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عنـــوان البحـث

تحليـل أحصائى لبعض متغيرات تحضيرات الغزل على جودة شريـط الكـرد .

الخلاصة : فى هذا البحث تم أستخدام " التجارب المتعدده العوامل " لبعث تأثير بعض متغـــيرات تحضـيرات الغـزل علـى جودة الشريـط الناتـج . وهذة العوامـل هى :
خطوط تفتيح وتنظيف / نظام تغذية الشوت فيد / ماكينـات الكرد - زمن الانتـاج - أقطان مختلفـــة وقد تم أجراء التحليـل الاحصائـى " تحليـل التباين " وبـين تأثـير العوامـل والتداخـل بينهـا علـــى وزن الشريـط (النمـرة) ، درجة الانتظام وعـدد العقد/ جـــرام .

Abstract:

In the present work, the experimental design technique was used to study the influence of some variables at the processing prior to spinning on the variation of card sliver quality. The variables considered to be affecting the card sliver quality are as follow: blowroom lines/chute feed arrangement, carding machines were used throughout, days of production and cotton fibers. A statistical analysis were made of the sliver parameters, its size, count variations, neps per gram and sliver irregularity, using three factor analysis of variance. The results declared that the chosen variables and interactions had a large influence on the sliver quality.

1. Introduction:

In Textile mills, all the effort of the spinner's are directed towards the yarn. It is the end product with which the mill must justify its existance (1). Also It must be stated that, all variations occuring at the process prior to spinning will pass into the yarn. For these reasons, the spinner's job to pinpiont quality deviations as early as possible and keep them within narrow limits.

In general, it can be said that, the work associated with spinning preparation has been almost entirely of improving the quality of card sliver in terms of count constancy, uniformity ratio (C.V%) and neps level:

i) Sliver count variation (2): is one of the most important parameter should be carried at cards and drawframes, because it influences the variation in yarn count,breaking force and the running properties in subsequent processing and the appearance of the finished fabric's.

ii) Uniformity of sliver[3]: the irregularity of material at the process prior to spinning influences the yarn count variation, within bobbin, for this reason, a low as possible irregularity value at the spinning prepartions is required and this necessitates a permanent supervision at these process. It was stated that, the following factors have an effect on uniformity of the card sliver: state of conditioning of fibers, fiber parameters, carding machine variables and carding cloth.

iii) Neps count: neps can be found in raw stock, card web, yarn and cloth made from cotton fibers[4]. It influences the appearance of woven or knitted fabrics quite considerably. Further more, neps of a certain size can lead to processing difficulties, particularly in the kinitting sector of the industry consequently[5]. Several research worker reported the causes of nep formation as following: raw material parameters (6,7), harvesting practices[8], Carding m/c variables[13].

In Egyption Textile industry, some work has been done on the subject of card sliver quality. The author and his collegue [14] studied the effect of some carding variables and their interactions on cotton sliver quality. Also, El-Bealy[6] examined the phenomene of nep formation at card web with respect to fiber parameters and mechanical processing.

In the present study, the work intended to analyse statistically the effect of some factors at the processing prior to spinning on card sliver quality. The investigation was carried out considering the following parameters:

I) Firstly, three variables considered to be affecting the quality: between blowroom lines/chute feed, between carding m/c's and days of production.

ii) Secondly, another three factors: between cotton fibers, blowroom lines/chute feed arrangement and carding machines.

The suggested program of control is to test the card sliver from three blewroom lines/ chute feed organisation, nine carding machines/daily. Test results are performed to show the variation in the average weight of sliver, sliver uniformity (C.V%) and neps level.

2. The statistical Design of Experiments:

The general method of analysis of the present study which is drawn from the previous literature of experimental design (16) will be described here as follows:

The technique of factorial design will be considered is a multifactorial experiment with all factors qualitative. suppose there are "K" variables or number of qualitative factors m,n,p,...t: levels of each factor respectively. the total numbers of levels for some of the factors may be equal or/and different but this will not affect the generallity of the analysis.

N = (mnp...t) the total number of observation inovolved. In the present work, three variables (k=3) will be considered and Table (1) show a simple illustration of three factor experiment.

For Calculating the main effects and all combinations of the levels of the different factors, the following expressions are used.

1. Sum of squares for the main effects:

T_i: The sum of all observations at i^{th} level of the first factor.,
(i = 1 ... m).

Table (1) data of mxnxp Factorial experiment
card sliver quality

Level of Factor "X_3"	Level of Factor (x_1) 1						2,3,..... i						m					
	Level of factor (x_2)...						Level of factor(x_2)..						Level of factor (x_2)					
	1	2	3	...	j	.... n	1	2	3	..	j	... n	1	2	3	..j	.. n	n
1																		
2																		
3																		
4																		
.																		
.																		
k																		
.																		
.																		
p																		

Table (2) Analysis of Variance

Source of variation		Sum of squares	Degree of Freedom
Between level of factor	x_1	$S_1 = T_i^2/(np...t) - T^2/N$	(m - 1)
	x_2	$S_2 = T_j^2/mp...t) - T^2/N$	(n - 1)
	X_3	$S_3 = T_k^2/(pq..t) - T^2/N$	(k - 1)
Interactions	$x_1 x_2$	$S_{12} = T_{ij}^2/pq...t) - T^2/N) - (S_1+S_2)$	(m-1)(n-1)
	$x_1 x_3$	$S_{13} = T_{ik}^2/(nq..t) - \frac{t^2}{N}) - (s_1+S_3)$	(m-1)(k-1)
	$x_2 x_3$	$S_{23} = T_k^2/(mg..t) - \frac{t^2}{N}) - (S_2+S_3)$	(n-1)(k-1)
Remainder	$x_1 x_2 x_3$	$S_{123} = T_{ijk}^2/(q...t) - T^2/N) - (S_1+S_2+S_3) - (S_{12}+S_{13}+S_{23})$	(m-1)(n-1)(k-1)
TOTAL		$T_{ijk}^2/(q...t) - T^2/N$	N - 1

2. Total sum of squares for two-factor interaction:

$$T_{ij}{}^2/(pq\ ....t) - T^2/N \quad \text{where}$$

T_{ij}: represents the sum of observations involving the $_i$th level of first factor and $_j$th level of the second factor.

T^2/N : Correction due to mean

3. Total sum of squares for three-Factor interactions

$$T_{ijk}2/(q....t) - T^2/N \quad \text{where}$$

T_{ijk}: sum of all observations for $_i$th level of first factor, the $_j$th level of second factor and $_k$th level of third factor.

Note: The other main effect and interactions sums of squares determined in a similar manner.

As shown in the previous section, the procedurefor calculating sum and mean of each level of each factor, and two-way table of sums of all combinations of the levels of the different factors leads to the analysis of Variance as shown in Table (2).

3. Experimental Work:

3.1 Material used: Two popular varieties of egyptian cotton fibers, Giza 75 and Giza 70, with different characteristics were selected for investigation.

3.2 Processing Procedures: In order to demonstrate the effect of processes prior to spinning on card sliver quality, a number of intersting experiments were made using three different organization as shown in fig (1). However during the comparative trail no parameters of process except the different preparatory lines were changed.

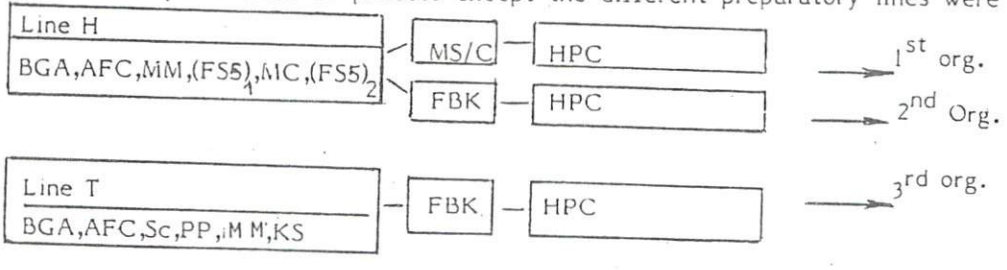


Fig. (1) Spinning preparations

3.3 Construction details of experiments:

3.3.1 The first plan of experiments:

In this case, the three variables considered to be affecting the quality are as follow:

(x_1) Between blowroom lines: three blowroom lines/ chute feed arrangement were chosen.

(x_2) Between carding machines: nine specific carding machine chosen by drawing from random number. were used

(x_3) Between days: six successive days of production

(i) For cotton fiber Giza 75 : (3x9x6) or 162 separate sampling of output, one for each blow room/chute feed-carding machine-day combination.

(ii) For cotton fiber Giza 70 : (2x9x5) or 90 observations for each property recorded of card sliver.

3.3.2 The second plan of experiments

Thirty six (2x2x9) samples were produced in accordance with the designation given in Table (3.3). The investigation carried out using three factors:

(X_1) Cotton fibers: two types of Egyptian cotton fibers Giza 75 and Giza 70.

(X_2) Blowroom line/chute feed arrangement : two spinning organisation, Line "H"/ chute feed "Ms/c" and Line "T"/ chute feed "FBK".

(X_3) High production carding m/c's : nine specific carding m/c's.

Table (3.1) 3x9x6 Factorial Experiments

X_3	X_1 : Blowroom Lines		
	Line "H"/chute Feed (MS/C)	Line"H"/Chute Feed(FBK)	Line"H"/Chute Feed(FBK)
Days	X_2 : Carding m/c No.	X_2: Carding m/c no.	X_2: Carding m/c no.
	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9
1			
2			
3			
4			
5			
6			

Table (3.2) 2x9x5 Factorial Experiments.

X_3	X_1 : Blowroom Lines	
	Line "H"/Chute Feed (MS/C)	Line"H"/Chute Feed (FBK)
Days	X_2: Carding m/c no.	X_2: Carding m/c no.
	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9
1		
2		
3		
4		
5		
6		

Table (3.3) 2x2x9 Factorial Experiment

	X_1 : Cotton Fibers			
	Giza 75		Giza 70	
X_3	X_2 : Blowroom Line/Chute Feed		X_2 Blowroom Line/Chute Feed	
Carding m/c	Line H/(MS/C) C hute Feed	Line T /(FBK) Chute Feed	Line H/(MS/C) Chute Feed	Line T/(FBK) Chute Feed
1				
2				
3				
4				
5				
6				
7				
8				
9				

In such an analysis as This no attempt should be made by the experimenter to alter the normal operating conditions. However the variables not being investigated should be controlled as much as possible i.e remain constant.

3.4 Measurement:

Card sliver count: according to the suggested program of control, 10 yard lengths of sliver/sample and 10 specimens for each card in operation were tested.

Sliver Irregularity: uster tester type II used for determining the evenness of card sliver.

Nep count: The resulting web was placed on standard velvet grading boards and the number of neps counted with the aid of magnification. Each experiment is the average of 20 reading and the average number of neps/inch^2 or/and neps/gram is calculated

4. Results and Discussion:

The sliver count is investigated and recorded on a chart due to the effect of processes prior to spinning, as shown in Figure (2). Besides the mean count values, the sliver irregularity (u% or c.v%) and count variation C.V% are two further important characteristic's are given in figures (3) and (4). Also, Figure (5) show neps per gram of fibers produced with respect to different spinning preparations.

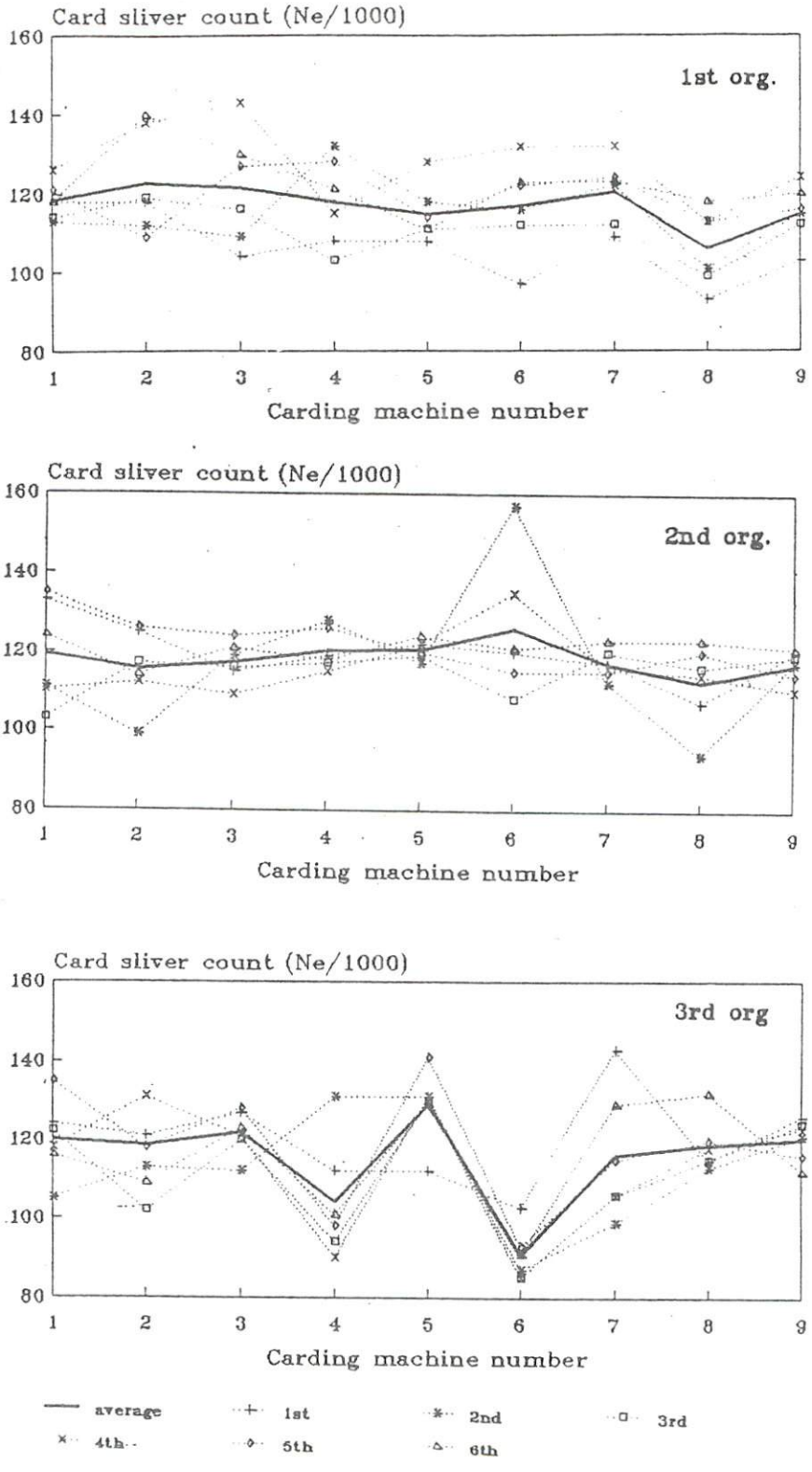
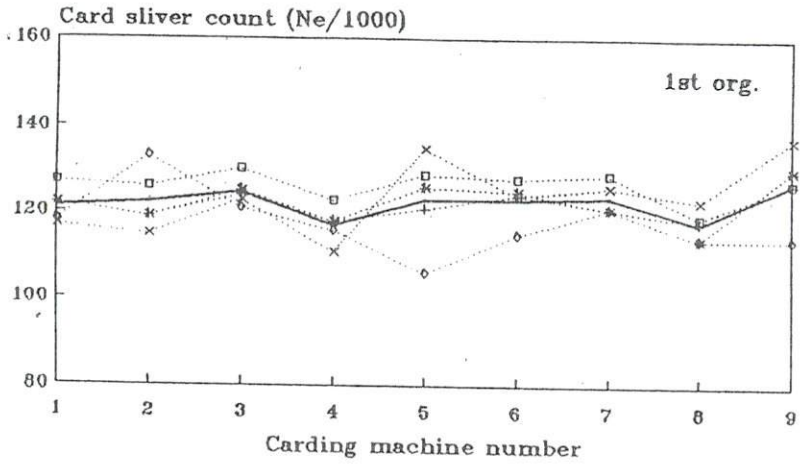
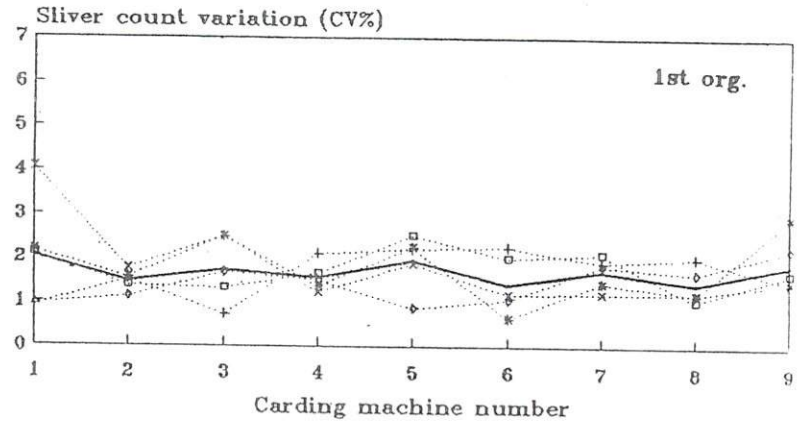


Fig (2.1) for cotton fiber "Giza 75"

Fig.(2) Comparison of card sliver count "Ne" from different spinning organisation lines.





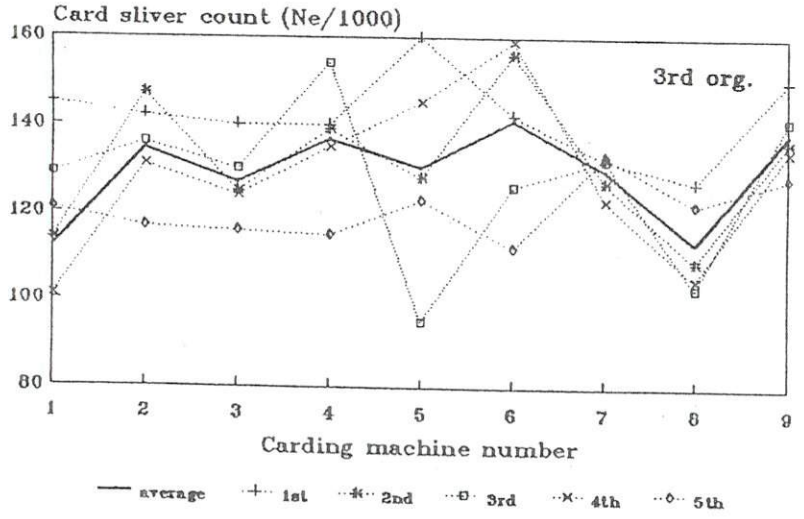


Fig.(2.2) for cotton fiber "Giza 70"

Fig.(2) Comparison of card sliver count "Ne" from different spinning organisation lines

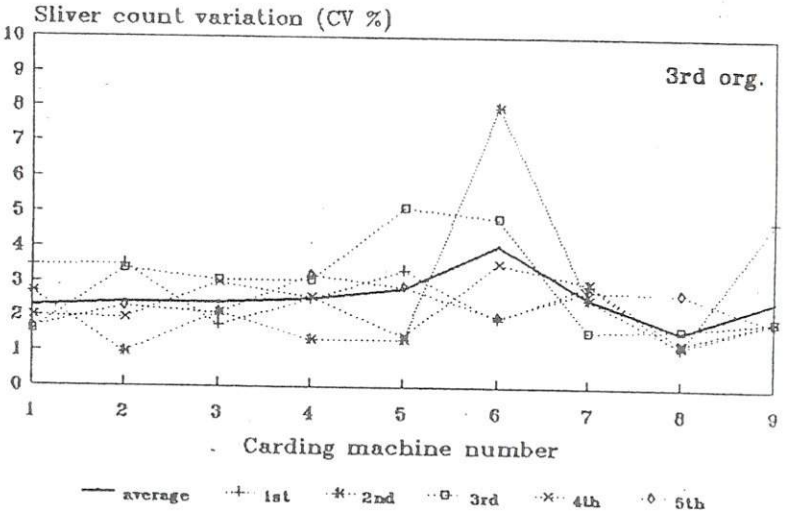


Fig.(3.2) for cotton fiber "Giza 70"

Fig.(3) Count Variation Comparison between card sliver produced from different spinning preparations.

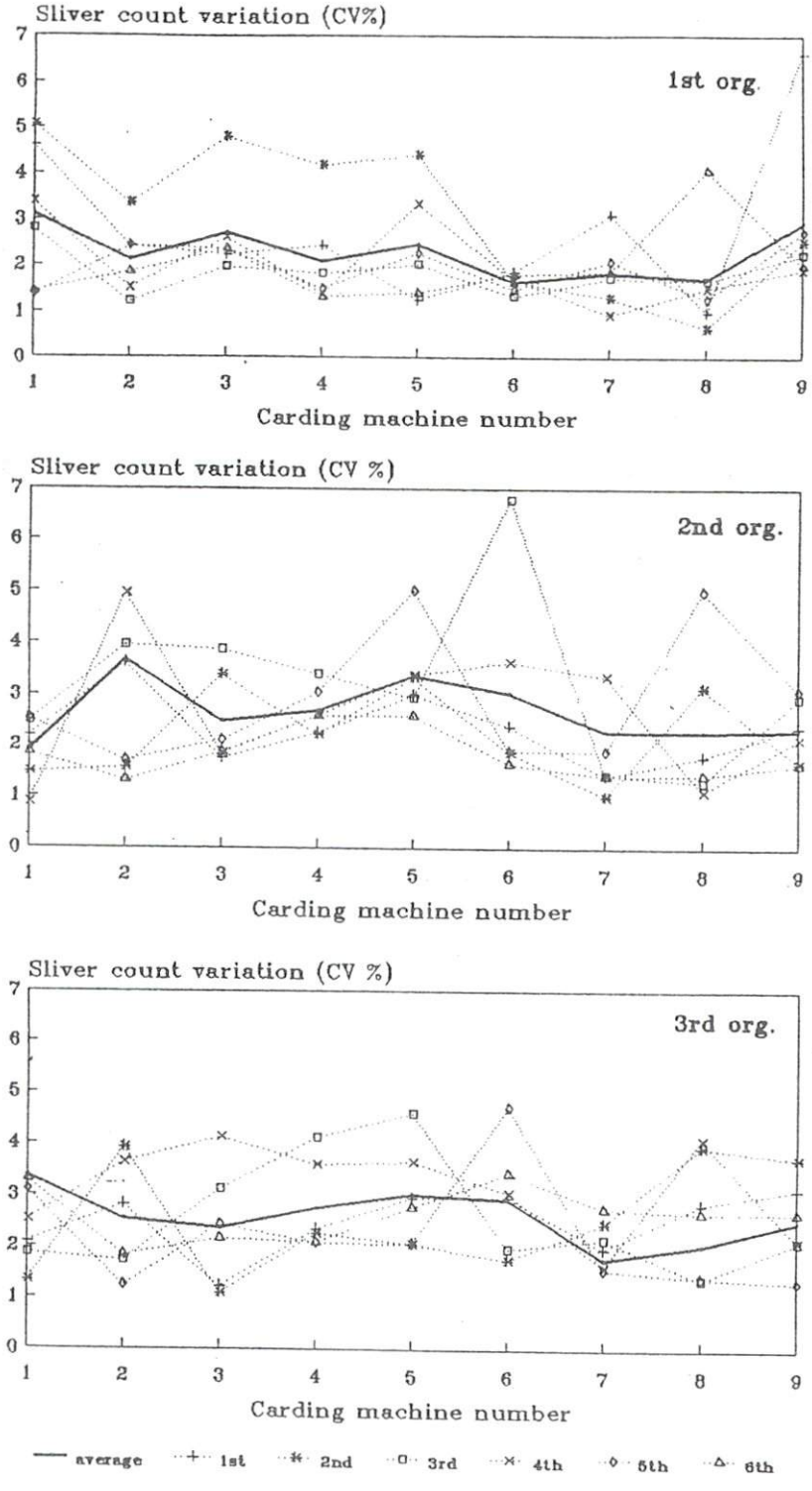


Fig.(3.1) for cotton fiber "Giza 75"

Fig.(3) Count variation comparison between card sliver produced from different spinning preparations.

4.1 Sliver Count:

Each of the points on the diagram represents the weight of one 100-yard card sliver sample. each of the samples was taken from a different can. The samples were taken in irregular intervals and over a pierod of approximately 6 days from each card. Samples from the nine cotton carding machine were taken and the results represented on the diagram as shown in figures (2) and (3). The variations within each separate group provide a picture on the variation of each separate card. The complete diagram compares the variations between the cards.

For cotton fiber "Giza 75" as comparing the sliver count distribution, Fig.(2.1), the three diagrams corresponding to spinning organization provides a quite different pictures. with 3rd organization (T/FBK), the sliver count results of each separate sample vary from each other, while samples lie with a much closer range in case of the first and the 2nd organization.
Also, the mean value of each card remains constant, for the 1st organization, and corresponds exactly with the nominal value and this in contrast to the card sliver from the third orgnization.
The coefficient of variation values of sliver count, Fig (3.1), confirm these reslts. for card sliver, produced on 2nd and 3rd org. a higher mean values of the coefficient of variations has been observed, while the 1st org. Shows alower coefficient of variation values, which can be considered as extremely good .

For cotton fiber, "Giza 70" the same trend has been observed as shown in Figures (2.2) and (3.2). Comparison of card sliver count and its variation from the 1 st and 3nd organization indicates again quite clearly the difference between spinning preparation lines. This difference in results was explained [15] by unsuitable blending, large variations in the climatic conditions. Also, such as effect can be introduced with chute feeding system, and as well as the differences in the degree of opening of the flocks.

4.2 Sliver Irregularity:

For cotton fiber "Giza 75", the curves refer to the sliver irregularity as checked on Uster Evenness Tester, as shown in figure (4.1), clearly that: the top diagram indicates a very even sliver for the 1st plan. The second diagram shows a sliver uniformity (C.V%) that is closer to the first, while the third organization shows the most uneven sliver.

In a similar manner to the trails carried out with cotton Giza 75, other experiments were undertaken with Giza 70. If one compares the diagram, Figure (4.2), in the top with the lower diagram a quite clear difference can be observed. The results proves that the sliver that was produced by the first organization is remarkably more regular than sliver prepared by the 3rd organisation which composed of conventional machines.

From the previous work, Tames[17] focusses his attention on the cleaning process as a source of unevenness. He points out the cotton with high trash content is frequently overcleaned, which leads to difficulties in carding and hence to porer sliver and yarn quality.

From the results shown here, it can be siad that:

- The difference of sliver uniformity (C.V%), it may be due to the feeding system to high production card. The statistical analysis again clearly that the chute feed arrangement hardly influences the sliver c.v% values.
- Also, The difference, it may be due to the lesser degree of opening with line "T" than that with blowroom line "H". This in agreement with the previous work (18). It was found that there is a substional higher cleaning efficiency for line"H"comprised

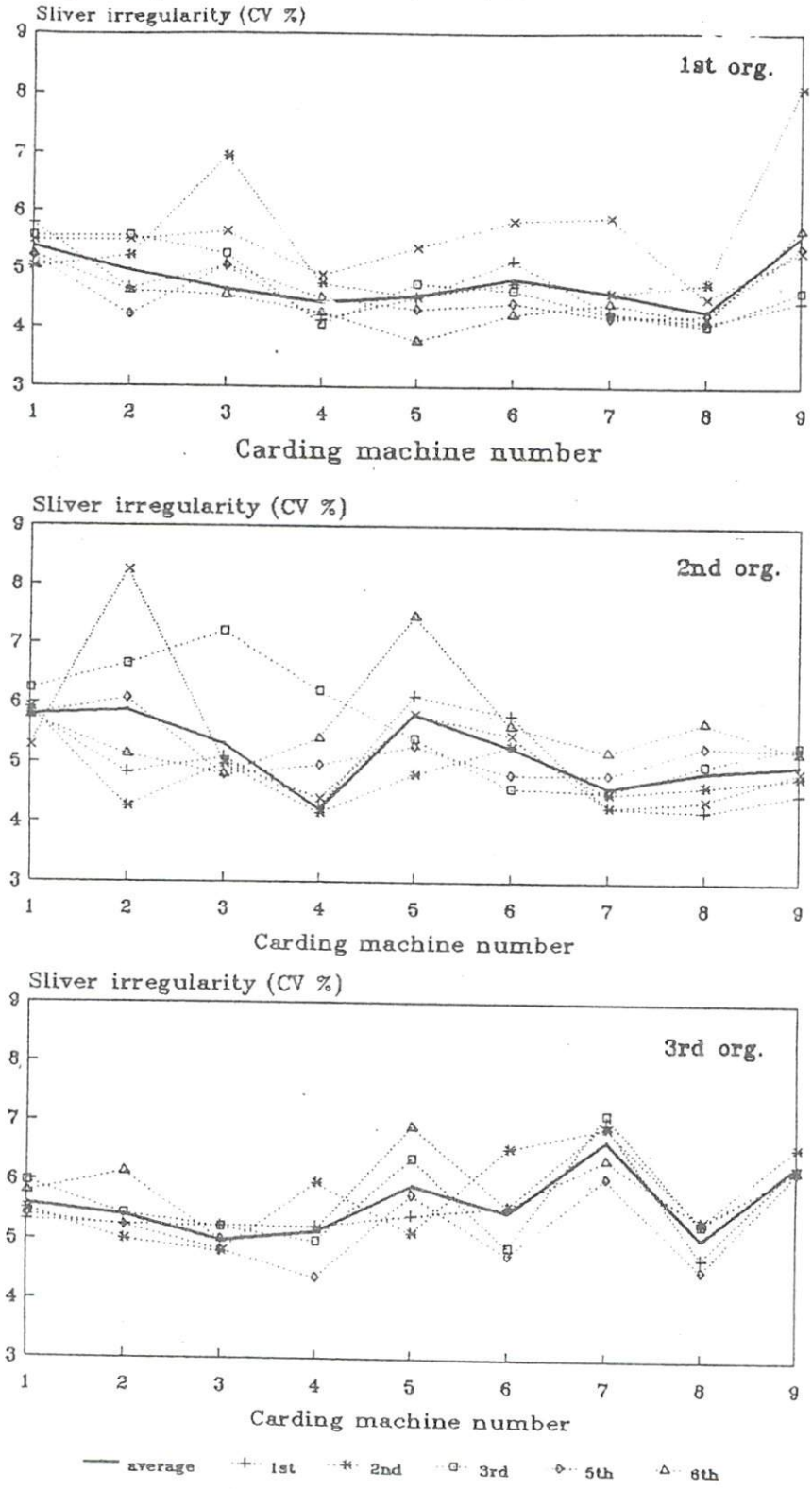


Fig. (4.1) for cotton fiber "Giza 75"

Fig.(4) card sliver irregularity (c.v%) as a function of the process prier to spinning

modern cleaning unit than that achieved in line "T" in case of processing low or high trash cotton fibers.

4.3 Nep Count :

The diagrams, Fig.(5.1) and (5.2), show the number of neps/gram of fibers for different spinning preparations. It has been found that, for cotton fiber Giza 75 the nep count increases considerably with the 1st organisation, which comprised of blowroom line "H", chute feed MS/C and high production carding machine, than with the 3rd organisation, blowroom line "T", chute feed FBK and high production card. Also, the same trend has been observed for cotton fiber Giza 70. This compitable with the earlier study[18], it was evident that a higher nep count associated with blowroom line H , than those for blowroom line "T". These finding may be due to the overbeating of new openers and consequently can be a contributing factor in causing card web neps.

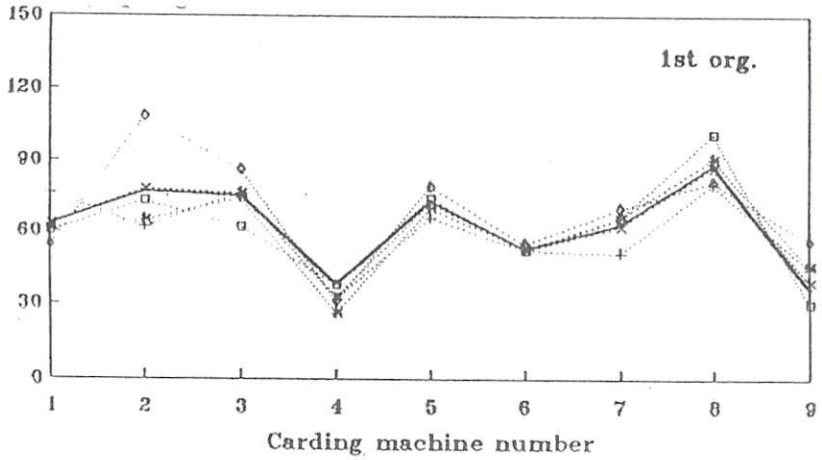
In terms of fiber parameters, El-Bealy[6] have found that the correlation beteeen nep and fiber characteristics is highly significant. This observation is confirmed by the present investigation, the results show a higher level of nep count accompaned with cotton Giza 70 than those for Giza 75 cotton fibers, and statistically the difference is highly significance as shown in Table (2.3).

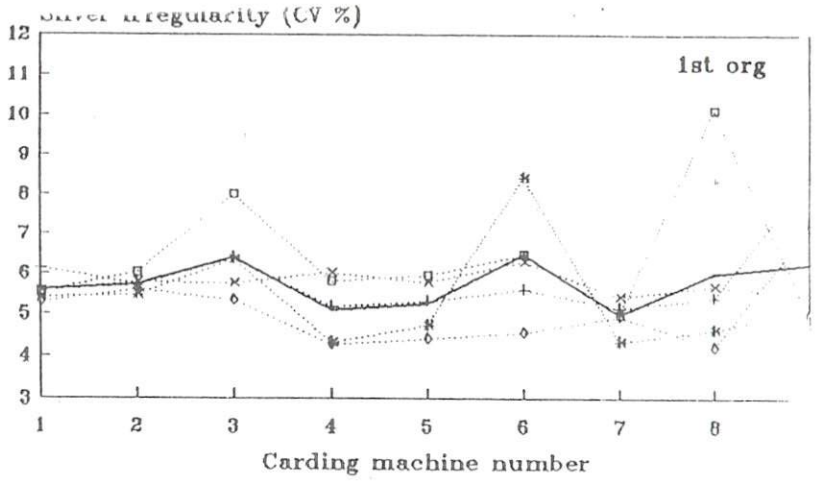
4.4 Statistical Analysis:

The statistical results, Table (2.1), (2.2) and (2.3) show the relationship between card sliver quality and some variables at spinning preparation. The variance analysis indicate that all main effects and two factor interactions, while the three factor interaction mean square is taken to give an estimate of the error variance. The variance component is significant if $F > 10\%$ value but $< 5\%$ level, and $F \geq 5\%$ value but $< 1\%$ level while it is highly significant if the 1% level is accepted (i.e $F > 1\%$ level).

Table (2.1) Analysis of Variance
(for 3x9x6 factorial experiments) cotton fiber: Giza 75

Source of variation	Degree of freedom	mean sum of squares (m.s.s)			variance ratio (fcal)		
		sliver count (Ne)	neps per gram	sliver irregu (c.v%)	sliver count	neps per gram	sliver irregularity (c.v)
Between levels of factors:							
(X_1) blowroom Line/ chute feed	2	138.358	11648.50	6.809	2.083	$68.187^{(***)}$	$30.074^{(***)}$
(X_2) carding m/c's	8	224.514	857.10	1.707	$3.389^{(***)}$	$5.017^{(***)}$	$7.539^{(***)}$
(X_3) days	5	263.611	909.47	0.399	$3.969^{(***)}$	$5.306^{(***)}$	1.766
Interactions:							
X_1X_2	16	385.831	1231.86	1.519	$5.809^{(***)}$	$7.211^{(***)}$	$6.708^{(***)}$
X_1X_3	10	237.929	349.11	1.287	$3.582^{(***)}$	$2.04^{(**)}$	$5.683^{(***)}$
X_2X_3	40	110.569	179.80	0.429	$1.660^{(**)}$	1.05	$1.850^{(**)}$
Residual ($X_1X_2X_3$)	80	66.417	170.83	0.226	---	---	----
Total	161						





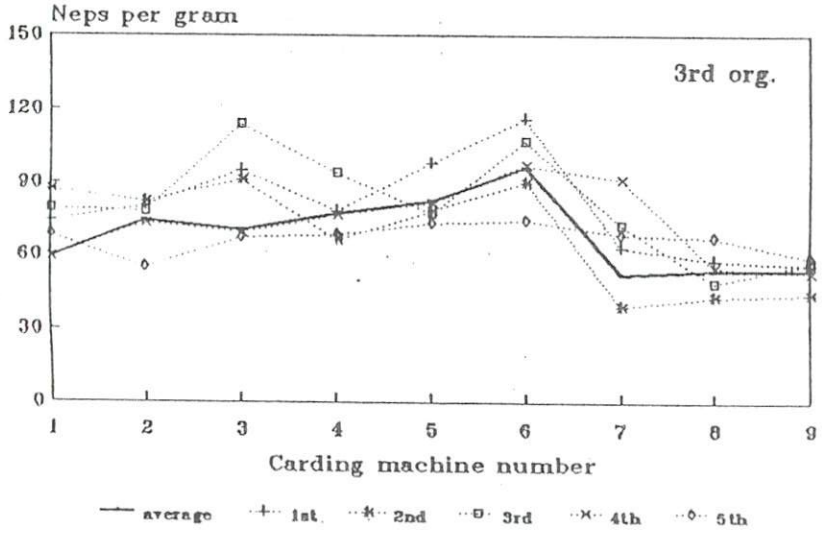


Fig.(5.2) for cotton fiber "Giza 70"

Fig. (5) Effect of spinning preparations on neps per gram of cotton fiber.

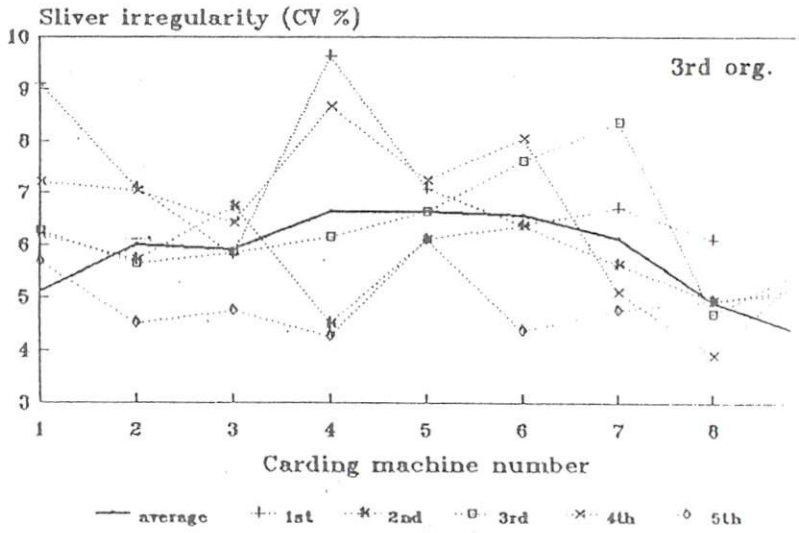


Fig. (4.2) for cotton fiber "Giza 70"

Fig.(4) card sliver irregularity (c.v%) as a function of the process prier to spinning

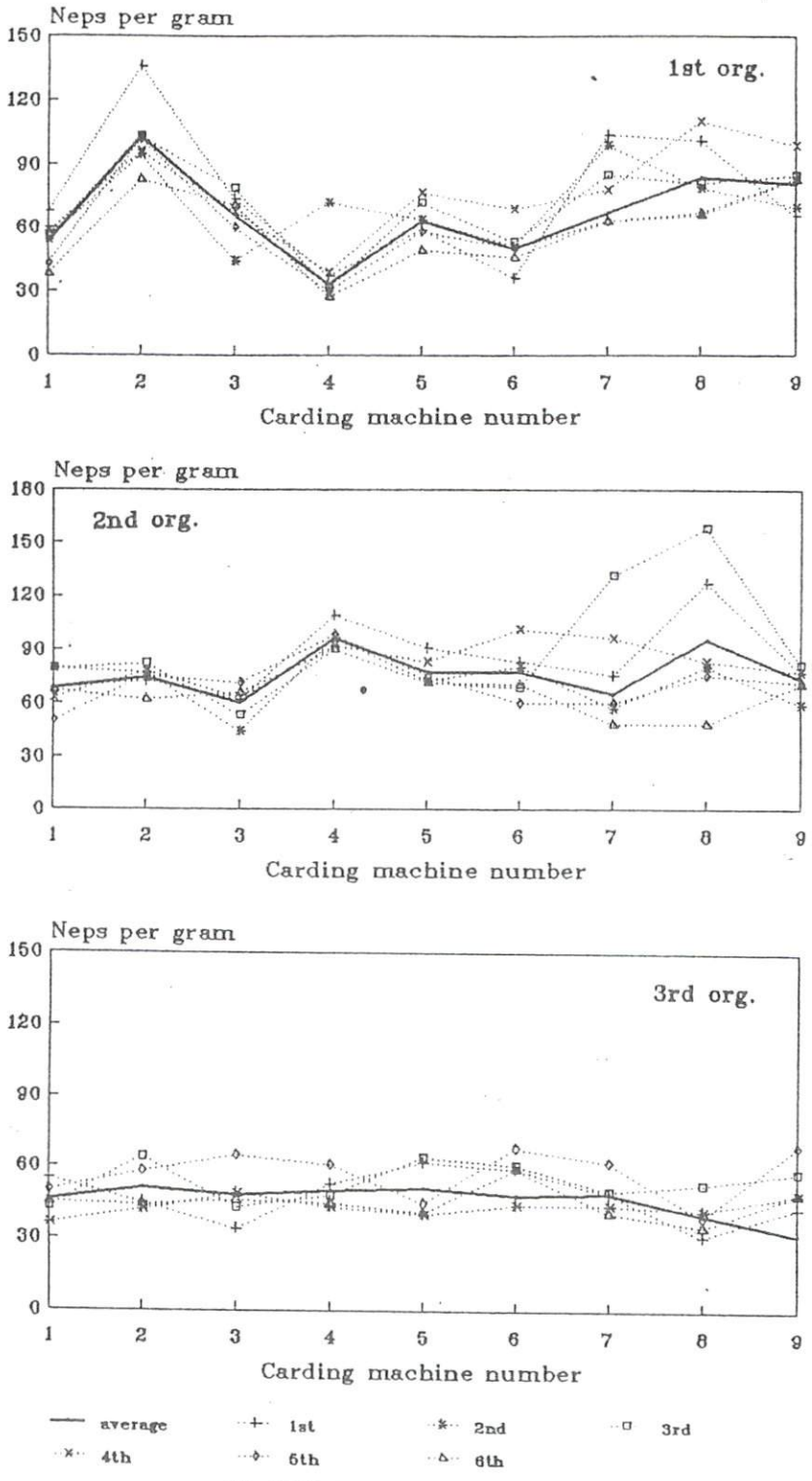


Fig.(5.1) for cotton fiber "Giza 75"

Fig. (5) Effect of spinning preparations on neps per gram of cotton fiber.

Table (2.2) Analysis of Variance
(for 2x9x5 Factorial experiments)
cotton fiber Giza 70

Source of Variation	Degree of Freedom	mean sum of squares (m . s . s)			Variance Ratio (Fcal)		
		Sliver count Ne	neps per gram	Sliver irregularity C.V%	Sliver count Ne	neps per gram	Sliver irregularity C.V%
Between levels of factors:							
(X_1)blowroom line/ chute Feed	1	1202.677	2958.41	3.532	14.026 (***)	29.013 (***)	1.867
(X_2) Carding m/c's	8	200.625	1232.638	0.954	2.339 (**)	12.088 (***)	0.500
(X_3) days	4	247.461	186.419	7.135	2.886 (**)	1.828	3.771 (***)
Interactions:							
$X_1 X_2$	8	210.753	1439.124	2.722	2.458 (**)	14.114 (***)	1.439
$X_1 X_3$	4	297.228	241.925	1.286	3.466 (**)	2.373 (*)	0.680
$X_2 X_3$	32	124.992	53.973	1.370	1.458	0.529	0.724
Residual $X_1 X_2 X_3$	32	85.746	101.965	1.892	--	--	--
Total	89						

Table (2.3) Analysis of Variance
For (2X2X9) Factorial experiments

Source of variation	Degree of Freedom	mean sum of squares (m . s. s)			Variance ratio Fcal.		
		Sliver count Ne	neps per gram	sliver irregu. C.V%	sliver sount Ne	neps per gram	sliver irregul. C.V%
Between levels of factors:							
(X_1) Cotton Fibers	1	890.028	729.0	2.839	9.326**	5.916**	10.243**
(X_2) Blowroom Lines/ chute Feed	1	96.695	455.112	1.688	1.013	3.694*	6.507**
(X_3) Carding m/c's	8	56.798	317298	0.184	0.595	2.575*	0.709
Interactions:							
$X_1 X_2$	1	210.249	1653.77	1.288	2.200	13.422***	4.965*
$X_1 X_3$	8	70.465	134.188	0.505	0.738	1.089	1.945
$X_2 X_3$	8	17.882	474.799	0.607	0.187	3.853**	2.339*
Residual $X_1 X_2 X_3$	8	95.438	123.215	0.259	--	--	--
Total	35						

(*) 10% , (**) 5% and (***) 1% Significance level

The analysis for the variables studied indicate that:

- The between cotton fibers variable ,in the present investigation, has a significant effect on sliver count, sliver irregularity and neps at the level of 5%.

- In terms of blowroom line/chute feed arrangement, the results clearly that : the effect is highly significant at the level of 1% for neps/gram. Also, at 5% and 1% for sliver uniformity, while for sliver count is significant at 1% level for Giza 70 and non-significant for Giza 75.

- The variation between carding m/c's is highly significant at the level 1% for neps/gram, sliver count and sliver uniformity, especially with large sample size (N=162). for small sample size (N=36), the effect is significant at the level 5% for neps/gram and not significant at any level for sliver count and uniformity.

- In terms of days of production, which reflect the variation in climatic conditions at the process prior to spinning, the results show that : the effect is statistically significant for all sliver parameters (neps, count and uniformity).

- The two factor interactions, in case of large observation, are statistically significant. Also, they are quite small compared with the main effects.

5- CONCLUSION:

The present study permits the following conclusions to be drawn:

1) The application of statistical quality control techniques "such as experimental design and the general analysis of variance" leads to: the determination of where the major variation of card sliver quality and what the characteristic's should be controlled. Also, it justify some of the results obtaining in the earlier work.

2) The experiments clearly indicate that the influence of the chosen variables on the card sliver quality:
   (i) The neps level, sliver count and uniformity are highly affected depends on the spinning preparation line (blowroom m/c's/chute feed/carding m/c), raw material and days of production.
   (ii) The results indicated substantial higher neps level, considerably lower sliver irregularity and more constancy sliver count for the first spinning preparation line, comprised of new machines, than those with the conventional m/c's in the third organisation.

3) The analysis of the variables considered to be affecting the quality of the card sliver indicate that:
   (i) All main effects and two-factor interactions, for large observations/are statistically significant at 1% and 5% levels.
   (ii) The variation "between levels of each factor", it may explained as following:-

   - "Between cotton fibers": is related to the difference in fiber fineness/length surface structure and stripiness of individual fibers, etc.

   -"Between days of production": is reflect the state of conditioning of fibers during processing (ie the flactution of humidity and degree of temperature).

   - " Between carding machines": apart from the influence stemming from the machine and carding cloth other factors may be affect on the sliver quality and considered as asource of variance such as:position of card in feeding system, production mode of the feed web, Autolevelling and control systems. Also, feeding and regulation systems.

   - "Between blowroom lines/chute feed arrangement". Even though the design of m/c's and principle of operations differ, the neps and sliver quality is highly

affected due to the differences in : degree of opening of flocks, uniformity of blending, trash content%, degree of compression in the filling box, and etc.

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