

INFLUENCE OF THE CLEANING OPERATION ON THE QUALITY OF THE YARN

by
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منوان البحث : تأثير عملية التنظيف في الراحل التحضيرية للنزل على جودة الخيوط المنتجة

من الاهداف الرئيسية لتحضيرات النزل هو تحقيق نظافة عالية لضميريات الخيط. دون حدوث تأثير ضار على خصائص الخواص النوعية. لذا فان البحث الحالي يهدف الى دراسة العلاقة بين عمليه التنظيف وجودة المنتج وأجريت الاختبارات طبقا لظروف التشغيل الصناعيه. وصفت التجارب بتغيير عدد دوابل وهي : تشغيل ثلاث أنواع من الاقطان المصريه (جيزه ٧٠، جيزه ٧٥، وجيزه ٢١) تتباين في خواصها مثل طول الضميريات ودقتها ونسبه احتوائها على الشوائب، اختلاف نوع المتشابك وردد ها في خط التنجيم والتنظيف، إنتاج خيوط بسرعه وسشطه بشره مختلفه على ماكينه النزل الحائس.

ويتركز البحث في المقارنه بين تأثير احلال مضرب ماستركلين الصنع حديثا بدلا من ثلاثه مشابك تقليديه (المدرب التدريج - مضرب بوركويمين - مضرب كهوشن) على كثافه التنظيف عدد المعد / جرام من الشديرات وجودة الخيوط الناتجه. وباستخدام طريقه حساب مساحه خلع الأخراس النسيه (كثافه التشغيل في مرحله التنجيم والتنظيف، والتشطبه، جردة الشريط بالكينه الكرد، وحسبان الخيوط الناتج بالكينه النزل الحائس) يمكن تقييم الجوده الكليه كدالة في نوع الشديرات وخواصها ونوع المشابك وردد ها في خط التنجيم والتنظيف.

ABSTRACT- The object of the present work is to study the influence of the progress of cleaning operation on cleaning action, neps per gram and yarn characteristics. The results of industrial evaluations, using three varieties of Egyptian cotton fibers, to produce ring-spun yarns ranged from carded to combed qualities, are presented. For all cotton fibers, comparison of the processing performance of a three cleaning units with Masterclean concept are favourable to the new cleaning unit (MAC). The modern set alone provides up to 64% cleaning efficiency and lower lint loss at 460 kg/hr production. Also, the results emphasize the high trash removal consequently the cards had to handle up to 42% less trash as a results of this the card sliver turned out to be 60% cleaner. On the other hand, cotton tufts and card sliver contained considerably more neps than that processed through the conventional cleaning units. It was found that, within the limits of this study, the cleaning operation had appreciable effect on yarn quality. There were a significant differences in strength, ends down, uniformity and imperfections of ring spun yarn, between the two organization. For cotton fibers with a higher micronaire values, the Masterclean concept achieve a better quality yarns than those obtained from conventional cleaning units.

1- INTRODUCTION

Several studies confirmed that the opening and cleaning process causes a considerable influences on degree of opening (1), cleaning action (2,3), fiber properties (4) and yarn characteristics (5). Leifeld (6) indicate that the effect of flow of material, stop-and-go and continuous working in the blowing room on the yarn quality. In Egyptian cotton mills, the author (7) studied the behaviour of different Egyptian cotton fibers qualities through different installations in terms of machine arrangements and fiber parameters.

The present work tends to demonstrate that the improvements which can be achieved by one new cleaning unit in comparison with three conventional cleaning machines. For true evaluation the performance of a new cleaning unit, it is necessary to determine:-

- The cleaning efficiency of the openers and the whole range of machinery, waste percentage per machine, residual trash content and lint % in waste, and;
- How does the new cleaning unit affect the neps per gram, of stock and card sliver, and the characteristics of the yarn such as strength, uniformity and ends down / 1000 spindle. Hr

2. EXPERIMENTAL WORK:

2.1 Material Used:

Three Egyptian cotton fibers, Giza 31, Giza 75 and Giza 70, with different initial trash content were selected. Additional data concerning the material will be found in Table (1). In case of cotton type Giza 75, there are two lots with regard to the original plant (Delta and Upper Egypt).

Table (1)

Cotton fibers	Property							
	Trash analysis				Mic. Value µg/inch	Fiber length		
	Lint %	Trash	non - lint			L2.5%	L50%	U.R.
			Inv.	total waste				
Giza 31	92.20	6.13	1.67	7.8	3.5	29.9	15.1	51
Giza 70	96.46	2.20	1.34	3.54	3.8	34.7	16.6	48
Giza 75 (n)	95.56	3.81	0.62	4.43	4.0	31.9	16.0	50.6
(s)	93.33	4.59	2.08	6.67	4.0	30.7	15.29	51

2.2 Processing Procedures:

Two blowroom lines, H and T, have some identical machinery such as Bale opener (GBA), Axl-flow machine (AFC) and the other cleaning points are different in their construction and principles. Line "H" included a new cleaning unit, Masterclean concept (MAC), coupled with two air fiber separator (AFS). On the other hand, Line "T" included three conventional cleaning units, Step cleaner (SC), porcupine (PP) and Kirschner beater (KS). The machine sequence for each line are shown in Figure (1).

The cotton fibers were processed in spinning preparation lines, under industrial conditions considered the recommended values of machine setting and production speed. The raw material which was used for such experiments ranged from production a carded to combed qualities. In this comparative studies no parameters of yarn process except the different preparatory line were changed.

2.3 Measurement:

Trash content determination by shirley was made on samples of cotton from bale, fibers at each cleaning point and card sliver. Neps from stock samples and card web determined according to ASTM (8). Yarn strength characteristic was determined on Tensomat strength tester and irregularity was measured by Uster Evenness tester.

3. RESULTS AND DISCUSSIONS:

From the previous studies (9) a comparative experiments between a conventional blowroom and Masterclean blowroom were executed in a ring spinning mill and open-end rotor spinning. Also, the raw materials which were used for such investigation: 100% Pakistan cotton with staple length $1\frac{1}{5}$ inch, Mic. 5.0 µg/inch and trash content 2.3% for carded ring spun yarn Ne 30, and blend of low grade cotton and reclaimed waste for open-end yarn Ne 18. It was found that, there is no negative influence on the quality characteristics of the yarn by using the Masterclean concept.

In the present work, the experiments are constructed for three Egyptian cotton fibers to investigate the influence of replacing machines with lower cleaning action by new ones with higher efficiency on carded and combed yarn quality. The

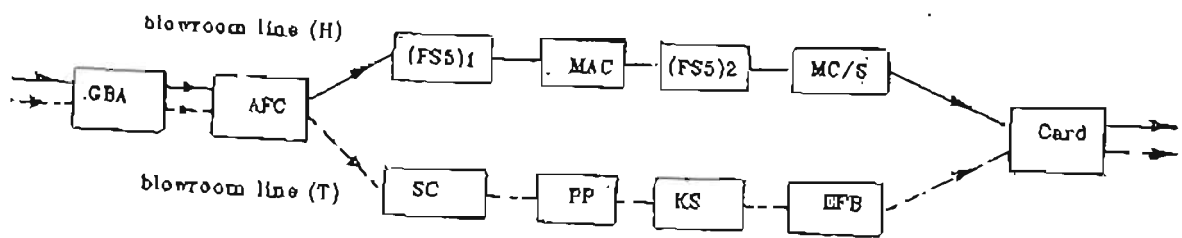
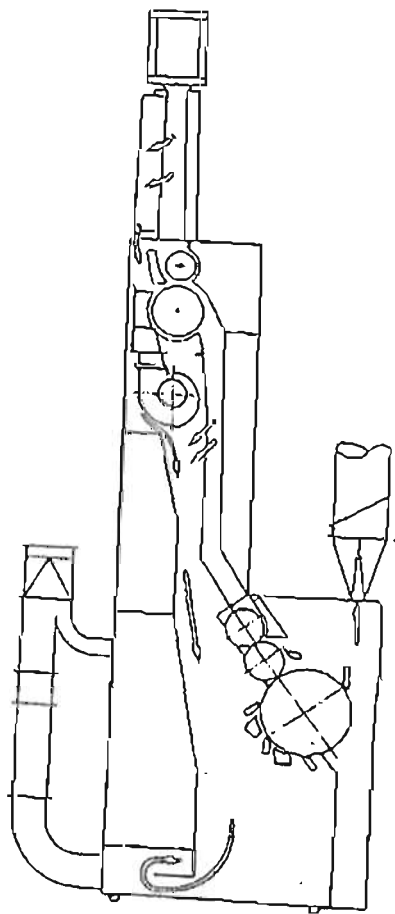
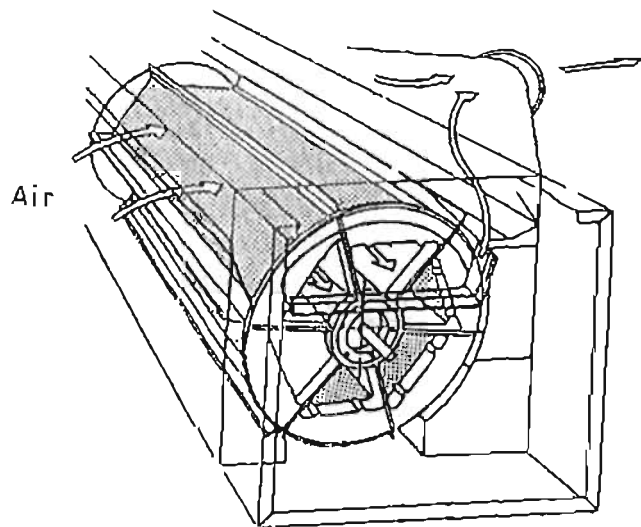


Fig. (1)_a Processing Lines Used in the Tests.



Masterclean MAC



Air fiber separator AFS

Fig. (1)_b Schematic Diagram of Masterclean Concept.

obtained results are illustrated in figures (2) to (11) and discussed in the following paragraphs.

(i) Influence on cleaning Efficiency:

The experimental results for running materials, Giza 31, Giza 70 and Giza 75 in both blowroom lines (H and T) are shown in Figures (2) and (3). The curves refer to the cleaning efficiency indicate that the line H comprised a Masterclean concept achieved a considerable improvement of cleaning efficiency up to the card sliver for all cotton fibers.

- with cotton fibers, Giza 31 and Giza 75 (s), has a higher initial trash content, a cleaning efficiency of 82% and 80% is obtained on line H respectively. For the same cotton quality, a cleaning efficiency of about 66% is obtained on line T. i.e. The cleaning efficiency obtained in line H is about 23% higher than the cleaning achieved in line T.

It is clear from the above results, that the differences in machines design of blowroom lines (H and T) affect significantly on the cleaning action. In addition, it can be stated that, the new cleaning machine (MAC) has a higher cleaning action than those obtained with three conventional beaters. Cleaning efficiency for new machines ranged from 58% for cotton with lower trash content to 77% for cotton with higher trash content. On the other hand, the results indicate that the averaged cleaning efficiency 45% to 48% for 3 conventional cleaning units.

ii) Influence on Residual Trash Content:

Figures (4) and (5) show the trash content of cotton in the bale, after processing through different preparatory lines (H and T) and in the card sliver. It is clear that from this investigation :

- For cotton fiber Giza 31, with initial trash content 6.13%, line H show a lower residual trash of 1.2% before the card than those obtained with line T 1.93%. The cards in this case had to handle 37.8% less trash as a result of this the card sliver turned-out to be 21.4% cleaner.
- With an initial trash content 4.6%, for cotton fiber Giza 75 (s), the machines installations in line H result in a low residual trash content 0.91% while 1.5% residual trash can be obtained for line T. The cards had to handle 42.2% less trash as a result of this the card sliver turned-out to be 60% cleaner.
- For cotton fibers, Giza 75 (n) and Giza 70, with initial trash content 3.81% and 2.2% respectively, the line H result in a less remaining trash content, 0.99% and 0.69%, before the card. The improvement is 20.2% for Giza 75 (n) and 16% for Giza 70. As a result of this the carded sliver turned out to be 33.3% and 22% cleaner.

iii) Influence on Waste Removal (%):

The test result of the waste percentage per machine is shown in Fig. (6) for all cotton fibers. Also, the analysis of waste by means of shirley analyzer shows the new cleaning unit in line H had more trash removal and less amount of lint in the waste as compared with the conventional three cleaning units (Fig. (7)).

The waste quantity obtained in line H is, about 18.2%, higher than the waste removed by line T for cotton fiber Giza 31. Also, for cotton fibers, Giza 70 and Giza 75 the experiments indicate a higher waste% (12%) for line H.

(iv) Influence on Neps/gram :

In Figure (8) the curves show the number of neps per gram for all blowroom stages and carding process. It has been found that the nep count increases considerably in processing from bale through blowroom machines for Giza 31, Giza 75 and Giza 70, where it reaches a maximum value at chute feed system then decreases in carding machine. For all cotton fibers the results show a slight change of nep count has been

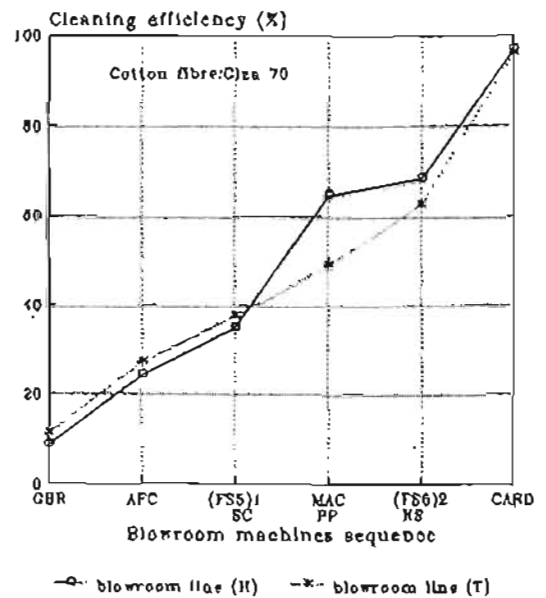
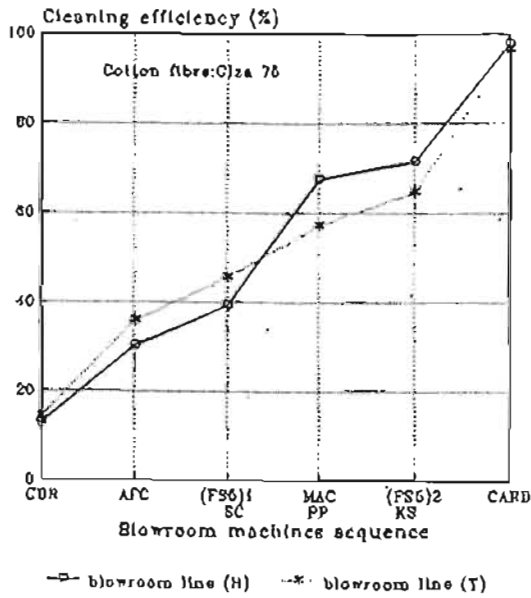
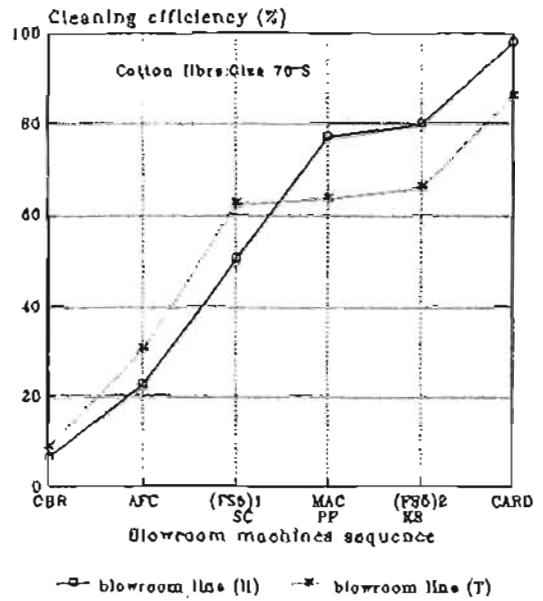
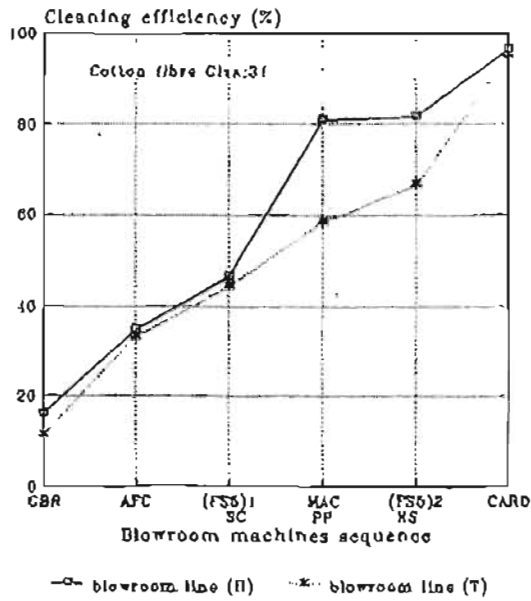


Fig. (2) Characteristic Cleaning Efficiency Curve

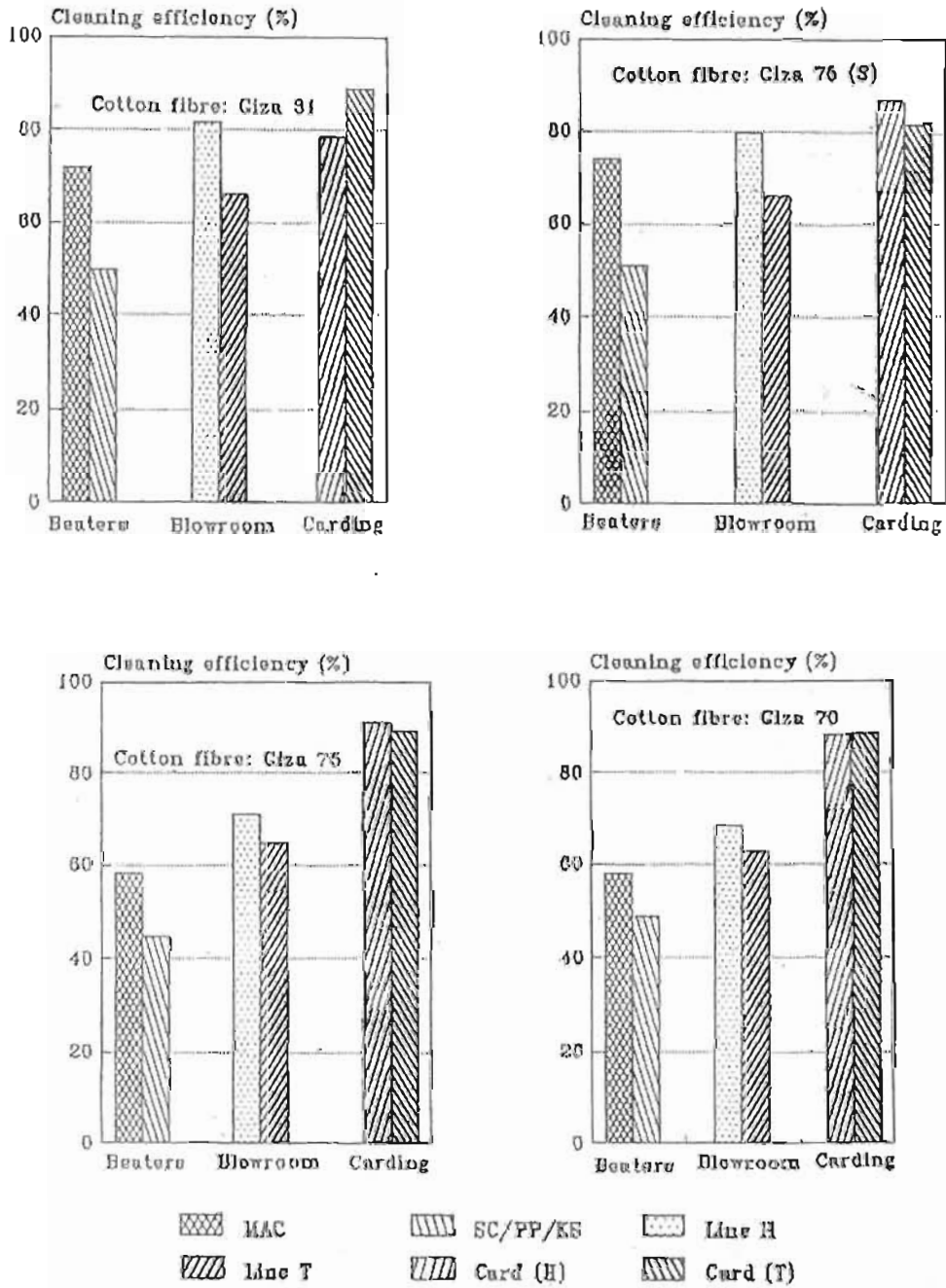
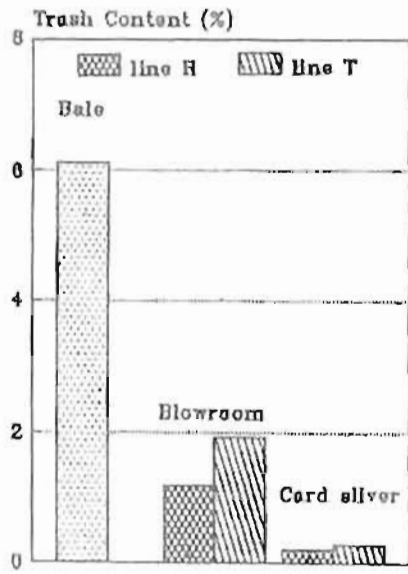
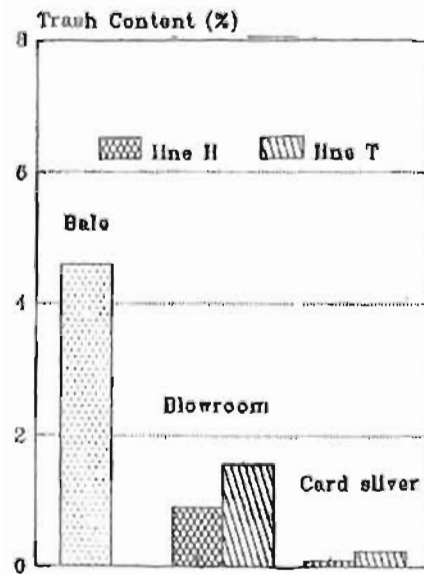


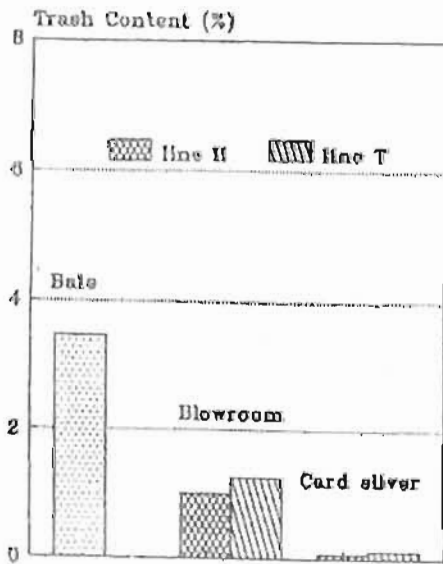
Fig. (3) Cleaning Efficiency of Openers - Cleaners, The whole range of Blowing Machinery and Carding.



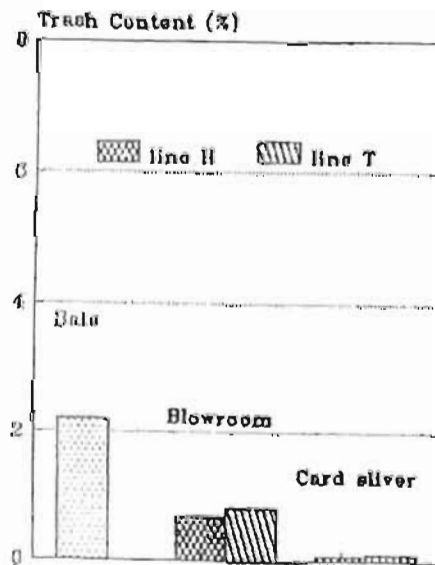
Cotton fibre: Giza 31



Cotton fibre: Giza 75 S



Cotton fibre: Giza 75

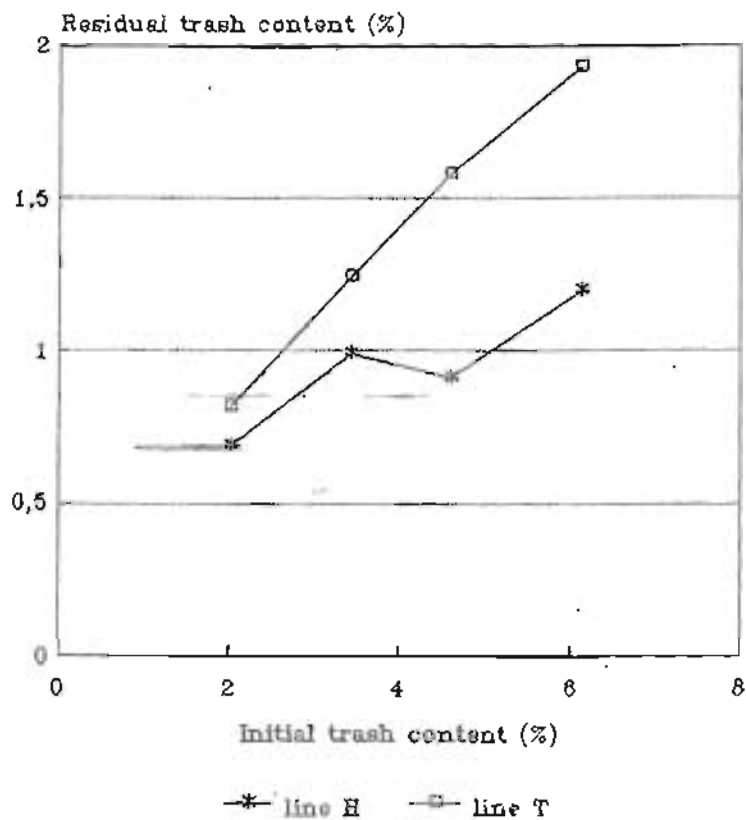


Cotton fibre: Giza 70

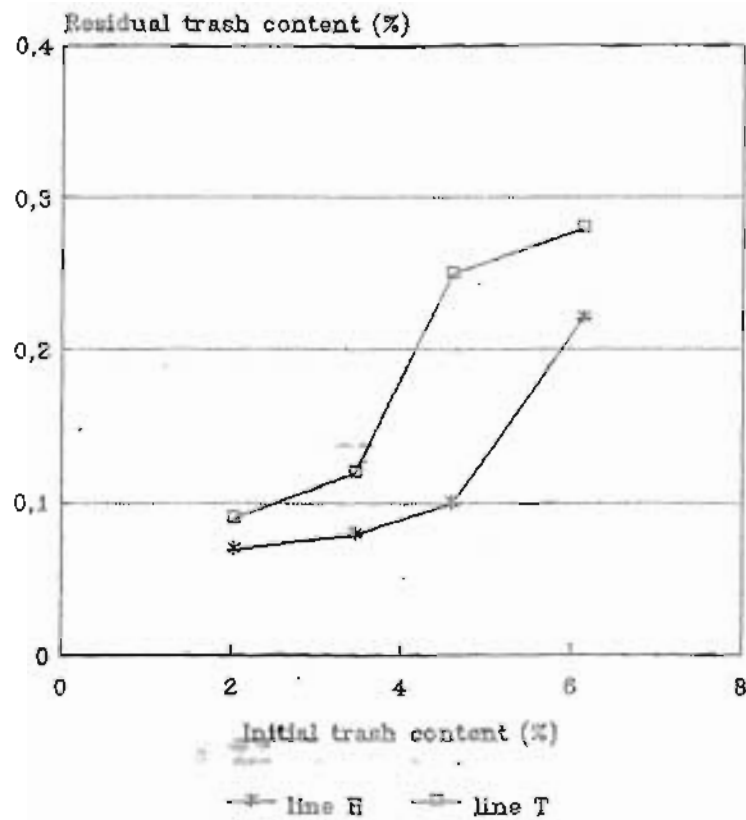
Fig. (4) Comparison of percent trash at Bale, Blowroom Lines and Card Silver.

Fig. (5) Relationship Between Residual Trash percent and Trash Content of The Input Material.

(i) for cotton tufts before card



(ii) for card sliver



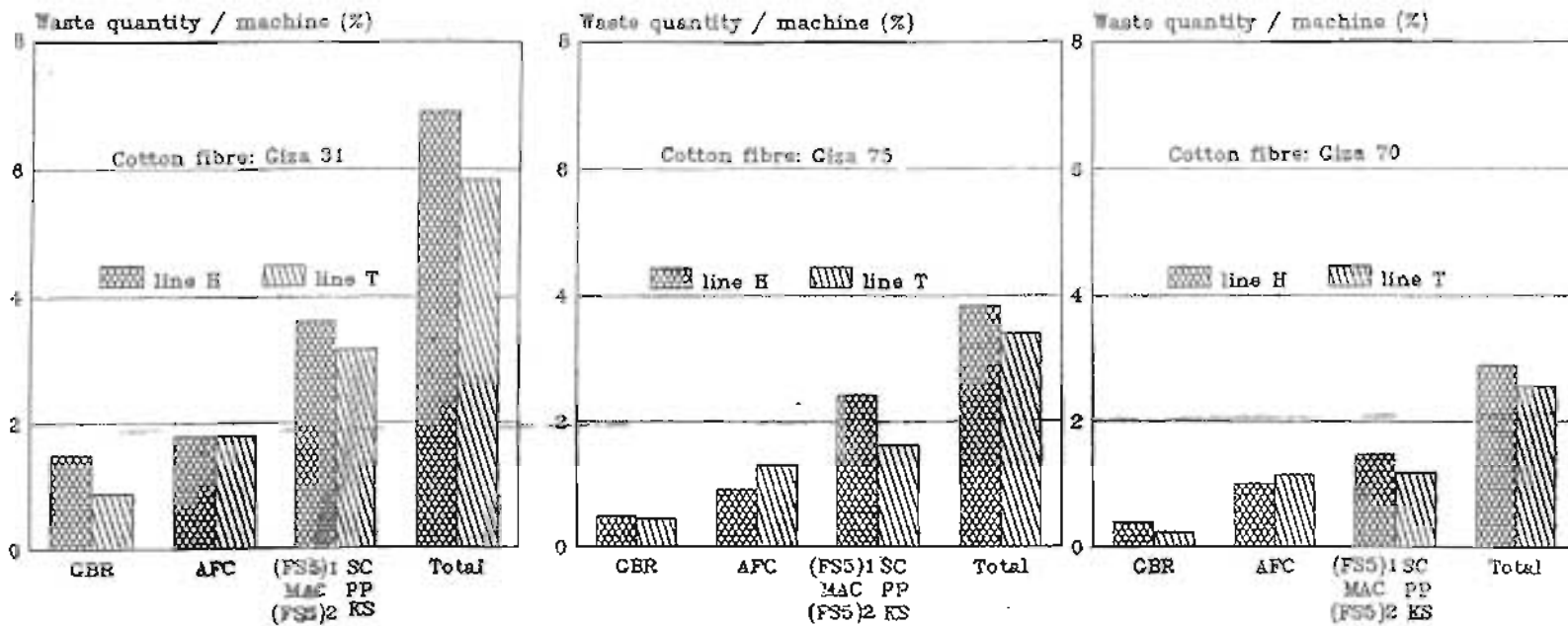


Fig. (6) Influence of Cotton Provenance and Cleaning Machines on the waste quantity in Blowroom Lines

Fig. (7) Average Fiber Content in Machine wastes.

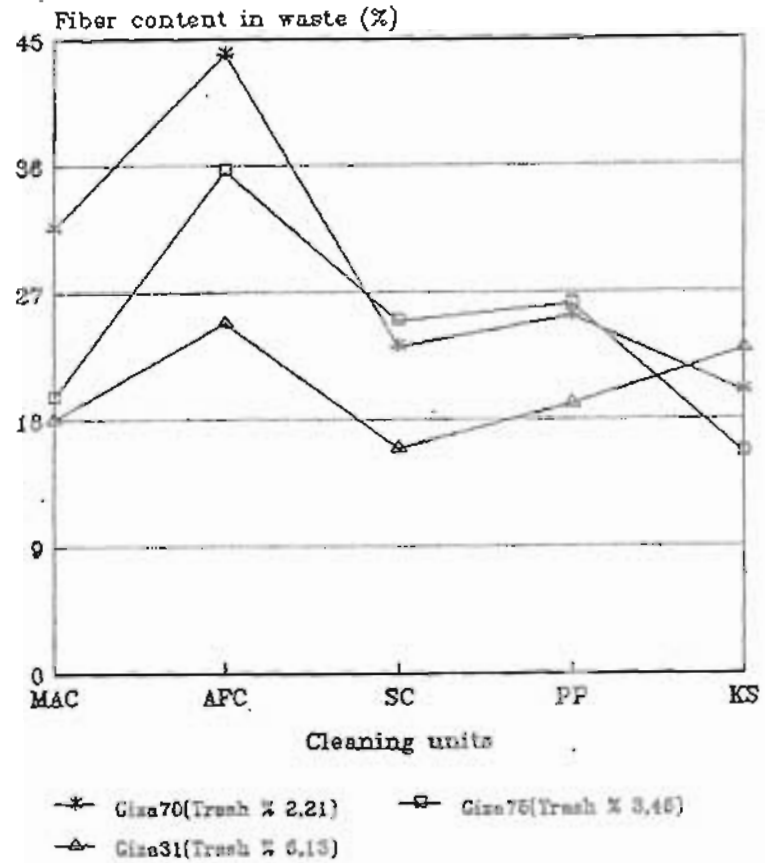
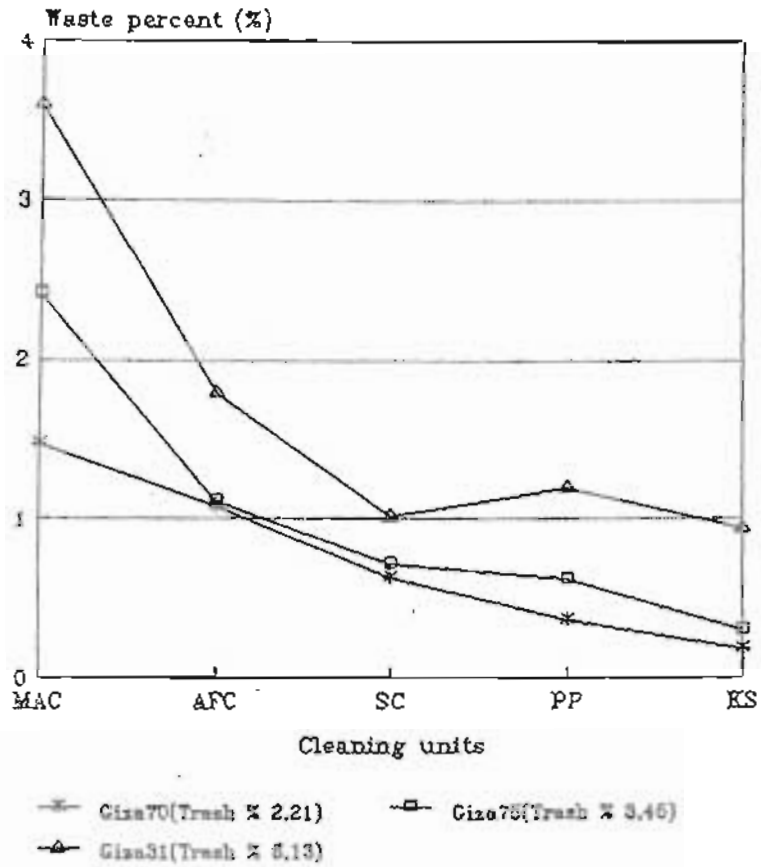
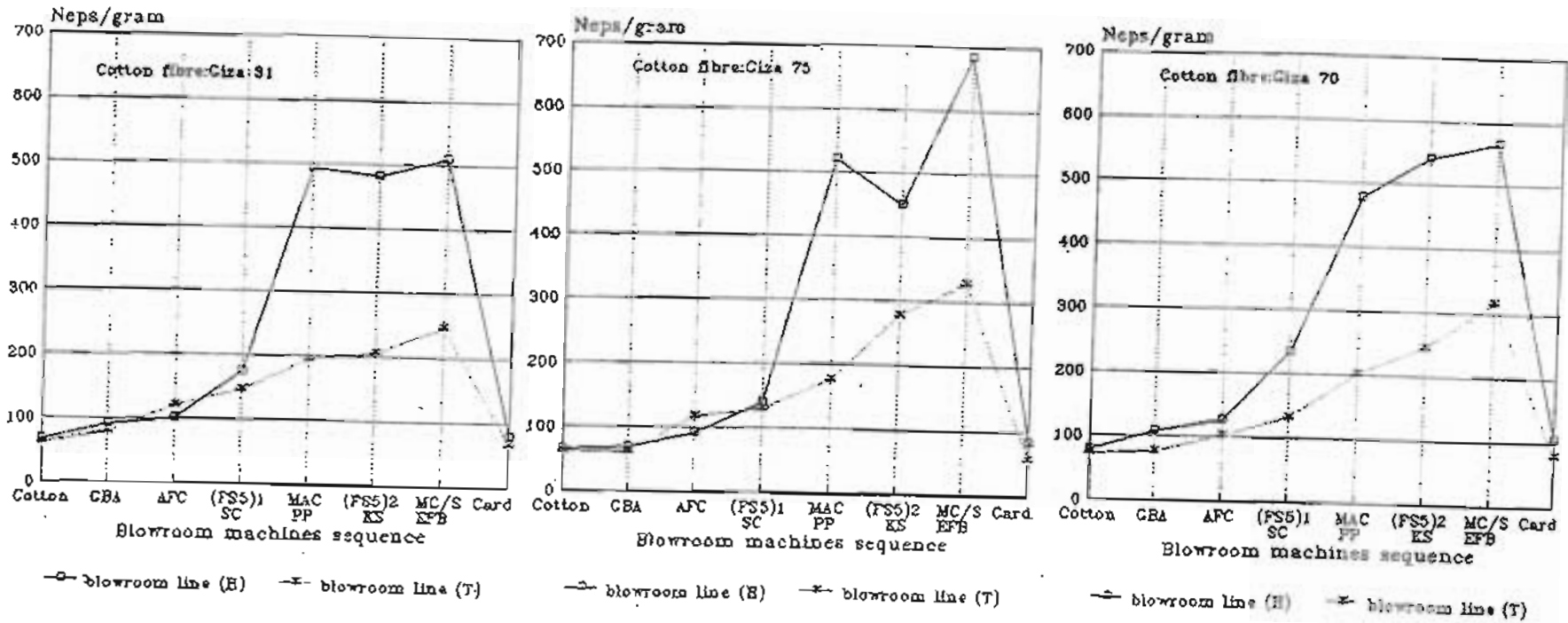


Fig. (8) Influence of Blowroom Machines Sequence and Carding on neps/gram of Cotton fibers



observed at the identical machines, while a significant difference occurs at the three subsequent cleaning points of blowroom installations. Examination of cotton tufts and card sliver quality reveals less neps/gram in case of line "T" than those obtained in line "H". Also, it has been seen that a higher nep count occurs with cotton fiber (Giza 31) having lower micronaire than those obtained with higher micronaire values (Giza 75).

(V) Influence on The Yarn Characteristics:

All yarns produced were tested and the results of strength characteristics, yarn uniformity and imperfections, and the rate of ends down per 1000 spindle. Hr. from both spinning preparation lines are presented graphically in figures (9) and (10).

The experimental results given in Fig.(9) display the effect of new cleaning unit on tensile strength of ring spun yarns. A Substantial increase in yarn tenacity is observed when processing cotton fibers, Giza 75 and Giza 70, in line "H". For cotton fiber Giza 75, an improvement occurs in yarn tenacity by 18% for carded yarns compared with 10% for combed yarns. Also, a considerable improvement in yarn strength by 15% for carded yarns compared with 6% for combed yarns from Giza 70. On the other hand, for Giza 31 the strength results of carded yarns are similar for both blowroom lines ("H" and "T").

Several studies and researches, executed in Hergeth Hollings worth company, concerned with the relationship between remaining trash contents in the card sliver and the yarn imperfections(9). The imperfection analysis program for carded ring spun yarn Ne 40 produced from 100% Acala cotton with $1\frac{3}{16}$ staple length, Mic. 4.2 $\mu\text{g}/\text{inch}$ and 2.3% trash content, indicate that a large quantity of yarn imperfections, 20% of thin, 38.9% to 78.9% of thick places and 57.9% to 100% of neps, which are seriously affecting the yarn quality are either caused directly or indirectly by trash particles.

The results of yarn irregularity and imperfections can be seen in Table (2). It is clear that, as cotton fibers processed

Table (2.1)

Ring - spun yarn	Carded yarn							
	Giza 75		Giza 70		Giza 31			
Cotton Fibers	30	36	40	30	36	20	24	30
Yarn Count, Ne	30	36	40	30	36	20	24	30
(i) Conventional Cleaning Units.								
Yarn Uniformity(C.V%)	15.99	16.93	16.73	15.96	15.48	16.86	18.76	19.17
Imperfections/1000m								
Neps (+ 200%)	241	371	353	384	227	175	201	387
thick (+ 50%)	234	361	342	324	211	282	458	680
Thin (- 50%)	12.4	11.3	19.1	5.0	8.0	20.1	46.8	87
Total faults/100,000	361.8	400	521.1	441.5	480	311.3	510.5	129.0
Dist.faults/100,000	7.8	6.0	4.6	6.9	8	3.0	7.2	13
(ii) Masterclean Concept								
Yarn Uniformity(C.V%)	15.50	16.72	16.52	16.81	15.72	17.9	18.76	20.31
Imperfections /1000 m								
neps (+ 200%)	166	247	287	391	370	169	234	398
thick (+ 50%)	168	324	294	392	261	374	524	817
thin (- 50%)	7.8	21	22.9	15	3	36	53	137
Total faults/100,000m	209	215	225	309.1	315	431.9	979	1817
Dist. faults/100,000 m	6.5	8	9.6	6.5	10	7.5	9.7	17.5

Fig. (9) Effect of Cleaning Operation on Ring-Spun Yarn Strength (gf/tex).

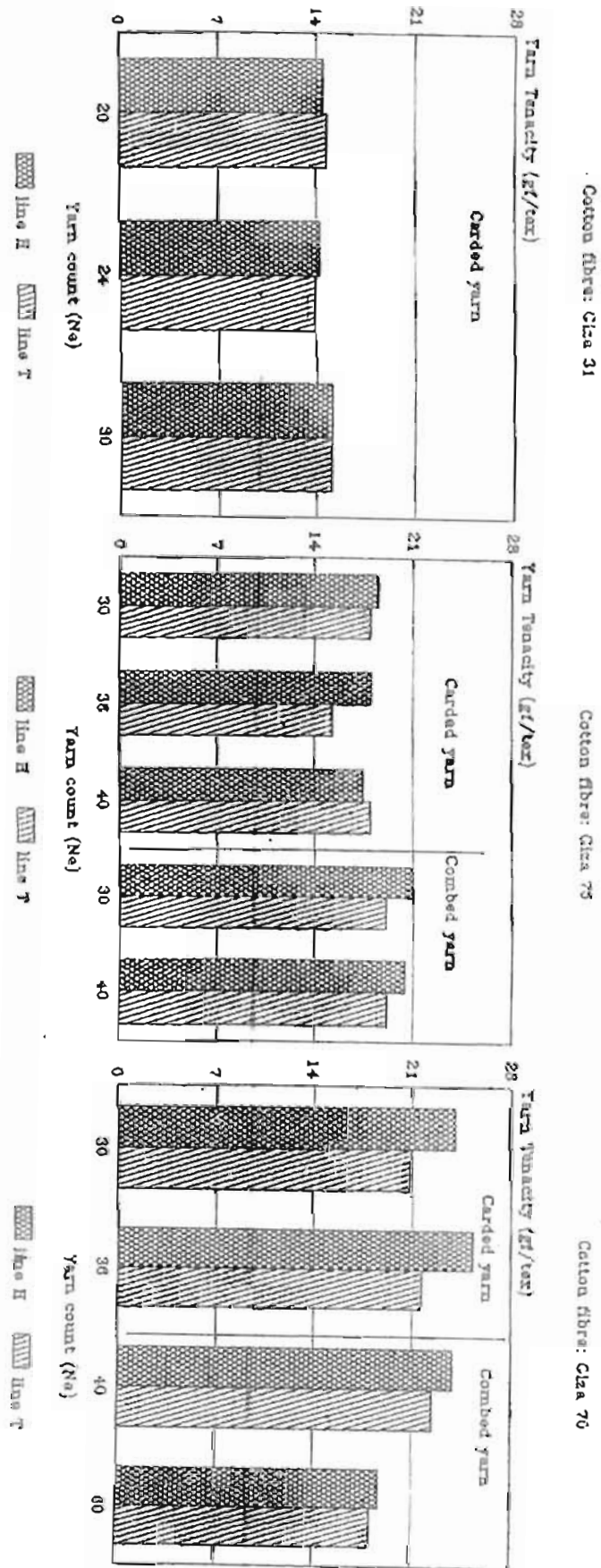


Fig. (10). Effect of cleaning operation on Ends down per 1000 spindle. Hr.

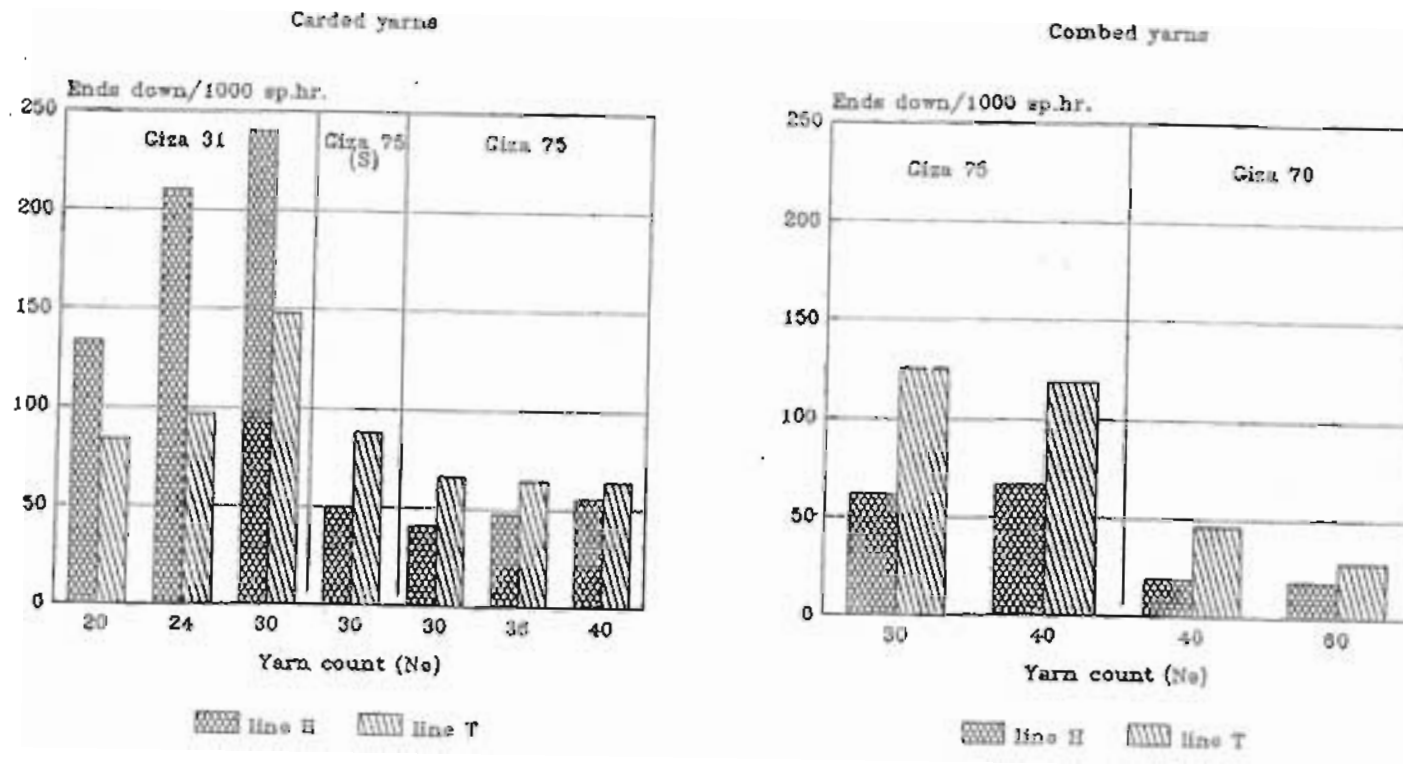


Table (2.2)

Cotton fiber	Combed yarn count Ne	Yarn uniformity (c.v%)	Neps per 1000m	thick places 1000m	thin places per 1000m	Total faults per 100,000m	disturbance faults per 100,000m
Giza 75	30 conv.cleaning	12.99	55	34	0.6	210.7	15.4
	40 units	13.97	111	80	1.9	244.6	14.4
	30 Masterclean	13.44	81	53	1.2	216	14.3
	40	14.43	144	107	2.6	261.7	12.2
Giza 70	40 Conv.cleaning	12.72	116	47	0.2	145.8	11.7
	60 units	16.67	231	169	45.2	489.9	14.2
	40 Masterclean	12.39	51	22	0.1	115.6	10.4
	60	16.75	123	149	61	369.7	17.2

through the modern set, the carded yarns spun from Giza 75 was better and more uniform than those obtained from cotton fibers Giza 70 and Giza 31. I.e the new cleaning unit show an improvement in yarn uniformity and reduction in the number of neps, thick and thin places with cotton fiber has a higher micronaire values and less trash content.

The results of ends down tests for carded and combed ring spun yarns are given in Fig.(10). The relations indicate that the number of ends down decreased with processing cotton fibers, Giza 75 and Giza 70, in line "H". Statistically it is evident that the difference, for all yarn counts, is highly significant. on the other hand, more ends down are obtained for cotton fiber Giza 31.

(Vi) Quality Polygon:

An alternative method of representing the results of the present investigation as shown in fig.(11). The minimum or/and maximum value of each property and the relative quality are plotted graphically by quality polygons. The closer to the center point the lower property is. As a result of this, the area of polygons proportional to the quality achieved and depends to a considerable extent on fiber parameters and the cleaning operation. The quality polygons shows:

- The comparison of cleaning action, neps per gram and yarn characteristics between three conventional cleaning units and new ones (HAC) developed recently.
- The results of new cleaning unit indicate that: cleaning action area is extremely higher for all cotton fibers, while the Neps level increases depends on micronaire values of the input raw material. Also, the cleaning operation plays an important role in the final yarn quality. The yarn characteristics are extremely better with cotton fibers has a higher micronaire values. In general, the total area of quality polygons increases markedly with every increase of micronaire value from 3.5 to 4 $\mu\text{g}/\text{inch}$

4. CONCLUSIONS

The results of industrial evaluations, using three Egyptian varieties of cotton

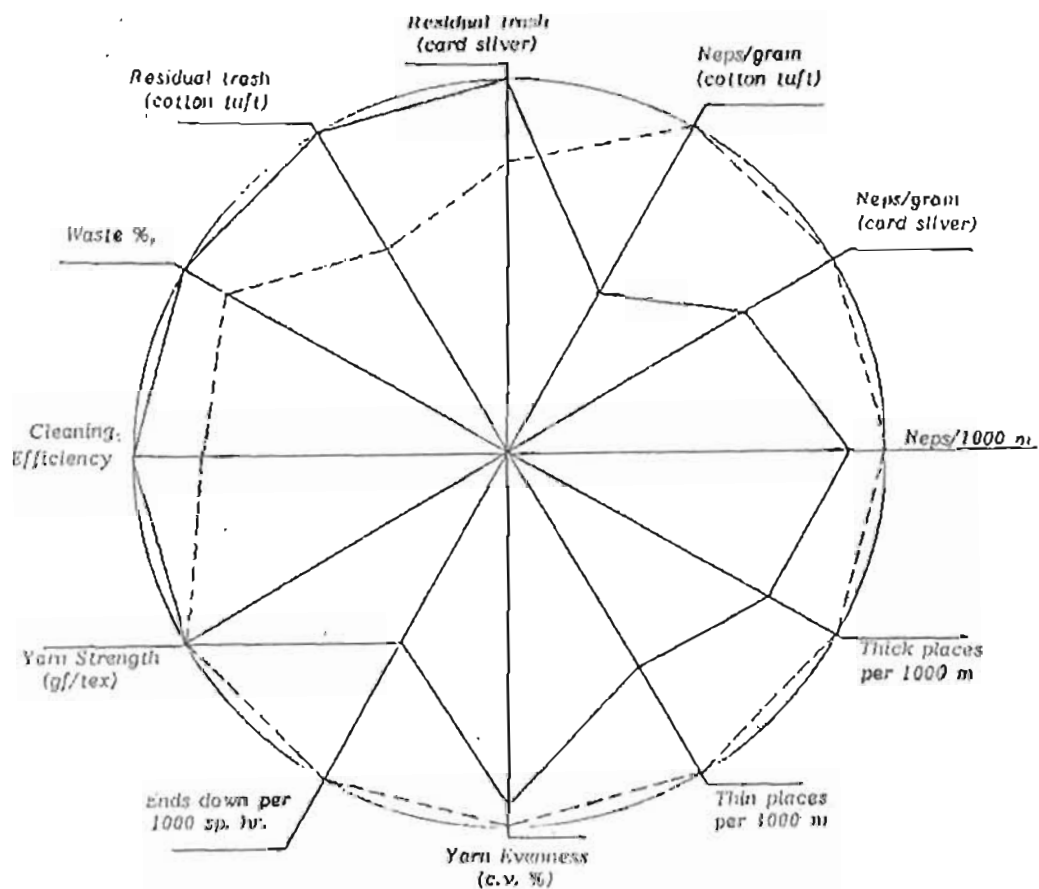


Fig. (11) Quality polygons for Egyptian Cotton fibres Through Blowroom lines, carding and Ring-Spinning Machine.

Quality polygon for cotton fibres, Giza 31
 (Mic: 3,5 µg/inch , Trash content (10%))

(—) Master clean unit

(---) Conv. cleaning unit

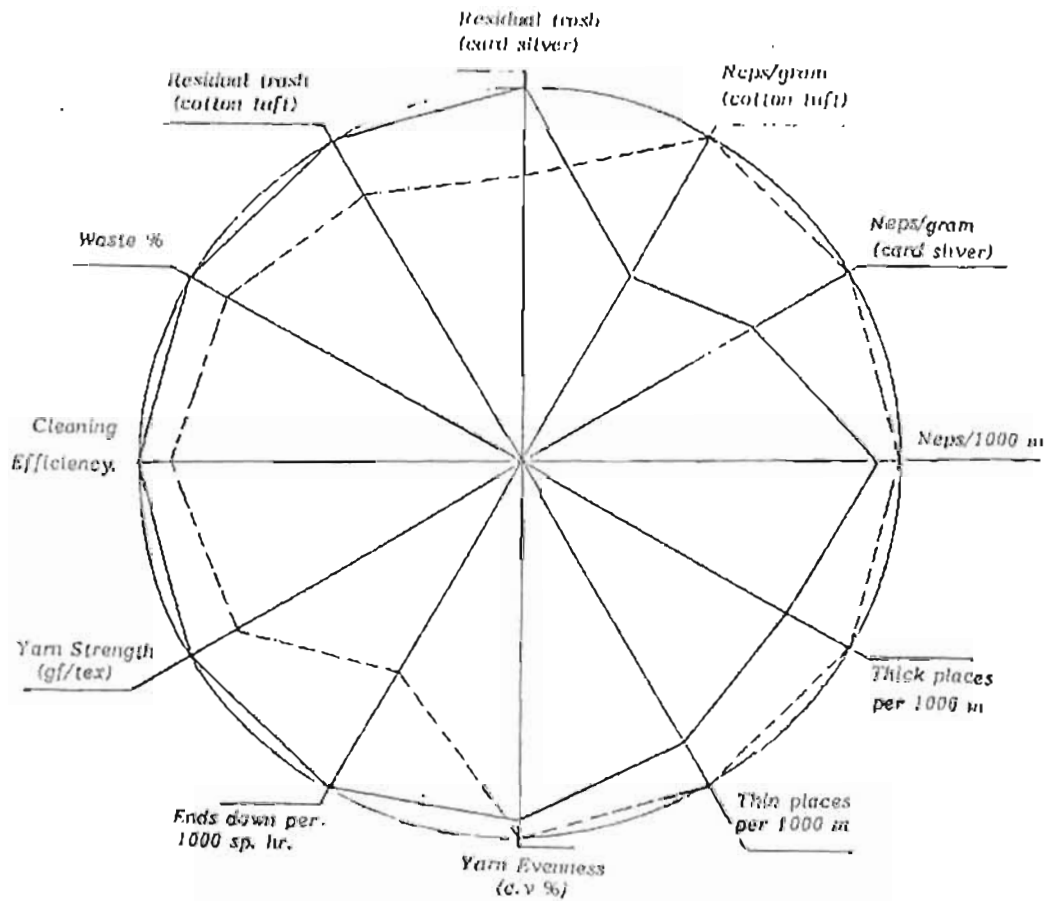


Fig. (11) Quality polygons for Egyptian Cotton fibers Through Blowroom lines, carding and Ring-Spinning Machine.

Quality polygon for cotton fibres, Giza 70
 (Mic: 3.8 $\mu\text{g}/\text{inch}$, Trash content 2.2%)

- (—) Master clean unit
- (---) Conv. cleaning unit

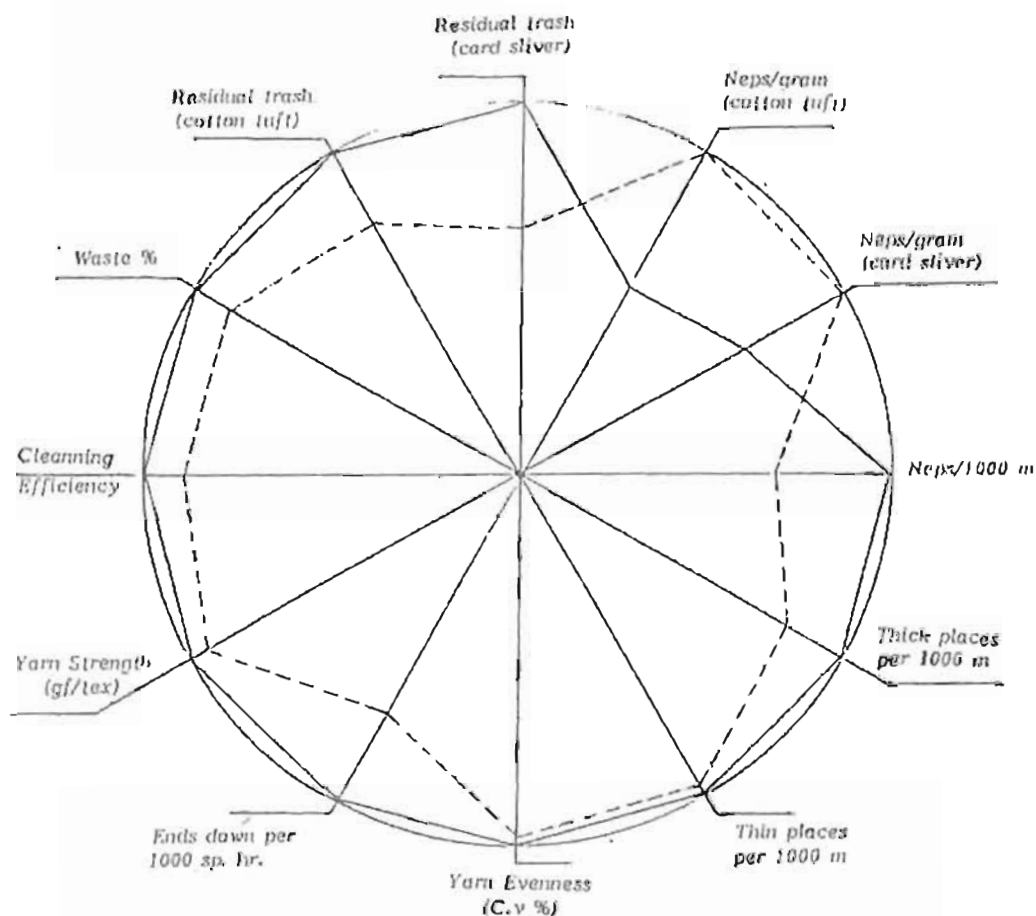


Fig. (11) Quality polygons for Egyptian Cotton fibers Through Blowroom lines, carding and Ring-Spinning Machine.

Quality polygon for cotton fibres, Giza75
 (Mic: 4 μ g/inch , Trash content 3.81%)

(—)Mauler clean unit

(---)Conv. cleaning unit

are presented. Comparisons of the processing on new cleaning unit (MAC) and three conventional cleaning units (step cleaner ; porcupine and kirshner) leads to:

- 1) The new machine appears to hold promise as an effective means of opening and cleaning cotton.
 - (i) The MASTERCLEANING unit alone provides a higher cleaning efficiency up to 64% against - 48% previously obtained with three cleaning units.
 - (ii) Cleaning efficiency of Master cleaning with two Air Fiber Separator (AFS) ranged from 58% for a low trash cotton to 75% for cotton fibers with higher initial trash content.
- 2) The results indicated substantial higher cleaning efficiency and considerably lower remaining trash content and lower lint in waste for the line "H" comprised the modern cleaning unit.
 - (i) For cotton fibers, Giza 31 and Giza 75 (S), has higher initial trash content, the total cleaning efficiency over the whole range before the card obtained in line "H" is about 23% higher than the cleaning achieved in line "I". Also, it is increased by 10% in case of processing low trash cotton fibers (Giza 75(n) and Giza 70). The figures for waste removal reflect the big difference observed in the cleaning efficiency data.
 - (ii) A significant reduction in trash content has been observed when different treatment were employed for the same cotton fiber. The machine sequence in line "H" coupled with the new cleaning units, emphasize the high trash removal-low lint loss features of masterclean. For cotton fibers, Giza 31 and Giza 75 (S), the cards had to handle 38% to 42% less trash as a result of this the card silver turned out to be 21% to 60% cleaner. On the other hand, the improvement is approximately from 16% to 20% for cotton with low trash content, Giza 70 and Giza 75 (n), consequently the card silver turned out to be 22% to 33% cleaner. With reference to lint in waste, the new cleaning unit permits the achievement of a low fiber content in waste compared with three cleaning units.
- 3) Even though the design and the principle of operations differ between master-cleaning unit and the three conventional beaters, the neps count of cotton tufts and card silver is highly affected. The modern set shows an increase in the number of neps per gram for all cotton fibers.
- 4) In terms of yarn quality, the following results were obtained:
 - (i) The tensile strength is highly affected depends on the spinning preparation line and raw material parameters. Masterclean concept achieved a considerable improvement of yarn strength. For carding phase: a slight change has been noticed for yarns from Giza 31 cotton fiber, while the improvement reached up to 18% for Giza 75 and Giza 70. For combing phase: the improvement of yarn strength reached up to 10% for Giza 75 and 6% for Giza 70 cotton fibers.
 - (ii) The yarn irregularity (c.v%), neps, thin and thick places are essentially different for the new and conventional cleaning units. The results which with Masterclean showed an increase of the yarn irregularity and number of faults, for cotton fibers with lower micronaire values (Giza 31 and Giza 70), while a better uniformity and a reduction in the number of yarn imperfections/1000 meter could be achieved for cotton fibers with higher micronaire values, (Giza 75).
 - (iii) In terms of ends down per 1000 spindle hour: The modern cleaning unit (NAC) show an improvement between 38% and 61% for combed yarn from Giza 70

and Giza 75, and from 13% to 38% for carded yarn from Giza 75. On the other hand the results for Giza 31 show an average of 60% more ends down.

- 5) The application of polygon area method clearly show that the quality achieved by using a new cleaning operation. For cotton fibers (Giza 31, Giza70 and Giza 75), the cleaning action increases markedly with the increase of initial trash content. Also, the neps level increases depends on Fineness of the input raw materials. The yarn characteristics are extremely better with cotton fibers has a higher micronaire values.

ACKNOWLEDGEMENT;

The author wishes to express his thanks to Eng.M.Talat for preparation and processing the yarns. Also, thanks to Eng. El-Sammanoady Head of spinning Section in Misr El-Mehalla spinning and weaving company and all the technical staff for their willing cooperation.

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