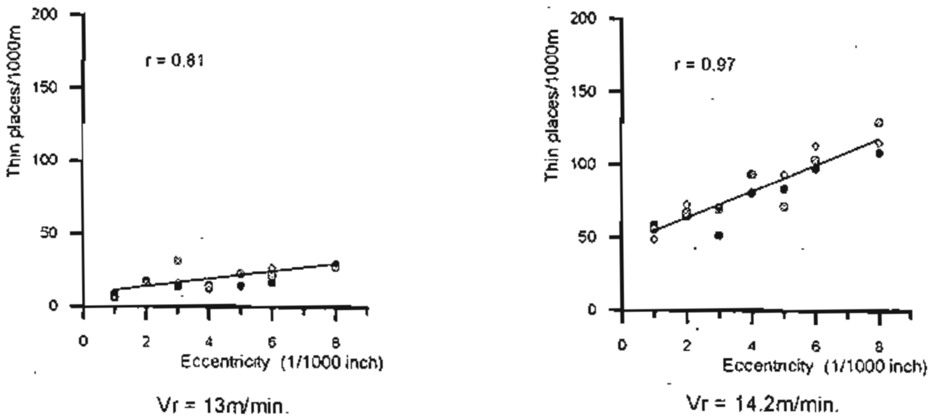


FIG. (2-3) AT THIRD PIN POSITION

FIG.(2) INFLUENCE OF TOP ROLLER ECCENTRICITY ON THIN PLACES / 1000m

TABLE (II) AMPLITUDE OF WEIGHT VARIATION AT DIFFERENT TOP ROLLER ECCENTRICITY

Top roll eccentricity x 10^{-3} inch	1	2	3	4	5	6	8
Amplitude of weight variation	0.88	1.76	2.64	3.52	4.4	5.28	7.35

As shown from fig. (1-a) and table (II) amplitude of the fault caused by top roll eccentricity increases as roller eccentricity increases. But as shown in fig. (1-a) only roller eccentricity of 0.006 and 0.008 inch have a significant effect on yarn irregularity, since the hight of the peak above the basic spectrum overstep 50% of the basic spectrum

As shown in fig.(1-1), (1-2) and (1-3) as delivery speed increases i.e, as front roller speed increases, although the main draft does not change, yarn irregularity increases and correlation coefficients increases. Also for lower delivery speed individual values for yarn irregularity are more scattered around regression line more than that for higher delivery speed.

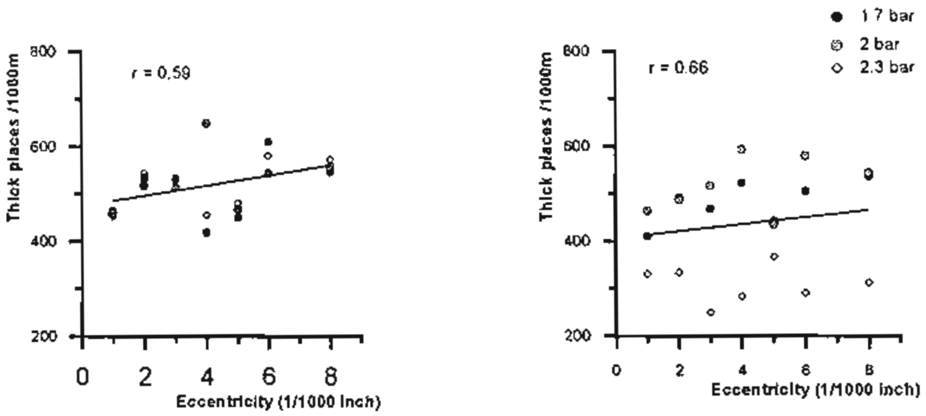
Fig. (5-1-a) and (5-2-a) show regression lines for yarn irregularity at the three pin positions (or pressure distribution in top arm) on yarn irregularity, where at the lower delivery speed pin position has a little effect on yarn irregularity. At the higher delivery speed first pin position deteriorated yarn regularity for roller eccentricity from 0.004 inch and the rate of deterioration is higher in a comparison with the other two positions.

3-2-Yarn imperfections (thin, thick places and neps)

Table (III) and fig. (2) show regression equations and the influence of top roller eccentricity on number of thin places per 1000m. As top roller eccentricity increases thin places increases. This is due to increased movement of front roller nip forward and backward. As a result of forward movement of the nip fibre ends are separated further apart and therefore make the drafted strand of fibres thinner than normal leading to more thin places.

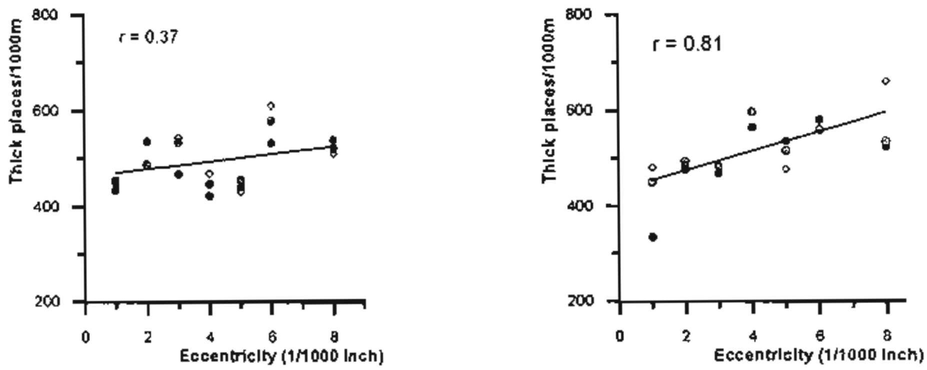
TABLE (III) REGRESSION EQUATIONS AND CORRALATION COEFFICANTS (r) FOR THIN PLACES

Delivery speed		13 m/ min.		14.2 m/min.	
		Regression equation	r	Regression equation	r
Pin Position	1	Y = 13.57 + 1.24X	0.61	Y = 33.51+ 12.81 X	0.84
	2	Y = 8.23 + 1.84 X	0.69	Y = 56.24 + 6.94 X	0.733
	3	Y = 8.45 + 2.27 X	0.81	Y = 45.36 + 9.12 X	0.97



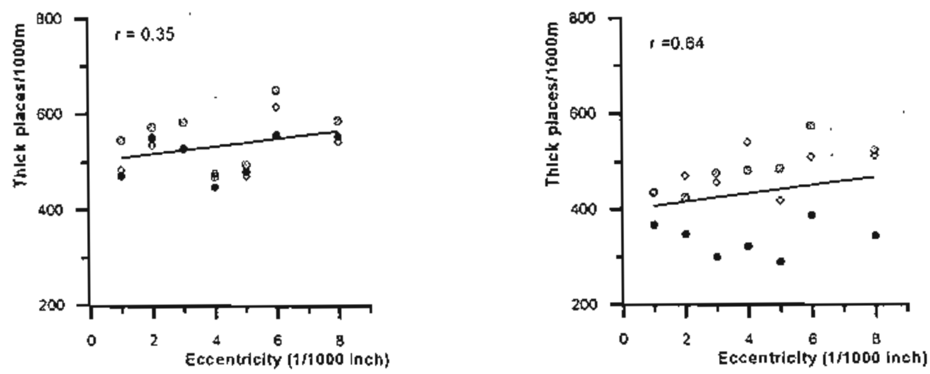
Vr = 13 m/min. Vr = 14.2 m/min.

FIG. (3-1) AT FIRST PIN POSITION



Vr = 13 m/min. Vr = 14.2 m/min.

FIG. (3-2) AT SECOND PIN POSITION



Vr = 13 m/min. Vr = 14.2 m/min.

FIG. (3-3) AT THIRD PIN POSITION

FIG. (3) INFLUENCE OF TOP ROLLER ECCENTRICITY ON THICK PLACES / 1000m

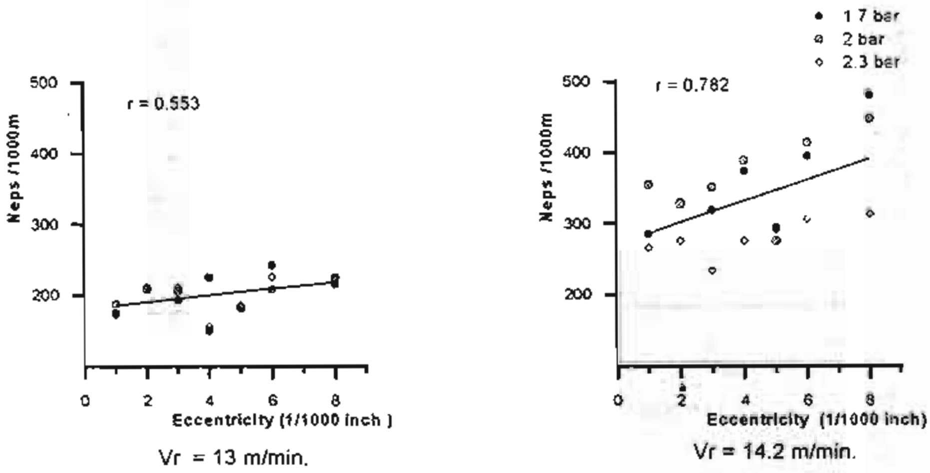


FIG. (4-1) AT FIRST PIN POSITION

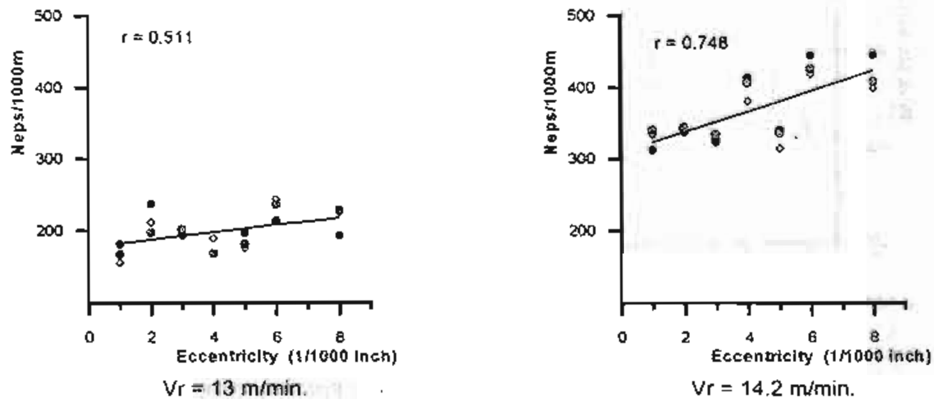


FIG. (4-2) AT SECOND PIN POSITION

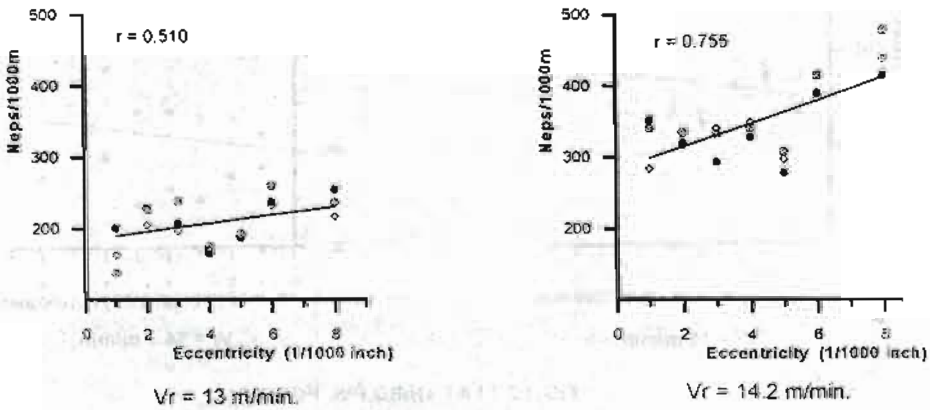


FIG. (4-3) AT THIRD PIN POSITION

FIG.(4) INFLUENCE OF TOP ROLLER ECCENTRICITY ON NEPS / 1000m

Delivery speed has a positive effect on thin places, as delivery or roller speed increases thin places increases correlation coefficients increases at the third pin positions as shown in fig. (2) and table (II).

For higher delivery speed 2.3 bar and 1st pin position or 1.7 bar with 3rd pin position helped in reducing number of thin places.

A little difference has been found in thin places due to changing pin position, as shown in fig.(5-1-b) and (5-2-b).

For lower delivery speed, correlation increase for third pin positions than that for second position than that for first one. For higher delivery speed, at first pin position results more scattered than that for second position, which is more than that for third position.

The influence of top roller eccentricity on number of thick places /1000m is shown in fig (3) and regression equations are shown in table (IV).

Number of thick places increases as roller eccentricity increases. At lower roller speed the correlation between calculated and actual values is too weak.

Top roller pressure of 2.3 bar results in lower number of thick places at first pin position and higher delivery speed. While at third pin position, top roller pressure of 1.7 bar results in the lower number of thick places.

Fig. (5-1-c) and (5-2-c) show that second pin position increased number of thick places at the higher delivery speed than that at first or third pin position.

TABLE (IV) REGRESSION EQUATIONS AND CORRALATION COEFFICANTS (r) FOR THICK PLACES

Delivery speed		13 m/ min.		14.2 m/min.	
		Regression equation	r	Regression equation	r
Pin Position	1	Y = 474 + 10.75X	0.59	Y = 405.7+ 7.52 X	0.66
	2	Y = 461.68 + 7.91 X	0.37	Y = 432.9 + 20.44X	0.81
	3	Y = 500.97 + 7.8 X	0.35	Y = 397.52 + 8.91 X	0.64

TABLE (V) REGRESSION EQUATIONS AND CORRALATION COEFFICANTS (r) FOR NUMBER OF NEPS

Delivery speed		13 m/ min.		14.2 m/min.	
		Regression equation	r	Regression equation	r
Pin Position	1	Y = 180.5 + 4.68X	0.553	Y = 271.4+ 14.96 X	0.782
	2	Y = 176.3 + 5.20X	0.511	Y = 308.97 + 14.28 X	0.748
	3	Y = 183.9 + 5.85 X	0.510	Y = 282.05 + 16.33 X	0.755

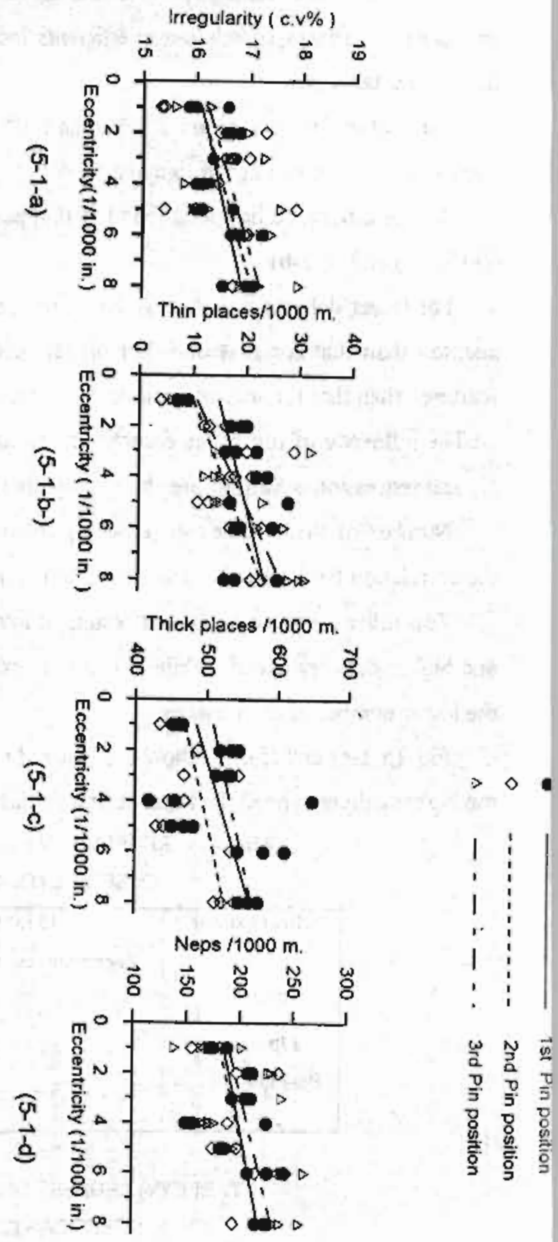


FIG. (5-1) Delivery speed (vr) = 13 m/min.

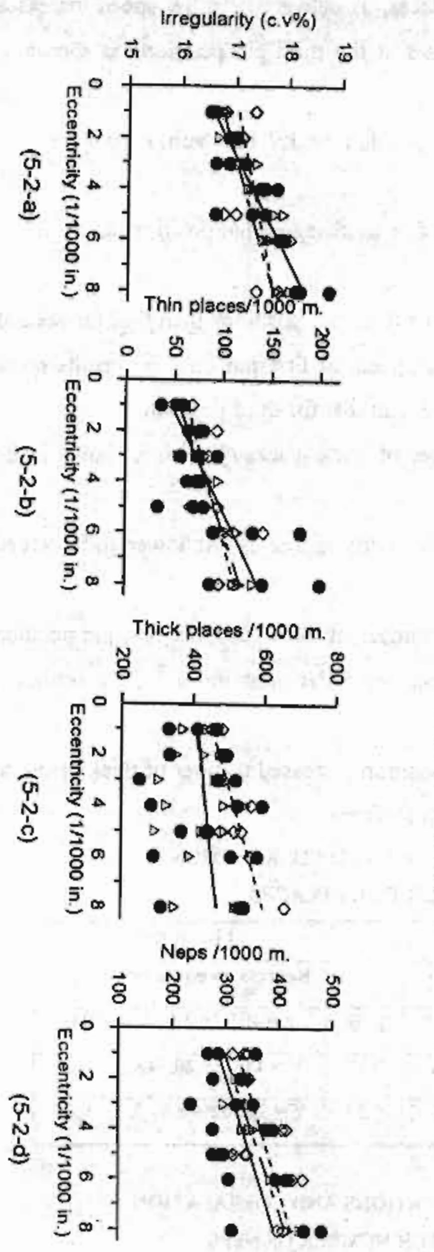


FIG. (5-2) Delivery speed (vr) = 14.2 m/min.

Regression equations for number of neps/1000 m are shown in table (V) and its results are plotted in fig. (4). For higher delivery speed, correlation is between 0.784 and 0.782 but for the lower speed the correlation is very weak. Number of neps increases as roller eccentricity increases and as delivery speed increases.

At higher speed, roller pressure of 2.3 bar results in less number of neps (at 1st position). For eccentricity from 0.0004 to 0.0008 inch and top roller pressure of 2.3 bar, number of neps is lower than that at top roller pressure of 2 bar for both second and third pin position
No differences were found in number of neps due to pin position at lower speed, but it is reduced at the higher speed at 1st pin position as shown in fig.(5-1-d) and (5-2-d).

4-CONCLUSION

The work reported above permits the following conclusions to be established,

1- It is confirmed that increasing front top roll eccentricity deteriorated yarn regularity.

2- As roll eccentricity increases yarn imperfections (thin, thick places and neps) increase.

3- The influence of roll eccentricity on the examined yarn properties is higher at the higher delivery speed.

4- At the higher delivery speed loading the top arm of 2.3 bar at first pin position or 1.7 bar at third pin position reduced thin, tick places and neps.

5- Pin position does not influence yarn irregularity and imperfections at the lower delivery speed.

6- At the higher delivery speed first pin position reduced thick places and neps.

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