INFLUENCE OF EGYPTIAN COTTON FIBER PROPERTIES AND MECHANICAL PROCESSING ON NEP FORMATION

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تاثير خواص شعيرات القطن المصرى وعوامل التشغيل على تكوين العقد فى شاشة الكرد والخيوط

خلاصة البحث : من الظواهر الهامة أثناء تصنيع الاقطان هو قابلية الشعيرات لتكوين العقد فى شاشة الكرد وينعكس ذلك على جودة الخيوط ومظهرية الاقمشة المنسوجة وتجانس الصباغات فى المنتجات القطنية .

ويهدف البحث الحالى الى تحليل تأثير بعض المتغيرات أثناء تحضيرات الغزل على مستوى عدد العقد فى شاشة الكرد وخيوط الغزل الحلقى . وتتركز التجارب فى دراسة تاثير عاملين أساسيين هما خواص شعيرات القطن والتأثيرات الميكانيكية فى خط التفتيح والتنظيف وماكينة الكرد على تكوين العقد بشاشة الكرد . وأجريت الاختبارات على ثلاثة انواع من الاقطان المصرية هى : جيزة ٣١ ، جيزة ٨١ ، جيزة ٧٥ تحت ظروف صناعية لانتاج خيط مسرح ٤٠/١ انجليزى وتشير نتائج البحث الى أن متغيرات خواص الشعيرات مثل دقة الشعيرات (الميكرونير) ، معامل الانبعاج (μ^2/μ^4) ووزن شريط الكرد (جرام/متر) تؤثر معنويا على عدد العقد فى شاشة الكرد . بالاضافة للعوامل السابقة يتاثر معدل العقد بتتابع الماكينات فى خط التفتيح والتنظيف ، سرعة الدوفر – كثافة اسنان كسوة الكرد – ضبط مسافات الفلاتس – أستخدام التراش ماستر . كما أمكن تحديد معامل الارتباط بين عدد العقد فى شاشة الكرد وعدد العقد فى الخيوط المغزولة .

ABSTRACT- The aim of the present work is to study the effect of several variables on the ultimate level of neps in card web and ring-spun yarn. The variables choosen include two main factors: fiber properties and mechanical treatment in spinning preparations. The experiments were carried out by running three Egyptian cotton fibers in the test and varying mechanical processing such as: blowroom stages, doffer and taker-in speeds, trashmaster, flats setting and card population "points / in^2". All test treatments were processed into card 40/1 yarn. Under fiber characteristics, micronaire value and fiber buckling coefficient affect significantly nep formation. within blowroom process neps can be created, while at carding machine more neps may be removed than created.

1. INTRODUCTION:

Neps in cotton have been a major problem in textile processing for many years(1). The term nep is applied to various physical phenomenon that occur in card web, yarn and cloth made from cotton fibers(2). In general, neps are associated with poor yarn and fabric appearance and have an effect on uniformity and dyeing quality (3,4).

Several studies have been conducted on nep phenomenon in terms of:-

i) Studies of the physical definitions and discription of neps:

According to ASTM(5) a nep is one or more fibers occuring in a tangled and unorganized mass. Pearson(1) reports that at least fifteen different kinds of neps can be found in raw stock. Lord(6) described five different kinds of neps found in cotton fabrics. Both of these discriptions involve only tangled fibers, for the most part immature or dead. Fiber entanglements accompanying seed coat fragments are included as neps by several authors including Fragher et.al(7). It further states that "Seed coat and mote fragments with lint or fuzz fibers attached are not neps". Bogdan's extensive review of literature(3) published in 1950 concerning neps illustrated the complexity of the problem of differentiating the types of neps and the particular causes of each.

ii) Studies of the dependence of nep formation on several factors:

Neps are formed during boll development, harvesting, handling, ginning and during yarn manufacturing process[8,9]. Entanglements of cotton fibers are propably caused by: mechanical manipulation of the cotton during processing and they can be called"mechanical neps". Others are due to extraneous plant material and can be referred to as "biological neps"[10]. Anthony[9]investigated the effect of varieties harvesting practices "such as timing of harvest, maturity level at harvest, date of harvest and machine adjustments" and ginning techniques on the nep content. Leonard[11] showed that mechanical treatment of seed cotton prior to ginning affects the number of neps in both saw and roller ginned lint. Other Reseachers confirmed that low nep count in ginned lint is typical for roll ginned cotton when compared to the count for saw ginned cotton[12]. Researchers examined the effect of cotton moisture content, processing rate and gin machinery type on total nep formation in ginning system [13].

Normal ginning conditions, three tower driers 65c and two lint cleaner, produced high card web neps than moderate ginning conditions,using no heat and only lint cleaner, at the same carding machine[14].

Cotton variety, location and season significantly affect the number of neps in cotton yarn[15], the effect of variety on nep content being the greatest of the three variables. There is a significant general tendency for the number of neps in yarn to increase as fiber length increases, fiber weight per inch decreases, percentage of thin walled fibers increases and the percentage of large motes increases, but a large part of the varietal variance in neppiness remains unexplained.

iii) Studies on nep determination methods:

The nep determination has been mentioned in several textile literature. Hebert et.al[10] investigate the neps obtained from different stages of cotton processing "ginning, spinning, weaving and dyeing"using light microscope. Those from stock and ginned samples were extracted from the classer's boards used in the one gram nep counting[21] test. Yarn neps were obtained by simply untwisting the yarns and fabric neps were picked from the surface.

Harrison and Bargeron[14] comparing four methods of nep determination: card web neps, document folder with template-defined viewing area, the ASM[16] nep test machine resembles a miniature card and yarn neps using Uster tester II model B.

Instruments, neptometer and RM 1100 nep tester were used for measuring the tendency of cotton fibers to nep formation. Also, a photoelectric scanning device was used for the determination of neppiness in card web.

In the present study, the work intended to explain several cotton processing conditions that affect nep formation. The experiments were carried out, under industrial conditions, to investigate:

i) Relationship of neps to fiber parameters: fiber fineness, buckling coefficient and card sliver weight.

ii) Effect of spinning preparations (opening-cleaning and carding conditions): blowroom sequence, doffer speed, taker-in speed, trashmaster, carding populations (points/in^2), flats setting on card web neps.

iii) The relationship between card web neps and yarn neps.

2. EXPERIMENTAL WORK:

2.1 Material used:

The experiments were carried out on three types of Egyptian cotton fibers. Table(2.1) shows the main fiber characteristics, in addition, all of these types of cotton fibers are free from honey-dew or other sticky contamination.

Table (2.1)

Fiber properties	Egyptian Cotton Fibers		
	Giza 81	Giza 75	Giza 31
2.5% span length (mm)	30.7	31.9	30.0
Micronaire reading (µg/inch.)	4.3	4.6	3.8
Maturity (%)	86.0	85.0	73.0
Non-Lint (%)	3.9	3.1	7.0

2.2 Construction Details of Experiments:

2.2.1 Effect of material parameters:

To study the effect of material parameters on nep formation, three varieties o Egyptian cotton fibers differ in fiber properties length's and micronaire values were processe through one card at two levels of doffer speed for producing card sliver "3.6, 4.3 and 5. gram/meter" while the other machine parameters were kept constant as shown in Table (2.

Table (2.2)

Cotton type	Giza 31		Giza 81		Giza 75	
Micronaire Value (µg/in²)	3.8		4.3		4.6	
doffer speed (r.p.m)	9.5	25	10.5	26	9.5	28
Card sliver weight (g/m)						
5.0	x	x	x	x	x	x
4.3	x	x	x	x	x	x
3.6	x	x	x	x	x	x

Cylinder speed 265 r.p.m, Taker-in speed 857 r.p.m and flat speed 7.8 cm/min

2.2.2 Effect of Mechanical Treatment.

i) To study the effect of opening-cleaning stages on the tendancy of cotton nep formation two types of Egyptian cotton fibers "Giza 81 and Giza 31" were processed through two opening lines as shown in Table (2.2).

Table (2.3)

Cotton type	Opening Line	Machine Sequance
Giza 81	Line "A"	Blending bale opener, Axi-flow, Hopperfeeder, Step cleaner, porcupine, kirshner, chute feeding.
Giza 31	Line "B"	Blending bale opener, Axiflow, H. feeder, porcupine beater (2), Automixer, kirshner, chute feed

ii) To study the effect of carding conditions on nepformation:
The cotton fibers were carded on a high production carding m/c for producing card sliver 0.13 Ne and the running conditions were set as shown in Tables (2.4), (2.5), (2.6), (2.7), (2.8).

Table (2.4)

Taker-in speed (r.p.m)	doffer speed (r.p.m)				
	8	22	26	30	34
750	x	x	x	x	x
850	x	x	x	x	x
950	x	x	x	x	x
1100	x	x	x	x	x

Table (2.5)

M/c	doffer speed (r.p.m)	flat speed (cm/min)	Taker-in speed			
			750	865	950	1100
with bad condition	29	10.3	x	x	x	x
with good	10	7.8	x	x	x	x
condition	26	7.8	x	x	x	x

Table (2.6)

Carding M/C	doffer speed (r.p.m) low speed (8 r.p.m)	high speed (26 r.p.m)
with trash master	x	x
without " "	x	x

Table (2.7)

Card Sliver (Ne)	flat setting (in")		
	0.009	0.012	0.015
0.12	x	x	x
0.14	x	x	x

Table (2.8)

carding cloth type	points/in² flats	cyl.	doffer	Egyptian cotton fibers Giza 81 doffer sp. r.p.m 8	Giza 81 doffer sp. 26 r.p.m	Giza 31 doffer sp. 26 r.p.m
A	370	795	388	x	x	x
B	380	780	367	-	-	x
C	420	806	358	x	x	x
D	450	865	340	x	x	-

Two drawing processes were used and the samples spun into yarn count Ne 40 (15 tex) with twist multiplier αe 4.2 on spinomatic with 480 spindle, ring diameter ϕ 48 mm and using S.K.F spendulum arm PK 225.

2.3 Measurements:

Card web neps: The resulting web was placed on standard black velvet grading boards and the number of neps counted with the aid of low mangnification. Each experiment is the average of 20 reading and the average number of neps per inch square of card web is calculated.

Yarn neps: were determined using Uster tester II, the results are neps per 1000 meter of yarn.

3. RESULTS AND DISCUSSION:

3.1 Relationship between fiber properties and nep formation

In terms of fiber fineness: the relation ship between card web neps and micronaire values is plotted graphically in Fig. (1.1) and (1.2) for two levels of carding production three levels of card sliver weight (g/m). It can be seen that, the finer cotton tends to more frequently and easier than coarser fibers, Also, the results indicate that a signific differences in nep count appeared among these varieties, "Giza 31, Giza 81 and Giza that was expected since these differed in micronaire values. The same trend has b observed either with varying the carding rate, from 10.5 r.p.m to 26 r.p.m, or/and s weight (g/m), 3.6 to 5 g/m.This is in agreement with the results obtained by Hebert (10). pointed out the immature fibers were a major cause of nep formation in cotton process

The statistical results show a strong correlation between neps / 100 in^2 and f fineness (μg/inch). The values of correlation coefficient are very high ranging betw r = - 0.799 and - 0.883 for low and high carding rate respectively as shown in Fig.

In terms of the combined effect of fiber fineness and fiber length as compon of the bending modulus on nep formation is shown in Fig. (3).

It is evident from the previous studies(17,21) that processing of fibers tends to prod neps through a stress build up / sudden release mechanism, which includes buckling a the fiber length(17). Also, stated that, the coefficient of buckling based on Euler parame correlated highly with standard fiber properties: micronaire which represents fineness well as maturity and length. This factor was expressed as (L^2/μ^2) where L:is the 2.5% s length of fibrograph and μ:is the micronaire value. These components of the bending modu determine the flexural rigidity of fibers.

The relationship of card web neps to coefficient of buckling (L^2/μ^2) is shown Fig. (3). The linear correlation coefficients 0.78-0.85 significant at 0.95 level, indicate t buckling due to sudden/relase in fiber processing is one of the parameters that cau nep formation.

In terms of card sliver weight: the effects of cotton type and card sliver wei on card web neps appear in Fig. (4). The graph's show a higher nep count associated w Giza 31 cotton fiber than those for Giza 81 and Giza 75 respectively. It is clear tha there were more neps in the 4.9 g/m than those of 4.2 g/m and 3.6 g/m carded sliv Also, a slight increase in card web neps has been observed for 3.6 g/m than those of g/m card sliver. This is in agreement with the earlier studies (18).

3.2 Relationship of mechanical treatment to nep formation:

The following graphs, Fig. (5), show the number of neps per gram for all Blowro stages and carding process. It has been found that the nep count increases considera in processing from bale through blowroom machines line "A" for Giza 31 and Line "B" cotton Giza 81. Where it reaches a maximum value at last opener, then decreases in cardi depending on card m/c parameters.

Fig (6.1) and (6.2) show the effect of doffer speed (r.p.m) and taker-in speed card web neps. The results indicate that as the doffer speed increases the nep conte increases. This trend has been observed for all different levels of taker-in speeds.

Card taker-in speeds of 750, 865, 950 and 1100 r.p.m were used in carding Giza cotton fibers. Generally, as shown in Fig (7.1) taker-in speed did not affect neps in t card web. Also, as shown in Fig. (7.2), if the card is in a good condition the neps m be reduced as low as 48-70 neps per gram of fibers for low and high doffer speed respec vely. while, if the card in poor condition, there are few neps taken-out, thus giving a w with a higher level of neps per gram of fibers

Fig. (6.2) shows the effect of doffer speed, as carding m/c equiped with or witho trash master, upon card web neps. The results indicate that, a drop of card web neps we achieved as trash master applied to carding machine. Also, the same effect of doffer speed has been observed, the higher speed causes more neps. Hughs[20] pointed out neps in the card web that has been flattened by crusher rolls showed up more plainly on the nep board. Consequently, crusher rolls improved spinning performance and yarn quality including neps/914 meter.

Fig (8) shows the effect of card flat setting on card web nep formation. Flat setting of 0.009, 0.012 and 0.015 inch were used in carding Giza 81 cotton fiber at speed 26 r.p.m. It is noticed that, for 0.009 and 0.012 inch settings, card web neps were low and at the same level. For wider flat setting 0.015 inch the number of neps was significantly higher than the other two closer settings. Control of these fibers is lost at this point and increased nep formation occurs. The industrial practice of increasing the flat setting reduces cylinder load further reduces the carding action needed for cotton fibers, causing more neps and deterioration of quality [18].

Fig. (9) shows the effect of population, points/inch², on card web nep formation for two Egyptian cotton fibers. It has been found that, for Giza 31 increasing the number of points/inch² has more significant effect upon reducing carding web neps. Also, at higher doffer speed, the same trend has been noticed for Giza 81, than those obtained at lower rate.

This is in agreement with the earlier investigation[19]. Numerous trials have been made to find the effect of increasing cylinder, doffer and taker-in population by the use of fine-rib wire upon carding performance. The required carding power was achieved as fine wire was applied to the main cylinder while for doffer and taker-in the results are not likely to indicate that there is significant improvement in carding performance.

3.3 Relationship of card web neps to yarn neps:

Card web neps are important because of the high correlation between card neps/100 inch² and yarn neps/1000 m as shown in Fig. (10.1) and (10.2). The values of correlation coefficient are very high ranging between $r = 0.88$ and $r = 0.91$ for fiber characteristics and mechanical treatment through carding respectively. Tnus, whatever the causes the card web neps can also be a contributing factor in causing yarn neps.

4. CONCLUSIONS :

The present study permits the following conclusions to be drawn:

1- Mechanical treatment of cotton fibers through spinning preparations causes more variation in card web neps as follows:

i) Blowroom stages affect significantly nep formation. The number of neps/gm increases from machine to machine in the blowroom, where it reaches a maximum level then decreases in carding

ii) The card web neps level depends on card conditions as the following
- It has been found that increasing the carding poupulation (points/in²) caused a significant effect on removal of neps
- Trash master at carding machine produced low card web neps/100 in² and lower yarn neps/1000 m.
- As the carding machine is in good condition,which is obtained by proper adjusting and mentainance, there are more neps taken-out.
- Increasing the flat setting causing more neps and deterioration of yarn quality.
- Higher doffer speed (r.p.m) increases the nep content.
- card taker-in speeds r.p.m used did not affect significantly neps in the card web.

2- In term of material variables, the existing correlation between nep and fiber characteristics is highly significant.

- Cotton fibers with lower micronaire value "μg/inch" Giza 31, tend to nep more frequently and easier than those with high micronaire values, Giza 81 and Giza 75". The correlation coefficient "r" varies between - 0.79 and - 0.83.
- Fiber buckling coefficient (L^1/μ^1) which is based on length at 2.5% and fiber fineness affect significantly the card web neps. A linear coefficient of correlation is 0.78 between buckling coefficient and neps/100 in^2.
- There were affects card web neps with 49 gm/m than with 3.6 gm/m card sliver weight

3- Card web neps plays an important role in the final yarn quality. It is clear that whatever the causes the card web neps can be a contributing factor in causing yarn neps. The statistical analysis yielded a very high correlation between card web neps and yarn neps, the coefficients r:0.88 and 0.91 for fiber parameters and mechanical processing at carding respectively.

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REFERENCES:

1) Pearson, N.L, U.S Department of Agri. Tech. Bull., No. 396, 19 pp., Nov. 1933.

2) American Society for Testing and Material, Standard test method for grading cotton card web for appearance, ASTM no. D3216, 1979.

3) Bogdan, J.F., Textile Industr., 114, 98-103, 105-107, 1950

4) Markezich, A.R. et.al., Textile Res. J. 28, 570-575, 1958.

5) ASTM Standards on Textile materials, American Society for testing material, philadelphia. 1947, part 33, p. 27.

6) Lord E., Emp. Cotton Grow. Rev. 25, 180-190 (1948).

7) Fargher. R. G., et.al., J. Text. Inst. 41, 590-608 (1950).

8) Mangialardi, G. J. Text. Res. J. 55, 756-761, 1985.

9) Anthany W. S. et.al., Textile Res. J, P 633, Nov. 1988.

10) Hebert J. J. et.al, Textile Res. J., 380, July 1988.

11) Leonard C. G., U.S. Dept. Agr. 1966-1969 (through Textile Res. J. Dec. 1985).

12) Griffin A.C. and McCaskil. O.L., U.S. Sept. Agr. Tech. Bull. 1407, 24 pp 1969 (through Text. Res. J. Dec. 1985).

13) Gino J. and Mangialardi J.R., Text. Res. J., P. 756, Dec. 1985.

14) Harrison R.E and Bargeron J.D, Text. Res. J, p77, Feb 1986.

15) Pearson, N.L, USDA Tech. Bull. No. 878, 1944 (through Text. Res. J. Oct. 1988).

16) U.S. Dept Agr., Cotton testing Service, Agr. Handbook no. 594, p. 14, 1982. (through Text. Res. J. Feb. 1986)

17) Alon G. and Alexander E., Melliand Textilber 59, 792-795, (1978).

18) Simpson J. and Fiori L.A, Text. Res. J, P.284 April (1976)

19) Grim Shaw K., The Design and Maintenance of card clothing for the modern cotton card, Huddersfield, England.

20) Hughs S.H. et.al., Text. Res. J. P. 578 Oct. 1988.

21) Hebert J.J. et.al., Text. Res. J. 56, 108-111 (1986).

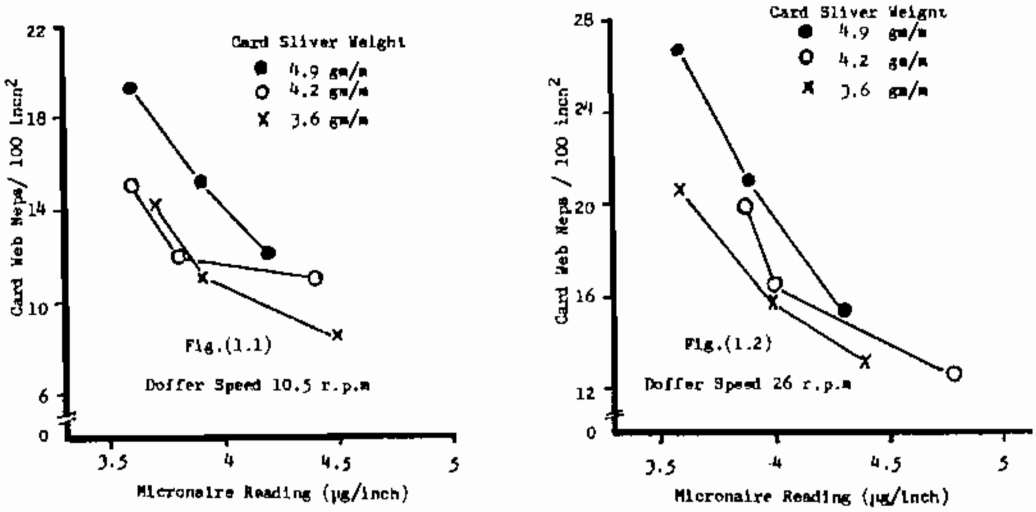


Fig.(1) Effect of Micronaire Reading on Card Web Neps/ 100 in^2

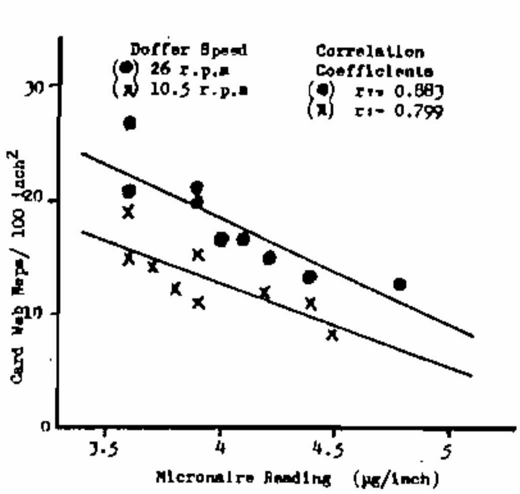


Fig.(2) Correlation Coefficients Between Card Web Neps and Micronaire Reading

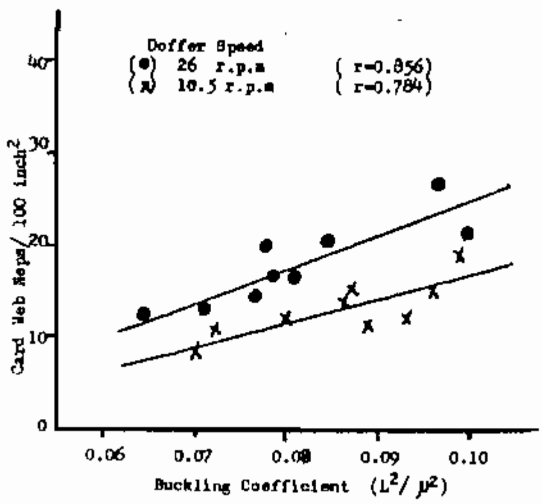


Fig.(3) Correlation Coefficients Between Card Web Neps and Fibre Buckling Coefficient

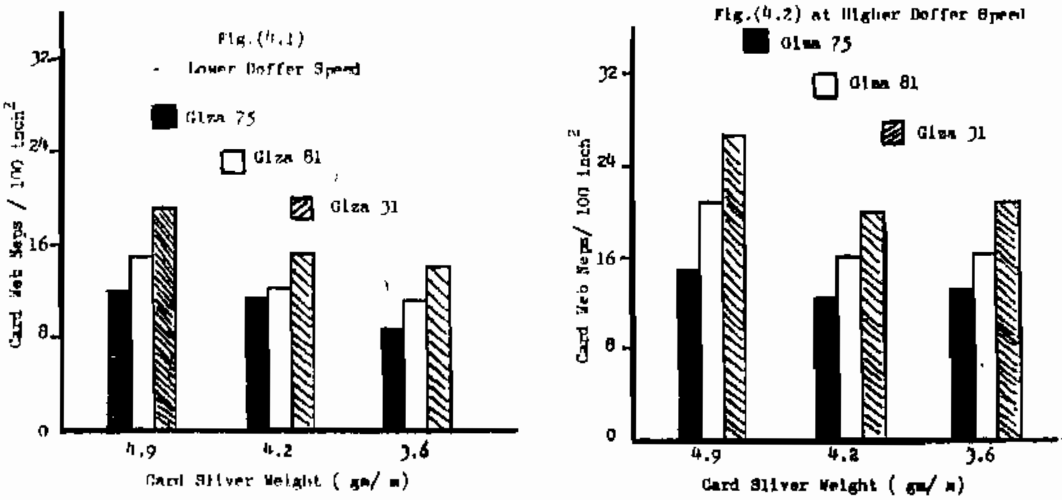


Fig.(4) Effect of Card Sliver Weight(gm/m) and Cotton Fibres on Card Web Neps

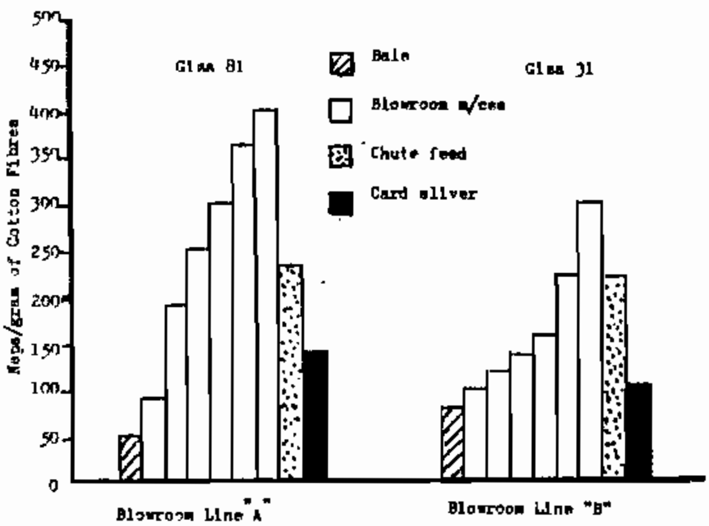
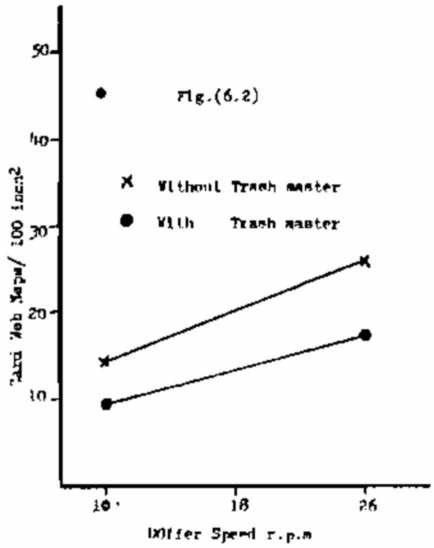
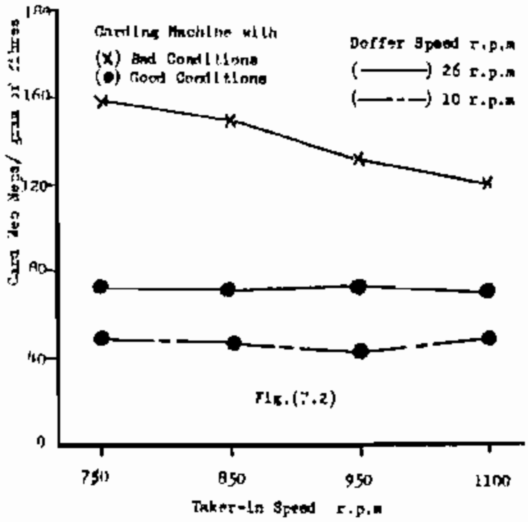


Fig.(5) Effect of Blowroom Machines Sequence on Neps Per Gram of Cotton Fibres





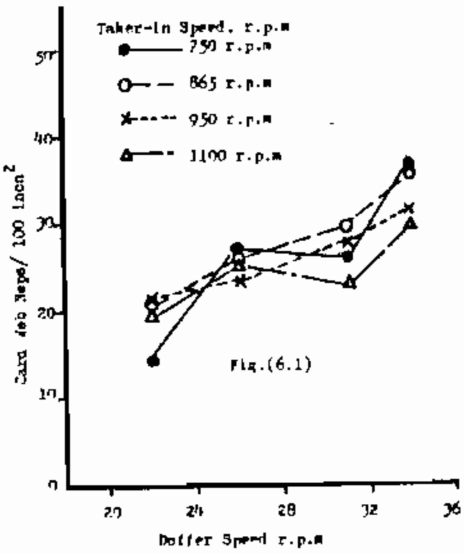


Fig.(6) Effect of Doffer Speed with varying Taker-in Speed and Trash master on Card Web Neps/ 100 inch^2

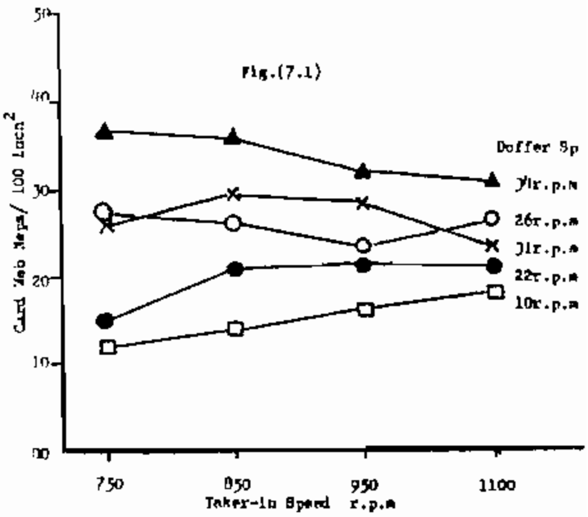


Fig.(7) Effect of Taker-in Speed on Card Web Neps

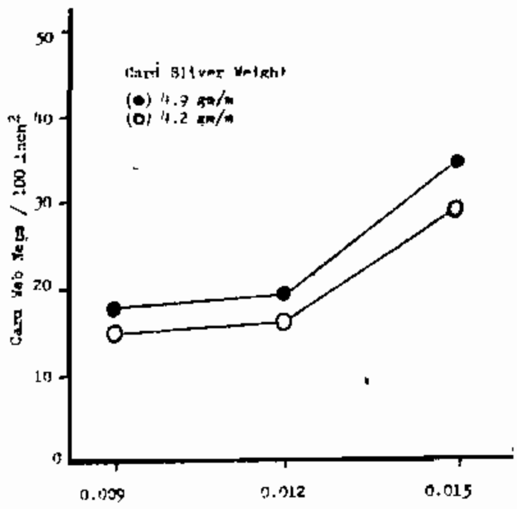


Fig.(8) Effect of Flat Settings on Card Web Neps/ 100 inch²

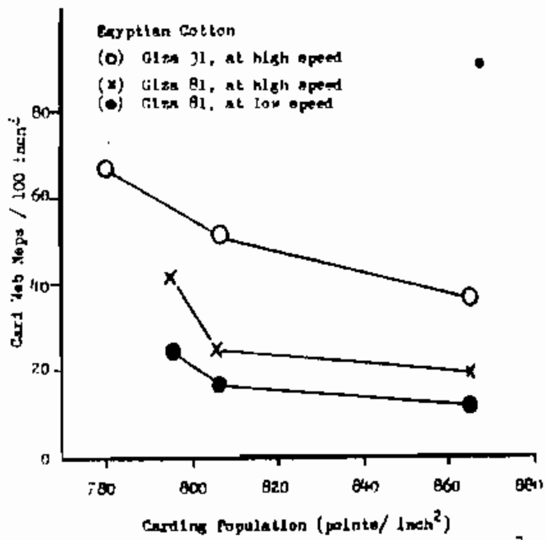


Fig.(9) Effect of Carding Population(Points/in.²) on Card Web Neps/ 100 in.²

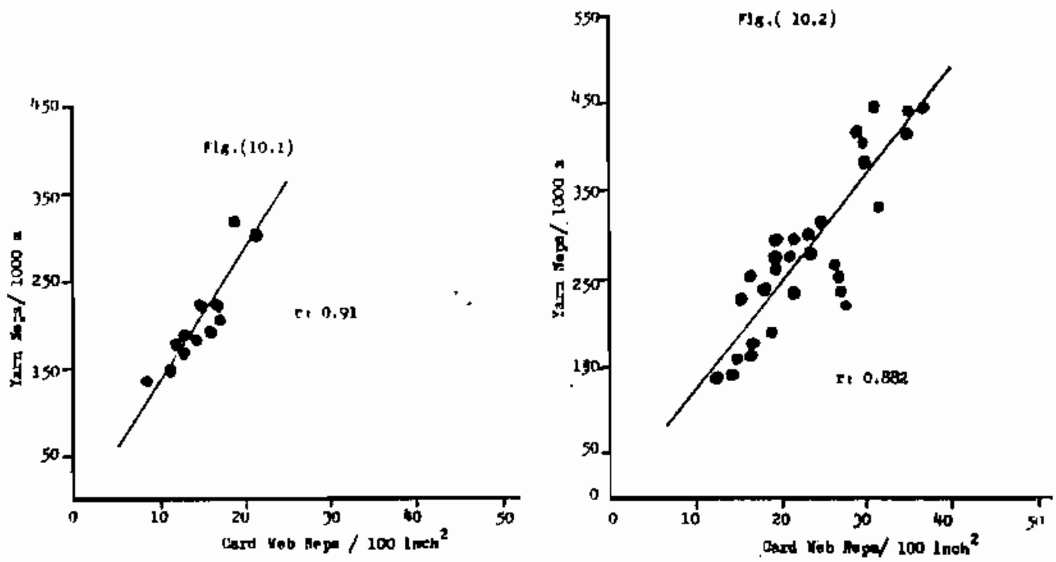


Fig.(10) Correlation Coefficients Between Yarn Neps /1000 m and Card Web Neps/ 100 in.²