EFFECT OF ROTOR SPINNING PARAMETERS ON WASTE AND SHORT-STAPLE COTTON YARN QUALITY

By

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"دراسة تأثير بعض متغيرات الغزل بماكينة الطرف المفتوح على جودة الخيوط المنتجه من قطن قصير التيلة وعوادم القطن".

الخلاصه: يهدف البحث الحالي الى دراسة تأثير بعض عوامل التشغيل بماكينة الغزل ذات الطرف المفتوح على جودة الخيوط المنتجة من عوادم القطن والشعيرات قصيرة التيلة (جيزه ٣١) وصممت التجارب بتغيير ثلاثة عوامل عند ثلاث مستويات مختلفة بطريقة بوكس وبينكان مع ثبات بقية العوامل الاخرى. وتتركز التجارب فى دراسة تأثير سرعة الروتور وسرعة سلندر التفتيح والنمر الناتجة على خواص الخيوط. وتشير نتائج البحث الى الحصول على أسطح الاستجابة التى تمثل العلاقة بين العوامل السابقةومتانة الخيوط واستطالتها ، درجة الانتظام ودليل جودة الخيوط، تحديد أمثل الظروف لتشغيل قطن جيزه ٣١، عوادم القطن المستخلصة من جيزه ٧٠ كما أمكن تحديد التأثير المعنوى لكل متغير على حده والتفاعل من عوامل التشغيلعلى جودة الخيوط المنتجة.

Abstract:

The present study has been made on two types of materials, waste fiber blends "extracted from Giza 70" and short-staple cotton "Giza 31", to compare the characteristice of open-end yarns under a given combination of three-variables. The variables considered are the rotor and combing roller speeds for different yarn linear densities. An experimental design technique (32) have been applied to domenstrate the effect of chosen variables on yarn tenacity, elongation at break, irregularity and yarn quality index. Also, this work, shows a technological interpretation of the results obtained in terms of one variable and two or more variables intersctions.

1. Introduction:

Open-end yarn quality is affected by many parameters such as properties of raw material, quality grade of sliver, open-end spinning machine variables and the envioromential conditions.

(i) In terms of raw meterial parameters, it should be mentioned that

The new rotor spinning machines has the capability of processing wide variety of raw material (1).

Several considerations has been given to proceesing of waste fiber by means of rotor Spinning (2) such as: waste fiber properties composition of waste and whether enough fiber is involved to make manufacturing worth while. Also, whether the investment necessary to re-cycle waste fibre can be covered in acceptable period.

As far as cotton waste fibers is concerned, there are different waste fiber which are processed on rotor spinning machine. In reviewing the literature (3), it was found that:

Both comber noil and card strips waste material can be processed successfully on rotor machine (4). Rotor spun yarn produced from a mixture consisting of 45% noils, 30% flat card stripping and 25% beater waste (5,6). Various textile mills are Spinning waste cotton fibers, comber noil's and others on rotor machines (7,8). Wolf (9) states the combing noils can be spun without any carrier fiber. Also, trails carried out with card strips, the fiber was cleaned, carded and spun into 100 tex yarns on rotor m/c that featured a trash extraction device (10).

On the other hand, Low grade cottons can be used as carriers (6). One mill (11) successfully spin a blend of 23.8 mm strict middling and comber noil. Also, short staple cotton fibres and even purified waste can be spun into commercially acceptable 100-125 tex yarns (12, 22). However, yarn quality and ease of processing dependent upon the amount of any part of waste that is added to the blend (4).

In addition, to produce good quality rotor-spun cotton yarns, attention should be paid to the fiber properties (13). As a result, of the earlier studies (14,15,16,17,18), it has been concluded that the order of importance of cotton fiber properties for open-end spinning is:

- The cleanness of material is very important for rotor spinning as fibre strength and fineness.
- Length and length uniformity appear to play only a minor role in rotor spinning.
- Also, fiber rigidty, crimp, elasticity and fiber-to-Metal friction are all important in rotor spinning.

(ii) In terms of quality grade of sliver, it is evident that:

Many articles have referred to the requirements of sliver that is to be processed on a rotor spinning machine (19,20,21). The best spinning results were obtained for sliver containing less than 0.4% non-lint. They also recommend that second passage draw frame sliver be used, the nep content should not exceed 150 neps/gram of sliver and the sliver should be regular.

For processing short staple material (2), the preparation of sliver is dependent on: a direct feed of the card sliver and the properties of sliver, such as regularity, constant count with minimum deviation, produced according to its suitability for presentation to the open-end machine. In processing waste, such as a blend of comber noils and flat and strip waste from the card, it may be impossible to subject the material to a drawframe passage and direct spinning from card sliver may be unavoidable (7,2).

(iii) In terms of Spinning Machine Variables:

A great number of studies have been carried out in order to establish the effect of machine parameter, such as rotor speed and the opening roller speed, on Spinning performance and yarn properties:

Grosberg and Mansour (25) studied the effect of rotor speed 20,000 r.p.m. to 100,000 r.p.m on yarn properties and showed that the tenacity generally increased but elongation decreased and yarn irregularity increased. Other workers (24,25,26) have reported contary results, viz. deterioration in yarn quality with increase in rotor speed from 40,000 to 60,000 r.p.m. Another study on open-end machine for cotton/polyester blend (27) and cotton/viscose rayon (28) revealed that rotor speed had little effect on the strength of open-end yarns.

In reviewing the Literature (29,30,31) it was found that, the increase in opening roller speed leads to a drop in yarn tenacity and elongation. Also, the irregularity decreases with an increase in opening roller speed up to 7750 r.p.m.

The present paper concerns a study of rotor Spinning parameters on yarn quality. The experiments were conducted according to a Factorial design technique proposed by Box and Behnken (32). Also, the work intended to investigate the following:

- The relations between rotor speed, opening roller speed, yarn linear density and open-end yarn quality.
- Determination the most suitable conditions of processing waste and short-slaple cotton on open-end machine and
- How the differences in the material, Giza 31 and waste fiber blends, affect the characteristics of open-end yarns.

2. Experimental Work:

The process is designed to use two different fibers, Giza 31 cotton fiber and waste fiber blends, and their properties are listed as follow:

- Cotton fiber "Giza 31" of 30 mm effective fiber length, micronaire reading 3.36 ug/inch and pressely index 7.04 .
- Waste fiber blends, composed of 40% comber waste, 20% card strips, 10% penumafil, 10% sliver rests and 20% opend roving and all fibers extracted from Giza 70. The mean value of fiber properties are 29 mm effective length, micronaire reading 3.48 ug/inch and pressely index 6.66.

An experimental design technique (32) is used to study the effect of some factors affecting open-end yarn quality. The variables considered are X_1: yarn linear density, X_2: The rotor speed and X_3: The opening roller speed. In this technique the variables are selected at three levels as shown in the experimental plan Table (1) and the actual levels of the variables are given in Table (2).

The response surface "Y" is given by a second order polynomial:

$$Y = b_o + \sum_{i=1}^{k} b_i X_i + \sum_{i=1}^{k} \sum_{j=1}^{k} b_{ij} X_i X_j;$$

where X_i = ith variable.
k = number of variables ($k = 3$) and
b_0, b_i and b_{ij} = Regression coefficients associated with the variables.

Table (1): Experimental plan for three variables.

Experimental trail No.	Levels of variables X_1	X_2	X_3
1	-1	-1	0
2	-1	+1	0
3	+1	-1	0
4	+1	+1	0
5	-1	0	-1
6	-1	0	+1
7	+1	0	-1
8	+1	0	+1
9	0	-1	-1
10	0	-1	+1
11	0	+1	-1
12	0	+1	+1
13	0	0	0
14	0	0	0
15	0	0	0

Table (2): Actual levels corresponding to coded levels.

Variables	Level -1	0	+1
X_1: yarn count (Ne)	12(49.2 tex)	20(29.5 tex)	28(21 tex)
X_2: Rotor speed(r.p.m.)	30,000	40,000	50,000
X_3: Opening roller speed (r.p.m.)	5000	6500	8000

Cotton fiber "Giza 31" and waste fiber blends were processed through Blowroom lines, carding m/c's. Then the cotton draw sliver and card sliver "from waste" were spun at open-end spinning machine according to the construction details of experiments.

All open-end yarns were examined according to ASTM standard to determine the yarn properties. The Uster Tensomat Strength tester was used for testing the single end strength and breaking elongation. The Uster Evenness tester was used for determining the yarn evenness (C.V%) and yarn imperfections. The yarn count was measured on Auto-sorter. Also, the twist was measured on zwiglc twist tester.

3. Results and Discussion:

The experimental results for yarn parameters were fed to a mini-Computer, and regression coefficients were determined. Tables (3) and (4) contain the equetions of the response surfaces obtained for the yarn parameters studied: regularity, tenacity, elongation at break and yarn quality index.

The empirical quality index was calculated as in earlier Studies (30)

$$YQI = \frac{\text{Yarn tenacity (gf/tex) x breaking elongation (\%)}}{\text{Yarn Irregularity (C.V\%)}}$$

Figures (1-8) clearly show the trends for open-end yarn characteristics studied as a function of the choeen Variables, such as rotor speed, opening roller speed, and yarn linear density for two types of fibers.

3.1. Yarn Irregularity:

The contour lines for yarn irregularity, Figures (1) and (2), are ellipses with a minimum falling outside the experimental field. The results show the influence of rotor speed, opaning roller speed and yarn linear density on yarn irregularity (C.V%).

The curves show that the yarn irregularity increases with the decrease in yarn linear density, from 49.2 tex to 21 tex.

The open-end yarn irregularity is affected by rotor speed as shown in Figures (1) and (2). The curves clearly indicate that:

(i) A substantial increase has been noticed in open end yarn irregularity with the increase of rotor speed. The effect is particularly prominent in Giza 31 cotton fiber and waste fiber blends at lower opening roller speed (X_3 = -1).

The relationship, Fig. (1.1), (1.2) and (1.3), indicates that the increase in rotor speed and the decrease in yarn linear density has increased the yarn irregularity from 16.2% to 19% for Giza 31 and from 18% to 25% for waste fiber blends. Also, it is clear that there exists a significant difference between the two type of fibers. In addition, the higher irregularities occur using higher rotor speed and medium count (Ne 28) and better yarn uniformity is obtained with lower rotor speeds and coarser count. Similar results have been reported by other Research workers (33,34,35). The increase in irregularity could be due to the fact that at high production speed, fiber individualization is poor because of the higher feed rete of sliver. This incressea the average number of fibers per fiber aggregate leading to a high short term irregularity. Another atudy (36) has shown that this is due to the percentage of sheath fibers increases with an increase in rotor speed.

Table (3)

Material	Open-End Yarn properties	Response Surface Equations	Correlation Coefficient
(i) Cotton Fiber (Giza 31)	1. Single End Strength (gm)	$Y = 356.103 - 188.908\,X_1 + 12.860\,X_2 - 3.265\,X_3 + 100.024\,X_1^2 - 21.696\,X_2^2 - 29.331\,X_3^2 + 10.405X_1X_2 + 4.780X_1X_3 + 15.125\,X_2X_3$	0.996
	2. Yarn Tenacity (gf/tex)	$Y = 11.476 - 1.040\,X_1 + 0.300\,X_2 + 0.010\,X_3 + 0.428\,X_1^2 - 0.429\,X_2^2 - 0.537\,X_3^2 + 0.523\,X_1X_2 + 0.138\,X_1X_3 + 0.158\,X_2X_3$	0.913
	3. Yarn Extension (E %)	$Y = 9.329 - 1.291\,X_1 - 0.300\,X_2 + 0.086\,X_3 - 0.793\,X_1^2 - 0.115\,X_2^2 - 0.081\,X_3^2 + 0.280X_1X_2 - 0.078X_1X_3 - 0.105X_2X_3$	0.963
	4. Yarn Irregularity (C.V%)	$Y = 19.815 + 1.265\,X_1 - 0.005\,X_2 + 0.180\,X_3 + 0.079\,X_1^2 - 0.628\,X_2^2 - 1.164\,X_3^2 - 0.308X_1X_2 + 0.378X_1X_3 - 0.853X_2X_3$	0.882
	5. Yarn Quality Index (YQI)	$Y = 6.768 - 1.859\,X_1 - 0.256\,X_2 + 0.130\,X_3 - 0.269\,X_1^2 + 0.063\,X_2^2 - 0.159\,X_3^2 + 0.570X_1X_2 - 0.298X_1X_3 + 0.483X_2X_3$	0.967

Table (4)

Material	Open-End yarn properties	Response Surface Equations	Correlation Coefficient
(ii) Cotton Waste blend	1. Single End Strength (gm)	$Y = 353.458 - 198.031\,X_1 + 26.000\,X_2 + 6.531\,X_3 + 69.118\,X_1^2 - 9.170\,X_2^2 + 28.525\,X_3^2 - 0.500X_1X_2 - 14.438X_1X_3 + 14.625X_2X_3$	0.982
	2. Yarn Tenacity (gf/tex)	$Y = 11.238 - 1.219\,X_1 + 0.501\,X_2 + 0.075\,X_3 - 0.269\,X_1^2 - 0.205\,X_2^2 - 0.298\,X_3^2 - 0.220X_1X_2 - 0.078X_1X_3 + 0.413X_2X_3$	0.836
	3. Yarn Extension (E %)	$Y = 7.446 - 1.103\,X_1 - 0.766\,X_2 + 0.126\,X_3 - 0.583\,X_1^2 + 0.127\,X_2^2 + 0.143\,X_3^2 + 0.165X_1X_2 - 0.190X_1X_3 - 0.103X_2X_3$	0.948
	4. Yarn Irregularity (C.V%)	$Y = 20.032 + 2.081\,X_1 + 0.035\,X_2 - 1.026\,X_3 + 0.203\,X_1^2 - 0.084\,X_2^2 + 0.921\,X_3^2 + 0.038X_1X_2 - 0.305X_1X_3 - 0.748X_2X_3$	0.951
	5. Yarn Quality Index (YQI)	$Y = 5.254 - 1.725\,X_1 - 0.291\,X_2 + 0.329\,X_3 - 0.298\,X_1^2 + 0.075\,X_2^2 - 0.376\,X_3^2 + 0.230X_1X_2 - 0.170X_1X_3 + 0.283X_2X_3$	0.905

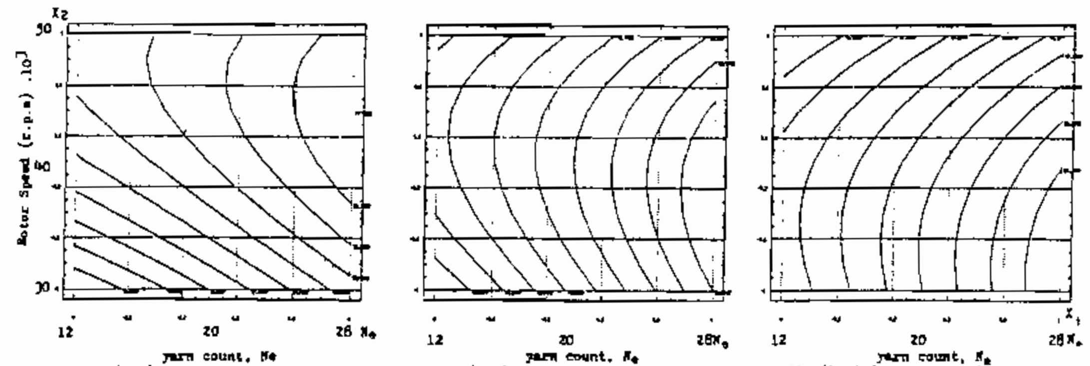


Fig.(1.1) Contours For Irregularity (X_3 = -1 : 5000 r.p.m)

Fig.(1.2) Contours For Irregularity (X_3 = 0 ; 6500 r.p.m)

Fig.(1.3) Contours For Irregularity (X_3=1; 8000 r.p.m)

Fig.(1) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed on Open - End Yarn Irregularity(for cotton; Giza 31)

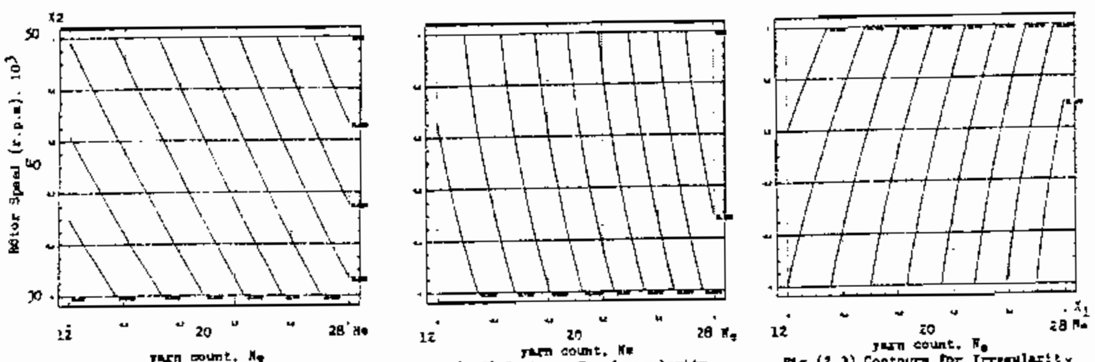


Fig.(2.1) Contours For Irregularity (X_3= -1; 5000 r.p.m)

Fig.(2.2) Contours For Irregularity (X_3= 0; 6500 r.p.m)

Fig.(2.3) Contours For Irregularity (X_3= 1; 8000 r.p.m)

Fig.(2) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed on Open-End Yarn Irregularity (for waste fibre blend)

(ii) Considering the effect of rotor speed at opening roller speed 6500 r.p.m. ($X_3 = 0$) as given in Figures (1.2 and (2.2), it is evident that a slight change in yarn irregularity occurs as the rotor speed increases.

(iii) It is also observed that the open end yarn irregularity is influenced by rotor speed at high opening roller speed 8000 r.p.m. ($X_3 = -1$). From the graphs (1.3) and (2.3), it is obvious that, the irregularity gradually decreased with increasing the rotor speeds. The lower C.V% values occurs at higher rotor speed and for coarser yarn.

Referring to the effect of opening roller speed, with varying rotor speed and linear density on yarn irregularity, the curves show that:

The irregularity decreases with an increase in opening roller speed. This effect is particularly prominent in waste fiber blends and compatible with earlier study (37). It was mentioned that, the higher C.V% values at lower opening roller speed are due to the insufficient opening of tufts. An increase in speed leads to more regular yarns.

On the other hand, for Giza 31, the results show a deterioration in yarn uniformity with increase in opening roller speed up to 6500 r.p.m., beyond which the irregularity started decreasing.

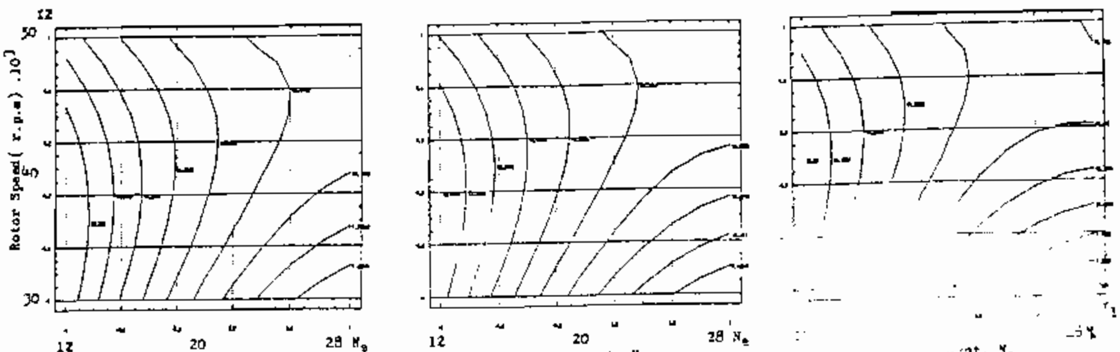
3.2. Yarn Tenacity:

The effect of three variables "rotor speed, opening roller speed and yarn linear density" on yarn tenacity is shown in Fig.(3) for cotton fiber "Giza 31" and Fig. (4) for waste fiber blends. As can be seen the contour lines conform to a saddle shape, through there is a displacement of their centre and passing from 5000 r.p.m. to 8000 r.p.m. of opening roller speed.

An increase in yarn count from Ne 12 to Ne 28 leads to a drop in yarn tenacity. It is also, intersting to note that the percent fall in strength is much greater for waste fiber blends (approx. 26.3%) that for cotton fibre "Giza 31" (approx. 24.3%). In addition, the strength of yearn spun from Giza 31 varies between 9.4 gf/tex and 12.5 gf/tex while it ranged from 8.7 gf/tex to 11.8 gf/tex for waste fiber blends.

The curves show the effect of rotor speed on yarn tenacity with varying the combing roller speed as follow: Firstly; when cotton fiber "Giza 31" are used as apparent in the results referring to coarser yarn Ne 12, the strength did not change with an increase in rotor speed up to 40,000 r.p.m., beyond which the strength started decreasing. For medium yarn count "Ne 28" a gradual increase in strength was observed as the rotor speed increased from 30,000 r.p.m to 50,000 r.p.m.

Secondly, the results obtained for waste fiber blend indicate that, the variation in rotor speed at lower opening roller speed did not show any change in yarn tenacity, while a considerable increase in yarn tenacity takes place as the rotor speed increases with varying opening roller speed between 6500 r.p.m. and 8000 r.p.m.

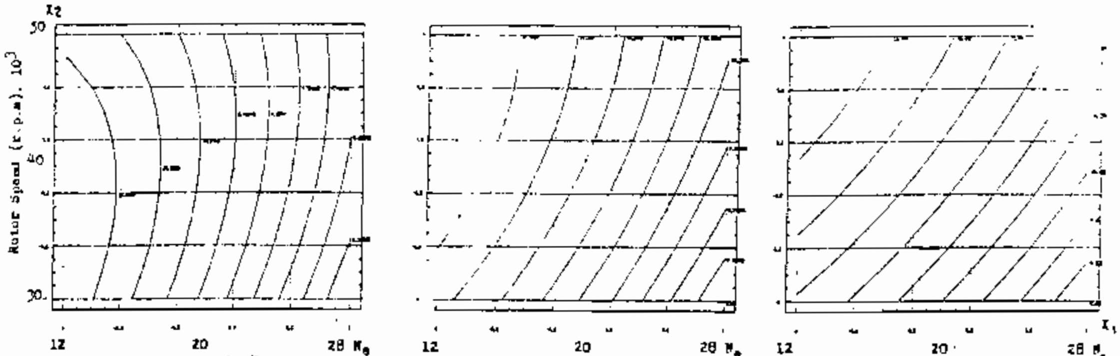


yarn count, Ne
Fig.(3.1) Contours For Tenacity
(X3= -1; 5000 r.p.m)

yarn count, Ne
Fig.(3.2) Contours For Tenacity
(X3= 0; 6500 r.p.m)

Fig [illegible] ...unt, Ne ... For Tenacity ...00 r.p.m)

Fig.(3) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed on Yarn Tenacity. (for cotton; Giza 31)



yarn count, Ne
Fig.(4.1) Contours For Tenacity
(X3= -1; 5000 r.p.m)

yarn count, Ne
Fig.(4.2) Contours For Tenacity
(X3= 0 ; 6500 r.p.m)

yarn count, Ne
Fig. (4.3) Contours For Tenacity
(X3= 1; 8000 r.p.m)

Fig.(4) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed On Open- End Yarn Tenacity.(for waste fibre blend)

Several explainations have been put forward to discuss the etrength variation as the rotor speed is increased:

(i) The strength decreases is attributed to:

- According to one hypothesis, the yarn roughs up at the surface of the doffing navel because of the high tension at high speed (25).
- Another study has shown that this is due to an increase in the wrapper fibers beceuse of the lengthening of tying-in zone (42).
- Also, that was explained by the increase in the twisting torque with increase in the rotor speed, tending to disturb the fiber orientation and the very short term uniformity (33).

(ii) The strength increases as the spinning speed increases, this probably owing to:

The increase in the centrifugal force, which presses the fibers into the groove of the rotor and thus straightens them as the spinning speed increases (23). The straight fibers will take a large part of the load and higher strength resulted.

With regard to the influence of the speed of the opening roller on yarn tenecity, it may be observed that, the tenacity oscillates between 9.4 gf/tex and 12.3 gf/tex at the (-1) level, it ranges from 9.9 gf/tex to 12.9 gf/tex at the (0) level and varies from 9.3 gf/tex to 12.28 gf/tex at the (+1) level. That ie to say, for cotton fiber "Giza 31", a slight change in tenacity occurs as the opening roller speed increased.

On the other hand, for waste fiber blend, a decrease in the speed of the opening roller results in a drop in yarn tenacity. In general, yarn tenacity varies between 8.9 gf/tex and 12.7 gf/tex at higher epeed 8000 r.p.m., and from 8.5 gf/tex to 10.8 gf/tex at lower opening roller speed 5000 r.p.m. This is in agreement with the results obtained by Barella and ViGo (41), while it is unlike the findings of some other researchers (38, 39).

Such reduction in open-end yarn tenacity due to the effect of opening roller speed has been reported as follow: The sharp fall in yarn tenacity with an increase in opening roller speed ie attributed to the greater extent of fiber length shortening due to fiber breakage (38,39). Apart from the reduction in fiber length mechanical stress imposed on fiber may be reducing its strength as reported by London and Jordan (40).

3.3. Yarn Breaking elongation:

The contour lines, Figures (5) and (6), demonstrate the influences of rotor speed, the combing roller speed and yarn linear density on breaking elongation.

The results obtained show that the yarn breaking elongation decreases with decrease in open-end yarn linear density, from 49.2 tex to 21 tex.

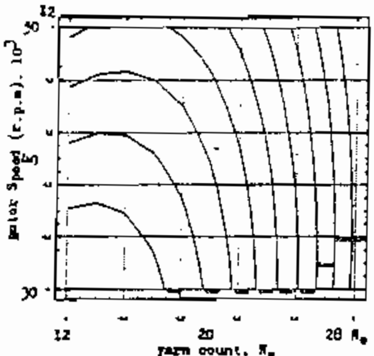


Fig.(5.1) Contours For Elongation
(X_3= -1; 5000 r.p.m)

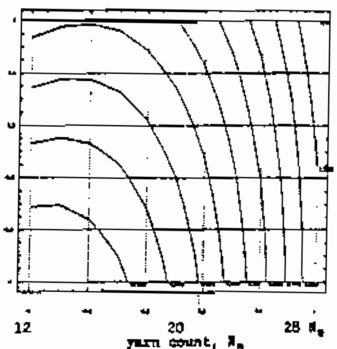


Fig.(5.2) Contours For Elongation
(X_3= 0 ; 6500 r.p.m)

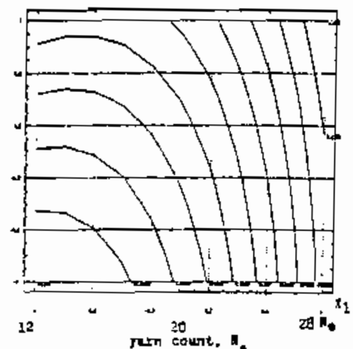


Fig.(5.3) Contours For Elongation
(X_3= 1; 8000 r.p.m)

Fig.(5) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed On Open-End Yarn Elongation.(for cotton; Giza 31)

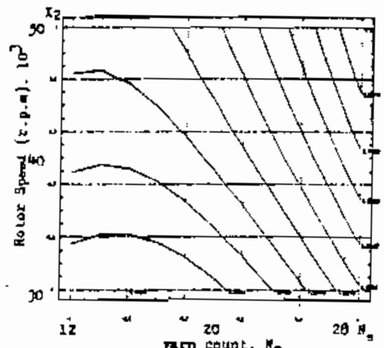


Fig.(6.1) Contours For Elongation
(X_3= -1; 5000 r.p.m)

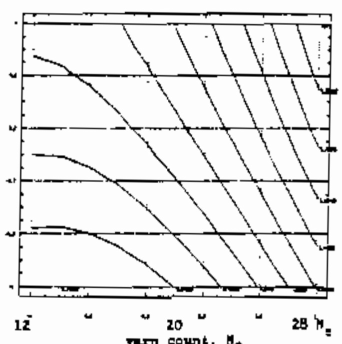


Fig.(6.2) Contours For Elongation
(X_3= 0; 6500 r.p.m)

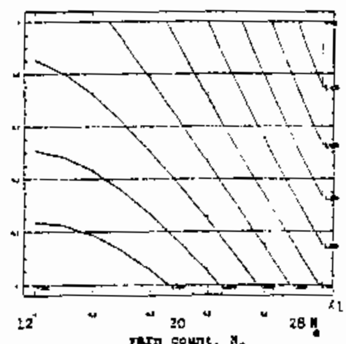


Fig.(6.3) Contours For Elongation
(X_3= 1; 8000 r.p.m)

Fig.(6) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed On Open-End Yarn Elongation.(for waste fibre blend)

The yarn elongation at break goes down as the rotor speed increases. The effect is particularly prominent with waste fiber blend for all yarn linear densities. Also, the same trend has been observed in the results obtained for cotton fiber "Giza 31" where the reduction in elongation occurs only for yarn count up to Ne 22 (26.8 tex). This is in agreement with the results obtained by Stalder (34). He explained this reduction to the increase in yarn tension, which is proportional to the square of the rotor speed.

Regarding to the effect of opening roller speed, the results indicate that, an increase in opening roller speed show very little change in yarn elongation. A reduction in elongation, 0.35 to 0.63%, occurs at highe rotor speed and for medium count, while a slight increase, from 0.46% to 0.70%, occurs at lower rotor speed and for coarser yarns.

3.4. Yarn Quality Index (YQI):

The contours for yarn quality index with varying yarn linear density and rotor speed at different levels of opening roller speed are shown in Figures (7) and (8).

Yarn quality index has been affected by linear density, the curves show a decrease in yarn quality with yarn linear density decreases. The same graph's show a higher quality index, from 4.5 to 9.2, for cotton fiber "Giza 31" than that for waste fiber blend., which ranged between 3.5 and 7.0.

The index, for both fibera, drops as the rotor speed increases. This effect is prominent at lower opening roller speed 5000 r.p.m. (X_3 = -1). Also, the same trend has been observed at opening roller speed 6500 r.p.m. (X_3 = 0) particularly for yarn count up to Ne 22. On the other hand, at the (+1) level of opening roller speed (8000 r.p.m), the increase in rotor speed show very little change in yarn quality index.

4. Conclusion:

The present study permits the following conclusions to be drawn: The Factorial design technique (32) allow to find for short staple fibers, Giza 31 and waste fiber blend, the most suitable conditions of rotor Spinning to the final yarn quality. Also, the analysis of spinning conditions in conjunction with open-end yarn characteristics leads to very intersting results as follow:

1) The relationships between linear density, material used and open-end yarn quality indicate that:

(i) An increase in yarn count from Ne 12 to Ne 28 leads to a deterioration in yarn regularity. Also, a more even yarn was obtained for coarser yarn Ne 12. The rate of increase in yarn irregularity much greater for waste fiber blend (7% C.V) than that for Giza 31 (3% C.V).

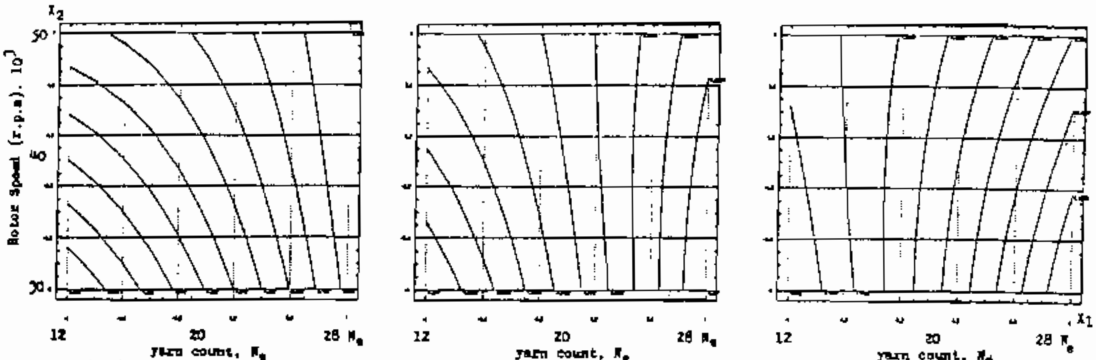


Fig.(7.1) Contours For Quality Index (X_3= -1; 5000 r.p.m) Fig.(7.2) Contours For Quality Index (X_3= 0; 6500 r.p.m) Fig.(7.3) Contours For Quality Index (X_3= 1; 8000 r.p.m)

Fig.(7) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed On Open- End Yarn Quality Index.(for cotton; Giza 31)

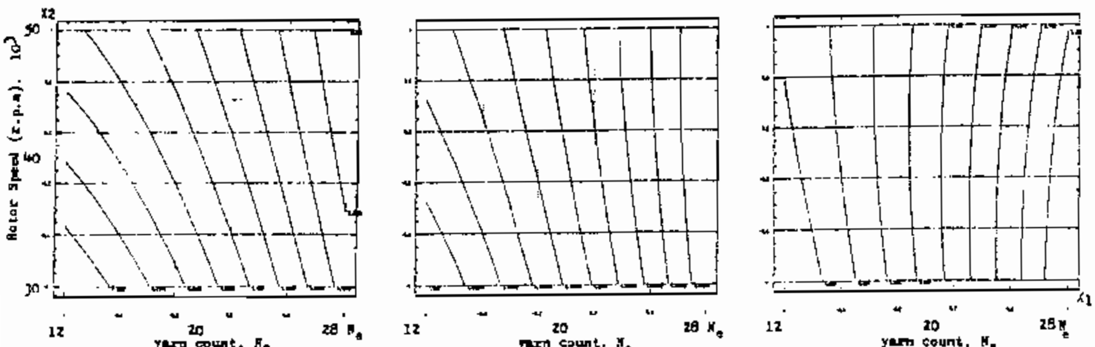


Fig.(8.1) Contours For Quality Index (X_3= -1; 5000 r.p.m) Fig.(8.2) Contours For Quality Index (X_3= 0; 6500 r.p.m) Fig.(8.3) Contours For Quality Index (X_3= 1; 8000 r.p.m)

Fig.(8) Effect Of Yarn Linear Density, Rotor Speed and Opening Roller Speed On Open- End Yarn Qality Index.(for waste fibre blend)

(ii) An increase in yarn count (Ne) leads to a drop in yarn tenaacity and the percent fall in tenacity is approximately 25%. Also, tenacity is better as the yarn spun from cotton fiber "Giza 31" than those obtained for waste fiber blend. The difference is ranged between 0.4 gf/tex and 1.5 gf/tex.

(iii) The yarn breaking elongation decreases considerably as yarn linear density decreases.

(iv) The yarn quality was highly improved as linear density increased. The index for yarns spun from Giza 31, ranged from 4.5 to 9.2; is higher than that for waste fiber blend, approxi. from 3.5 to 7.0.

2) Regarding to the rotor speed, it is evident that:

(i) An increase in rotor speed causes the yarn regularity to fall for both fibers, Giza 31 and waste fiber blend, at low opening roller speed. Also, a slight change occurs at 6500 r.p.m. On the other hand, the yarn irregularity decreased when the rotor speed increased at opening roller speed 8000 r.p.m.

(ii) The yarn tenacity increases as the rotor speed was increased from 30,000 r.p.m. to 50,000 r.p.m. for medium count and combing roller speed varies between 6500 r.p.m. and 8000 r.p.m. On the other hand, there is a particular no change in yern tenacity as rotor speed increases for coarser yarns and too low opening roller speed.

(iii) An increase in rotor speed causes the elongation at break goes down, for all yarn counts, spun from waste fiber blend. The same trend has been observed for cosrser yarns up to Ne 22 which spun from cotton fiber "Giza 31".

(iv) For coarser ysrns, a lower index of quality obtained as the rotor speed increases with varying opening roller speed between 5000 r.p.m. and 6500 r.p.m. On the other hand, for medium count, the increase in rotor speed st opening roller speed 8000 r.p.m. results in a little change in index of quality.

3) In terms of opening roller speed, the results indicate that:

(i) For open-end yern spun from waste fiber blend, too low a speed tends to deteriorate the yarn regularity. On the other hand, for Giza 31, an increase in speed up to 6500 r.p.m. leads to irregular yarns, beyond which the irregularity started decreasing.

(ii) An inadequate speed of opening roller leads to a deterioration in yarn tenacity. A decrease in the speed of combing roller results in a drop in yarn tenacity.

(iii) An increase in opening roller speed leads to a little reduction in yarn elongation.

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