EFFECT OF SOME CARDING PARAMETERS ON COTTON SLIVER QUALITY
Part: 1 Card Web Neps and Trash content %

تأثير بعض عوامل التشغيل فى ماكينة الكرد ذات الانتاجية العالية على جودة الشريط الناتج
(الجزء الأول : عدد البنس ونسبة الشوائب فى شريط الكرد)

BY

Dr. I. Rakha Dr. R. EL-Bealy

Dept. of Textile Engineering, EL-Mansoura University

الخلاصة : ترجع أهمية ماكينة الكرد ذات الانتاجية العالية الى تأثيرها على جودة الخيوط المنتجة وكذلك استمرار عملية استحداث وتطوير الماكينة مما يؤثر على حدود التشغيل من حيث السرع وضبط المسافات وبالتالى نوع الخامة وحدود النمر المنتجة وكذلك درجة جوده الشريط الناتج . ونظرا لاهتمام قطاع الغزل والنسيج بمصر باجراء عمليات الأحلال والتجديد فقد أدخلت ماكينات كرد حديثة ومتنوعة لذا فان البحث الحالى يهدف الى دراسة تأثير بعض عوامل التشغيل فى ماكينة الكرد ذات الانتاجية العالية على جوده الشريط وبتركز الجزء الأول على دراسة البنس ونسبة الشوائب فى شريط الكرد الناتج من تشغيل نوعية من الاقطان المصرية جيزة ٧٠ وجيزة ٨١ وبأوزان مختلفة (جرين / باردة) وقد صممت التجارب بتغير ثلاثة عوامل (سرعة الدوفر ، سرعة السلندر ، سرعة المنشار) عند مستويين (2^3) . ومن النتائج أمكن تحديد التأثير المعنوى لعوامل التشغيل كل على حدة على عدد العقد بشاشة الكرد . وكذلك نسبة الشوائب المنسقبة بشريط الكرد . وبالاضافة لذلك تتأثر جودة الشريط بنوع الخامة ووزن الشريط جرين / باردة وبتفاعلات العوامل مع بعضها كما فى حالة سرعة المنشار مع السلندر وكذلك سرعة الدوفر مع سرعة السلندر .

Abstract:

In the present work two types of Egyptian cotton fibres were carded at High production carding m/c into different sliver weights. The experiments were carried out by varying three parameters " doffer, cylinder and Taker-in speeds" . Using 2^3 factorial design technique. card web neps and trash content in the card sliver were observed.

The results declared the influences of organ speeds, cotton fibre feed to card and sliver weights on cotton sliver quelity. In addition, the two factor interactions such as taker-in with cylinder speed, and doffer with cylinder speeds affect significantly on trash content % and card web neps respectively.

1. Introduction:

The card, as the final link in the opening and cleaning line is considered " The heart of the spinning operations" or in another sentence " Well carded is half spun". That was explained as following(1,2).

i) The machine show a significant influence on:

* The quality of the spun yarns and
* The efficiency in the spinning process and in particularly on the open end product line.

ii) The machine is the only unit in the entire spinning process in which the material is used to individual fibers and there by offers the following:
* The best possible situation for effective trash removal and dedusting.
* Further optimum parallization of fibres.
* Further it contributes to openning or removal of neps, and
* Finally the card forms a weight controlled evern sliver io preparation for further processing into yarn.

For all these reasons, the work associated with carding has been almost entirely of solving the problem of " high quality and high production are naturally opposed in carding " in terms of:

i) Studies the dependence of quality at carding on several factors:

* NEP COUNTS: Nitsche[3] reviews the problem of nep formation with special reference to the function of the hooked ends of the fibres. Redzsch[4] describes experiments to ascertain the effects of various flat velocities and settings on nep formation. Also several mill tested the influence of taker-in, doffer and cylinder speeds at conventional flat-carding m/c on neps[5,6].
* FIBREHOOK in the Card Sliver: A study was made of the effect of carding variables like carding rate and cylinder speed[7], the effect of fibre configuration of the fibre feed to the card[8], presence or absence of flats and type of card clothing on fibre hooks[9].
* CARD WASTE: Most waste reduction program[10] deal with the control of carding waste which composed of perfectly good material. The carding waste can be controlled to a large exent by mechanical changes in speeds, aettings and modifications of the card.
* Sliver WEIGHT[2]: To establish a consistent sliver weight delivery during cerding process: one has to feed either an even lap to the card or a uniform consistent-small tufts-are feed in the case of chute feeding to the feed table/taker-in of the cards .Also. it is advisable to integrate autonatic levelling device.

ii) A development nature in relation to high production processing. Several Manufacturer took a significant share in this development of high production carding, to develop new and additional carding elements, in order to be eble to process satisfactorily with the increased surface speeds, to ensure gentle feeding, to optimize the fibre load on the various elements as well as to increase the accuracy and stability of the machine(1).

Several Egyptian cotton Mills had tried different models of High production carding m/cs. High or low level of quality appeared to be using or not applying all the changes recommended. In addition, a little work has been done or published on the subject of carding in Egyptian Textile industry. Thus, the present work intended to examine the influence of some cerding parameters and their interactions on the card sliver quality . The investigation was carried out considering the following parameters :-

i) Vary three carding parameters: taker-in, cylinder and doffer speeds using 2^3 factorial design technique[11].

ii) Two Egyptien cotton fibres were processed through Toyoda high production cerding m/c., snd three levels of sliver weight were produced.

This first part of the series of papers deeling with nep counts in the eard web and trash content (%) in the card sliver.

2. Experimental Work:

2.1 Material used: the experiments were carried out on two typea of Egyptian cotton fibres. Gise 81 heving 2.5% span Length 29 mm and micronaire reading 3.65 while Giza 70 having (35) mm fibre length and 4.2 µg / inch.

2.2 Factorial Design: In the present study 2^3 factorial design epplied to demonstrate the effect of carding machine veriables on the card sliver quality. The variables considered are taker-in, cylinder and doffer speeds (r.p.m). The variables were selected at two levels(-1) and (+1). The experimental plan is given in Table (2) and the actual levels of the parameters are given in Table(1).

2.3. Card sliver production: Each type of cotton fibre as slap form was processed through TOYODA CK-C_7 high production carding m/c for producing card sliver of 56 gn/yd weight (0.15 Ne). Also, according to the construction details of experiments, another two levels of sliverweight (44 and 76 gn/yd) were produced from cotton fibre Giza 81. All the other machine parameters were kept constant.

Table (1): Actual levels of variables

Level	-1	+1
Variables:		
X_1 : Taker-in speed (r.p.m.)	990	1260
X_2 : Cylinder speed (r.p.m.)	300	450
X_3 : Doffer speed (r.p.m.)	18	26

Table (2): Experimental plan for three Variables

Experimental trail No.	Levels of Variables			Y: Sliver quality	
	X_1	X_2	X_3	neps/100 in^2	Trash content
1	+	+	+	Y_{11}	Y_{21}
2	+	+	-	Y_{12}	Y_{22}
3	+	-	+	Y_{12}	Y_{22}
4	+	-	-	Y_{12}	Y_{22}
5	-	+	+	Y_{12}	Y_{22}
6	-	+	-	Y_{12}	Y_{22}
7	-	-	+	Y_{12}	Y_{22}
8	-	-	-	Y_{18}	Y_{28}

2.4. Measurements: The card sliver quality in terms of neps and trash content were investigated : Neps were obtained by methods of the A.S.T.M. Trash content (%) was examined by shirley Analyser.

3. Results and Statistical Analysis:

According to the experimental plan, Table (2), the results of the card sliver quality : neps and trash content have been determined as shown in Tables (3) and (4) .

Tables (3)and (4) Experimental combination Results for three Veribles

Teble (3): Two Egyptian cotton fibres.

Experimental trsil No.	Levels of variables			Y: Sliver Quality*			
	X_1	X_2	X_3	nep count/100 in^2		Trash content %	
				Giza 81	Giza 70	Giza 81	Giza 70
1	+	+	+	15	11	0.144	0.136
2	+	+	-	10	10	0.136	0.106
3	+	-	+	18	12	0.126	0.209
4	+	-	-	9	10	0.122	0.198
5	-	+	+	12	12	0.173	0.227
6	-	+	-	11	11	0.232	0.191
7	-	-	+	18	14	0.252	0.194
8	-	-	-	8	6	0.241	0.198

* Sliver weight: 56 (gn/yd.).

Table (4): Two Sliver Weight

Experimental trail No.	Level of variables			nep count/100in^2		Trash content %	
	X_1	X_2	X_3	Sliver weight 76(gn/yd.)	44(nn/yd.)	Sliver weight 76(gn/yd.)	44(nn/yd.)
1	+	+	+	10	56	0.184	0.108
2	+	+	-	15	24	0.162	0.108
3	+	-	+	24	30	0.155	0.113
4	+	-	-	12	24	0.162	0.099
5	-	+	+	16	32	0.324	0.189
6	-	+	-	15	27	0.239	0.160
7	-	-	+	30	34	0.207	0.232
8	-	-	-	22	20	0.270	0.137

* For cotton fibre " Giza 81 "

The results were fed to an Apple II computer equiped with plotter HP, in order to get the regression coefficients, the response surface equations for carded sliver quality as shown in Table (5). The coefficients were tested for significance at three levels of significance. The experimental results plotted graphically by the plotter. The first group of graphs (1,2) relate to neps and the last group (3,4) to trash content.

4.Discussion

4.1 Card Web Neps: Figures (1-2) show the effect of carding variables " taker-in, cylinder and doffer speeds" on card web neps.contours for neps with varying cotton fibre (Giza 70 and Giza 81) are given in figuces (1.1), (1.2) and (1.3) while the influence of card sliver weight are shown in figures (2.1), (2.2) and (2.3).

The contours, figs (1.1) and (2.1), clearly show that at X_3 (doffer speed) = 0 level, the card web neps decreases as the cylinder speed increases. For heavy sliver weight, the lowest speeds of cylinder and taker-in show the highest neps in the card web.

The effect of X_3: doffer speed and X_1: taker-in speed for X_2= 0,i.e. cylinder speed 375 r.p.m., on neps represented by the contours shown in figs (1.2) and (2.2). An increase in doffer speed (r.p.m) leads to an increase in card web neps. With regard to the influence of taker -in speed, as can be seen,there is a higher neps at lower speed of taker-in while the doffer speed, lie between 18 r.p.m. and 22 r.p.m.

In figures (1.3) and (2.3), the contours for neps as a function of doffer and cylinler speeds while X_1; taker-in speed is kept constant . The results show an increase in neps associated with the increase of doffer speed. This trend has been obsarved at lower cylinder speed.

The effect of cotton type and sliver weight on card web neps are shown in figures (1) and (2). In respect of cotton fibre processed through carding machine, as can be seen, a fewer rate of neps for cotton Giza 70 than those obtained for Giza 81. Regardino to the influence of sliver weight on neps the results show that it is like that obtained from the previous studies[12]. At different levels of doffer speed, sliver weight had a greater effect on card web neps. Increasing sliver weight from 44 (gn/yd.) to 76 (gn/yd.) caused a decrease in neps.

4.2 Trash content %: Figures (3-4) shows the influence of some carding variables, Material feed and sliver weight on trash content(%).

The results clearly indicate the effect of X_1: taker-in speed with varying X_2: cylinder speed or X_3: doffer speed on trash content. The cotton

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Table (5) Response Surface Equations

Sliver Quality and Material paroneters		Y : Response - Surface Equations $= bo + \sum_{i=1}^{k} b_i X_i + \sum_{i<j} b_{ij} X_i X_j$
nep Count :	For Giza 81	$Y = 12.625 + 0.375 X_1 - 0.625 X_2 + 3.125 X_3 + 0.125 X_1 X_2 + 0.375 X_1 X_3 - 1.625 X_2 X_3 + 0.625 X_1 X_2 X_3$
	For Giza 70	$Y = 10.75 + 0.00 X_1 + 0.25 X_2 + 1.50 X_3 - 0.50 X_1 X_2 - 0.75 X_1 X_3 - 1.00 X_2 X_3 + 0.75 X_1 X_2 X_3$
Trash Content %	For Giza 81	$Y = 0.17825 - 0.04625 X_1 - 0.007 X_2 - 0.0045 X_3 + 0.015 X_1 X_2 + 0.0075 X_1 X3 - .00825 X_2 X_3 + .00925 X_1 X_2 X_3$
	For Giza 70	$Y = 0.182375 - 0.02 X_1 - 0.017 X_2 + 0.009 X_3 - 0.0238 X_1 X_2 + 0.0011 X_1 X_3 + 0.007375 X_2 X_3 - 0.002625 X_1 X_2 X_3$
nep count :	Sliver wt (76 gn/yd)	$Y = 19 - 1.75 X_1 - 3.0 X_2 + 3.0 X_3 + 2.25 X_1 X_2 + 0.75 X_1 X_3 - 2.0 X_2 X_3 - 0.25 X_1 X_2 X_3$
	Sliver wt (44 gn/yd)	$Y = 28.375 + 0.125 X_1 + 1.375 X_2 + 4.625 X_3 + 0.125 X_1 X_2 - 0.125 X_1 X_3 - + 0.125 X_1 X_2 X_3$
Trash Content %	Sliver wt (76 gn/yd)	$Y = 0.212875 - 0.047125 X_1 + 0.014375 X_2 + 0.004625 X_3 - 0.007125 X_1 X_2 - 0.000875 X_1 X_3 + 0.022125 X_2 X_3 - 0.014875 X_1 X_2 X_3$
	Sliver wt (44 gn/yd)	$Y = 0.14325 - 0.03625 X_1 - 0.002 X_2 + 0.01725 X_3 + 0.003 X_1 X_2 - 0.01375 X_1 X_3 - 0.01 X_2 X_3 + 0.0065 X_1 X_2 X_3$

fibres are cleaned substantialy more by the action of the higher taker-in speed. While, it is evident, the increase of doffer speed result in no change of trash content. In addition to the effect of taker-in speed, it may be noticed the two factor interaction X_1X_2(taker-in and cylinder speed) brings about change in trash content. This is occur when the ratio of taker-in speed to cylinder speed was maintained constant especialy at higher speeds.

For both cotton fibers " Giza 70 and Giza 81", it is evident that, the trash content % in the card sliver is almost the same and compatible with the recomended values (0.05-0.3% foreign matter)[13].

The effect of sliver weight on trash content is given in fig.(4). It can be seen that, heavy sliver weight had a higher trash content than the light weight sliver. That might be explained by the increase of sliver weight, means a heavier layer of meterial on the doffer, which in consequence defines that more fibres are transfered for a return of the cylinder and this in term means that the fibres spend less time on the cylinder. This results in the materials being less opened and less cleaned.

5.Conclusion:

The present study permits the following conclusions to be drawn:.

1. Card web neps:
   * A lower rate of neps is obtained by a low rate of doffer speed, optimal rotational speed of taker-in, and higher cylinder speed.
   * The most important factor of the three carding parameters which affect the card neps is the doffer speed .
   * The two factor interaction such as doffer and cylinder speeds affect significantly on neps.
   * Within the limit of experimantation: increasing sliver weight caused a decrease in the card web neps. Also cotton fibre " Giza 81" show a higher ratis of neps compared with those obtained for Giza 70.
2. Trash content (%):
   * The most significant parameter which affect on trash elimination is the taker-in speed.
   * The variation in cylinder speed is less important and causes a slight change in trash content % at ratio of higher speeds of taker-in/cylinder
   * As sliver weight increased result in the fibers less opened and higher percentage of foreign matter still in the card sliver.

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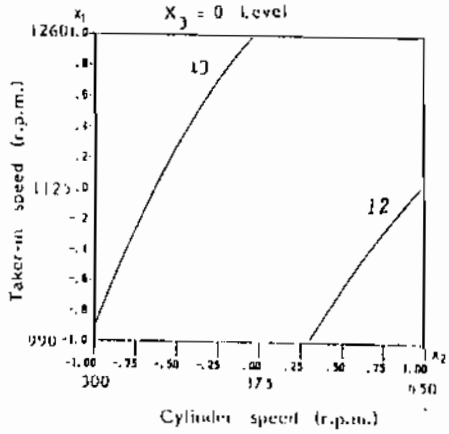

Fig (1.1)

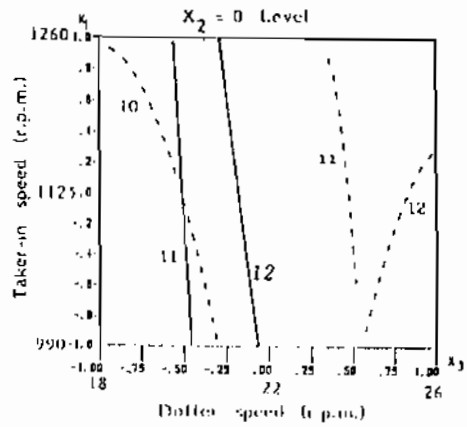

Fig (1.2)

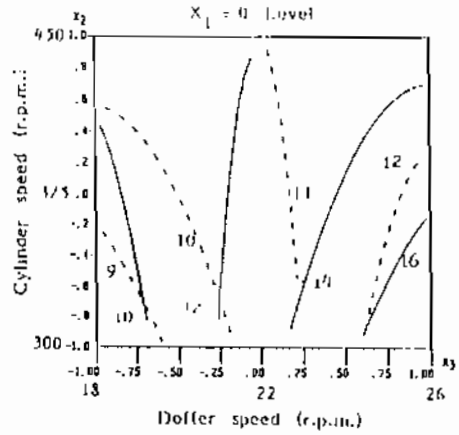

Fig (1.3)

Fig (1) Contours for tep const

(——) Giza 81 (----) Giza 70

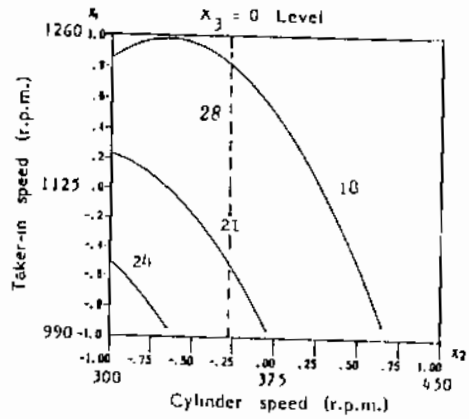

Fig (2.1)

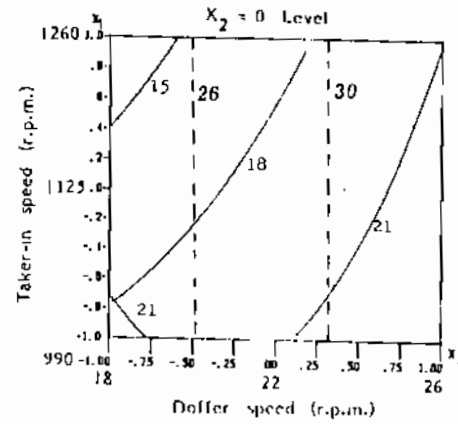

Fig (2.2)

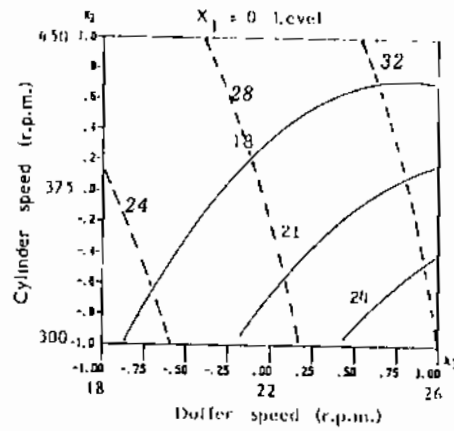

Fig (2.3)

Fig (2) Contours for nep count

(——) Sliver weight (76 $\frac{gn}{yd}$)

(– – –) sliver weight (44 $\frac{gn}{yd}$)

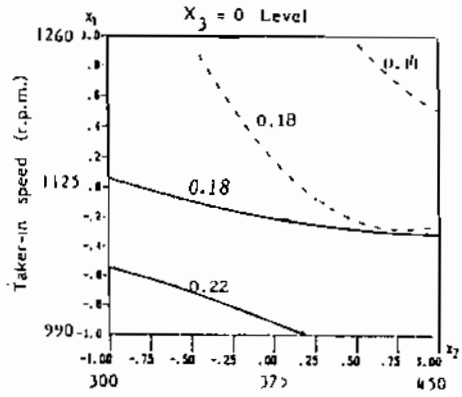

Fig (3.1)

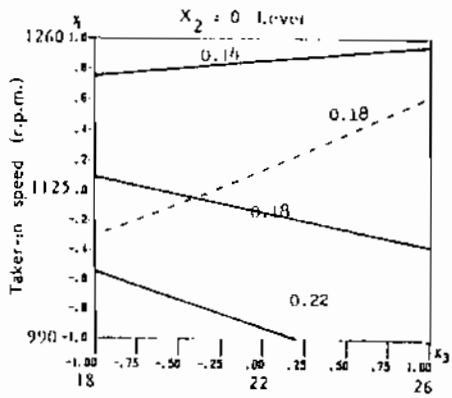

Fig (3.2)

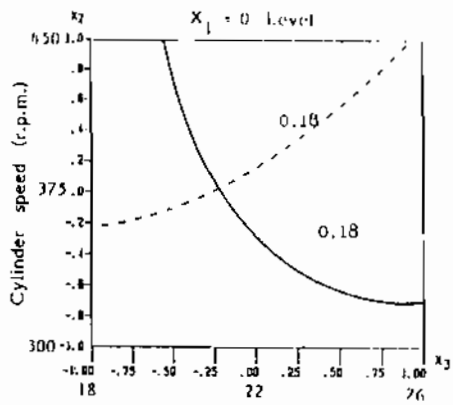

Fig (3.3)

Fig (3) Contours for Trash Content (%)

(——) Giza 81 (— —) Giza 70

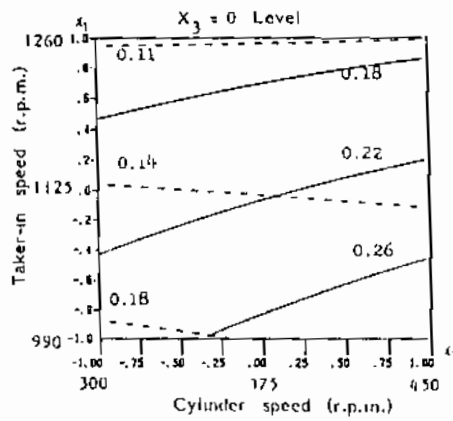

Fig (4.1)

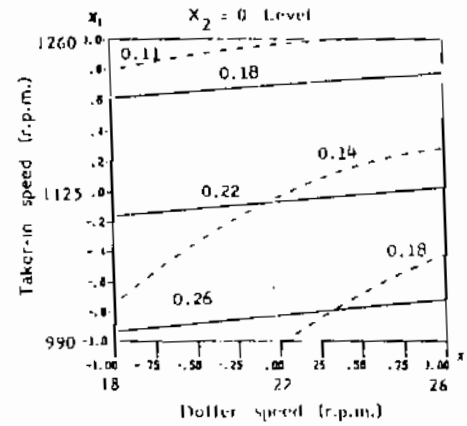

Fig (4.2)

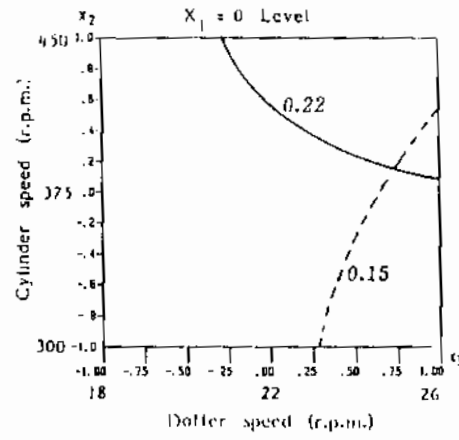

Fig (4.3)

Fig (4) Contours for Trash Content [%]
(——) Sliver weight (76 gn/yd)
(- - -) sliver weight (44 gn/yd)