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BEHAVIOUR OF EGYPTIAN COTTON FIBRES IN OPENING AND CLEANING PROCESS

by

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سلوك الاقطان المصريه اثناء تشغيلها فى بعض خطوط التفتيح والتنظيف

الخلاصة : من الخواص الهامة للاقطان فى مرحلة التفتيح والتنظيف والكرد نسبة احتواء الشعيرات على الشوائب والاتربة ، وزيادة نسبة المواد الغريبة تؤدى الى حدوث صعوبات اثناء عملية التشغيل فى مراحل الغزل كما انها تؤثر على جودة الانتاج . لـــذا فان البحث الحالى يهدف الى دراسة درجة نظافة الاقطان المصريه واجريت التجارب بفحص خمسة انواع من الاقطان (جيزة ٣١، ٧٥، ٧٠، ٧٧، وجيزة ٨١) وتشغيلها طبقا للظروف الصناعيه على اربع انواع من خطوط التفتيح والتنظيف (موديل تروتزشلر) تتبعها ماكينات الكرد (ريتر ، وتيودا ٥٠٠) وقد تم قياس نسبه الشوائب بواسطه جهاز شيرلى فى القطن الخام وبعد المضارب فى خط التفتيح والتنظيف ، وفى الملف وشريط الكرد .

ويتركز البحث حول دراسة تأثير تتابع ماكينات التفتيح والتنظيف وماكينة الكرد على احتواء القطن على المواد الغريبة ، وطول الشعيرات ونسبة الشعيرات القصيرة ، وايضا نسبة الشوائب المتبقية فى شريط الكرد . المقارنة بين خطوط التفتيح والتنظيف مع ثبات نوع الشعيرات القطن وايضا سلوك الاقطان المختلفة تحت تأثير نفس ظروف التشغيل - كذلك تحديد كفاءة التنظيف فى مرحلتى التفتيح والكرد كدالة فى خواص الشعيرات (نسبة الشوائب الداخلة فى القطن ودقة الشعيرات) ، ونوع الماكينات وتتابعها فى خط التفتيح والتنظيف .

ABSTRACT: The aim of the present work is to study the cleanability of most Egyptian cotton fibres. Five different cotton, with wide range of shirley trash content, were used. The experiments were done on different "Trützschler" blowroom lines followed by "Toyoda" and "Rieter" carding machines.

The data presented show that the change of non-Lint(%), fibre length characteristics and the level of residual trash content as a function of machines arrangement. Also, the results of experimental Lines are compared for the same cotton fibres. In addition, the cleaning action of preparation Lines was investigated in terms of the properties of the cotton fibres itself and machine parameters.

I. INTRODUCTION:

Opening and cleaning of raw cotton fibres are carried out through a series of different machines connected by transport duct. The assembly of blowroom Line depends among other factors on : raw material parameters, such as fibre type, fibre properties and dirt content, as well as material throughput. Also, the results of opening and cleaning action dependent upon : opening elements, feeding condition and grid parameters as well as position of the machine in the machine sequence[1] and speeds of the opening element.

Several research workers confirmed that, the blowroom machines causes a considerable influences on:

(i) Degree of opening: Artzt et.al[2] studies the effect of blowroom stages on the degree of opening. They indicate that the degree of opening changes along a blowroom, Also, an additional stages would probably causes stressing of the fibres without further improvement.

(ii) Cleaning action. The blowroom eliminate a higher percentage of the incoming matter in the raw material, approximately 40-70%. The results is dependent material, machines and on the envioronmental condition[1]. Also, dust removal an easy operation. Mandl[3] found that it is mainly the suction units removes percentage (64%) of dust.
The cleaning efficiency of a cotton blowroom line depends to a large extent on ade opening of the bale material at an early stage. Röder [4] describes the effect of sp and settings at different machines on subsequent cleaning and shows that high spe

operating with close settings give intensive opening which is reflected in more efficient trash removal at the next machine. Leifeld[5] predict a simplified equation for determination the cleaning value of a preparation line-without card. The obtainable cleaning result is essentially based on the machine parameters and the influence of the properties of cotton fibres.

(iii) Fibre characteristics: blowroom machines provides a negative influence on fibre property, especially strength, elasticity and fibre length. Temas[6] indicates the percentage of short fibres is increased by over 10% if the blowroom line contains one more cleaning machine than is necessary. The increase in neps is also very noticeable in the blowroom.

(iv) Yarn Quality: it has been confirmed that processing through multiple beating stages in the blowroom will cause nep generation, and although an optimum combination of beaters may exist for a given type of cotton, the less treatment given to the cotton in the blowroom, the better yarn quality[7]. Leifeld[8] indicate the effect of flow of material, "stop-and-go" and continuous working in the blowingroom on the yarn characteristics. The c.v% and the tensile strength are virtually hardly affected. Continuous working shows a 20% reduction in the number of neps, and 30 to 50% in the number of thin places and thick places similarly were 15% less.

(v) Production cost: the blowroom machines must eliminate impurities, but they can do this with the simultaneous elimination of some of the good fibres. Since the loss of raw material has a significant effect on costs, it need closer attension during operation

Looking over the spinning preparation lines of the different Egyptian cotton mills, a wide variety of machine organization are found in use. Through blowroom installations, not only the type of machinery vary markedly but the number of cleaning stages varies also within wide limit. On the other hand, raw cotton parameters are of the important factors which affect on fibre strand quality. Some of these parameters such as cleanliness, trash content and nepiness of the raw stock is important variable in the area of sliver preparation from bale opening through carding.

Thus, the present work tends to study the cleanability of Egyptian cotton fibres, i.e the behaviour of different Egyptian cotton fibre qualities through different blowroom installations followed by carding machines. The experiments carried out to investigate the following:

- The effect of successive machines of blowroom on removal trash and fibre length properties.
- The cleaning efficiency of different blowroom lines in terms of material parameters and machine arrangements, and,
- The residual trash content of scutcher lap or/and flocks and sliver card.

In the next work, the investigation on the area of spinning preparation will be continued in order to obtain:

- The cleanability-factor for Egyptian cotton fibres. The method of determination based on the assumptions given by leifeld[5].
- The correlation between the cleaning efficiency in spinning preparation and yarn quality.

2. Experimental Work:

2.1 Material used:

Five popular varieties of Egyptian cotton fibres, Giza 70, Giza 75, Giza 77, Giza 81 and Giza 31, with different characteristics were selected. In case of cotton type "Giza 75" there are two lots with regard to the original plant "Delta and Upper of Egypt". The main fibre properties of all cotton are given in Table(1). For most cotton fibres,non-lint varies between 3.85% and 6%, while Giza 31 has 12%. In case of G31, this may be due to the influences of such parameters as: harvesting and ginning condition, also the method of bale packaging and storage.

2.2. Processing Procedures:

Four blowroom lines: blowroom Line "A" and Line "B" as a conventional lines, line "C" is a combination between two different types of opening and cleaning m/c's and Line "D" is new blowroom line with chute feeding arrangement. The machine sequences for each line is shown in figures (1-4) and Table (2). In the present investigation, each two types of cotton fibres were processed through one line. Also, the materials were processed under the industrial conditions, considering the recommended values of machine setting and production speeds. The lap or/and flocks from each line were then carded into sliver and the carded sliver was drawn twice at drawing machines.

2.3. Measurements:

Trash content determination by shirley analyser, fibre length characteristics by Digital fibrograph were made on samples of cotton from bale, fibres at each cleaning point. Also, from the lap or/and flocks and card sliver. Fibre fineness by shilfeld micronaire and fibre strength by pressely were determined for a samples of cotton from bale

Table (1) fibre properties

Raw cotton Fibres	Trash analysis good fibres (%)	non-lint (%) trash	dust	inv. waste	total	Fibrograph span length (mm) 50%	25%	Micronaire value (µg/ inch)	pressely index
Giza 31	87.96	7.60	0.38	4.06	12.04	14.5	30.5	3.75	9.24
Giza 75 (n)	96.15	2.48	0.23	1.13	3.85	15.8	31.5	4.90	10.60
(s)	94.00	4.28	0.28	1.14	6.00	15.8	31.5	4.90	10.60
Giza 81	95.12	3.76	0.12	1.00	4.88	15.8	32.0	4.20	10.10
Giza 77	97.15	2.28	0.34	1.26	3.88	16.8	35.0	3.80	10.50
Giza 70	95.57	2.46	0.37	1.60	4.43	17.5	36.0	4.30	10.80

Table (2) spinning preparation lires

(i) Blow room installation:

Blowroom Line "A"	Blowroom Line "B"	Blowroom Line "C"	Blowroom Line "D"
- 2 Bale opener - Condenser Hopper Feeder Step Cleaner - Axi - Flow - Multi-mixer - Condenser Hopper Feeder double opener and cleaner - Hopper Feeder double scutcher lap m/c.	- Waste opener 2 Bale opener blending conveyor - Axi-Flow - Condenser Feeding unit Step cleaner Cleaner - Multimixer - Condenser Feed trunk Cleaner Condenser penumatic feeder	-4 Bale opener Conveyor belt - Condenser Feeding unit Step cleaner - Multi-mixer - Transfer fan,condenser,feed trank (2) horizontal opener - Condenser Hopper feeder Scutcher lap machine	-Waste opener (2) Bale opener Blending conveyor - Metal Seprator Condenser Feeding unit - Step cleaner Cleaner -Transport Fan Multi - mixer -Condenser Feed trunk Cleaner - Transport fan - Chute feeding

ii) Carding machine

Toyoda	Toyoda	Toyoda	Rieter

3. Results and Discussions:

3.1 Effect of blowroom stage on:

(i) Trash Analysis:

Figures (5-8) shows a comparitive test results on the running material for percentage of good fibres, trash content and dust at various blowroom machines. Also, the results indicate that the cleanliness of Egyptian cotton fibres changes along opening and cleaning machines from raw stock to lap or/and flocks befor the card.

It is clear from the curves, all cotton fibres were affected by the successive machines of blowroom as following :

- Blowroom installation removes a large amount of trash from Egyptian cotton fibres, approximately varies between 65% to 85% depending on the machine sequences of Trützschler lines and the running cotton fibres.
- A higher cleaning effect has been observed at the first three cleaning stages, while an additional stages resulted in a little drop in the level of trash elimination.
- Dust elimination at the various machines of blowroom, as analyzed by the shirley analyser, varies between 10% and 25% depends on the machine effect and the dust content of the raw material.
- The opening and cleaning operations causes an increase in the percentage of good fibres.
- With running two different cotton fibres on the same blowroom line, the cleaning differences were statistically significant or non-significant dependence on the initial trash content and cotton fibre cleanability.

(ii) Fibre length characteristics:

In order to determine whether the subsequent process, blowroom and carding machine, had any influences on fibre length characteristics , the length was determined by the Digital fibrograph. Span length at 50%, 2.5%, uniformity ratio and percentage of short fibres for all treatments, different cotton fibres at various cleaning lines, were plotted graphically as shown in Fig. (9). The experimental results indicate a changes in fibre length parameters as a result of subsequent processes. There is a trend for length at 2.5%, 50% and uniformity ratio to be lower for carded sliver than those for lap and raw cotton fibre respectively. Also, number of beating in blowroom and carding process resulted in an increase in short fibre percentage.

3.2 Cleaning efficiency of preparation lines

3.2.1 Effect of raw material parameters:

In terms of how the influence of cotton fibre parameters reflect on the cleaning efficiency of spinning preparation lines, each blowroom line used for processing two different types of egyptian cotton fibres. The fibre parameters may be listed is following:

(i) The initial trash content of feed stock lie in three categories:

1. Two types of cotton fibres with extreme differences in initial trash content as shown in fig. (10) .
2. Fibres with a slight difference in trash content as illustrated in fig. (12).
3. Cotton fibres with the same initial trash % as presented in figures (11) and (13).

(ii) Each pair of the experimented cotton fibres (G 31 and G 70, G 81 and G 75(s), G 70 and G75, G75 and G77) has an apreciable difference in fibre fineness (µg/inch).

For cotton fibres G31 and G70, as shown in fig. (10), apreciable difference between fibre fineness has been observed, also the the test results shows an extreme differences in trash content. For G31 the initial trash content (7.6%) is higher than that for G70 cotton fibres (2.46%).

The experiments indicate that a higher cleaning efficiency is required for G31 than that for G70 (86% against 71%) at blowroom Line "A". In addition, the carding operation resulted in a total cleaning efficiency 92% for G13 and residual trash content 0.6% in the card sliver. While a 89% cleaning action for G70 with 0.28% residual trash content.

The experimental results for running material G81 and G75(s) in Line "C" are shown in fig. (12). It can be noticed that a cleaning action of 71% obtained with G81, has 3.76% trash content and its micronaire value 4.2 µg/inch, against a cleaning efficiency of 67% for G75 which has 4.28% trash content and fibre fineness 4.9 µg/ inch. Also, more efficient cleaning is achived through carding machine. Finally for both cotton fibres the total cleaning efficiency is almost the same 95% and residual trash content in card sliver is 0.2%.

In figores (11) and (13), raw cotton fibres with an apreciable differences in micronaire value and with simillar initial trash content were processed through Line "B" and Line "C".
The results, Fig.(11) , indicate that a lower cleaning efficiency associated with G70 (69% at blowroom and 64% at carding) than those obtained for G75 (82% at blowroom and 73% at carding). consequently the trash content in card sliver is 0.3% for G70 against 0.12% for G75.

As shown in fig. (13), for blowroom Line "D", it can be noticed that a cleaning efficiency of 68% obtained with G75 has a trash content 2.48% against 72% for G77 with initial trash content 2.78%.In addition, the carding machine show a cleaning action 82% against 90% for both cotton fibres respectively.

3.2.2 Effect of Machine Sequence :

Figures (14) and (15) compares graphically two opening and cleaning lines. The lines have some identical machinery while machines arrangement and number of cleaning points are not the same.

With cotton fibre G75 has 2.48% trash content, a cleaning efficiency of 68% is obtained on line "D". For the same cotton quality, a cleaning efficiency of about 82% is obtained on Line "B". However a good running condition af carding machine results in a better cleaning (82% against 73% respectively) which finally show a simillar total cleaning action.

For cotton fibre,Giza 70, the machines sequence in Line "A" shows a cleaning efficiency 71% while the Line "B" show that a 66% cleaning efficiency which is lower than the preceding installation. At carding m/c.s after blowroom lines "A" and "B" a simillar cleaning action 65% is obtained and total cleaning efficiency 88% was reached for G70 at both installations.

It is clear, from the above results, that the differences in the machines sequence on blowroom Line "A" and "B" as previously remarked and some change in design on Line "D" would affect significantly on the cleaning action.

3.3 Residual Trash Content:

Figure (16) shows the interdependence between the obtainable cleaning efficiency of different blowroom installations and value of trash content.

It is clear that from this investigation:

1. With an initial trash content (7.6%) the cleaning efficiency, for cotton fibre Giza 31,

increases up to 85% to obtain a residual trash content of 1.5% before the card.

2. For cotton fibre, Giza 81, Shirley analyser results shows the value for trash content is 3.76%. As residual trash content drop from 1.5% to 1%, the cleaning efficiency raises from 60% to 70%.

3. With cotton fibres (G70, G75(n) and G77), a lower value of trash content between 2.3% and 2.5% is observed. If we consider the residual trash content 1.5% is an acceptable level, that is attained at cleaning efficiency 40% . The blowroom cleaning efficiency raises up to 60% if the trash content drop from 1.5% to 1%. Also, a low residual trash content 0.5% can be achieved at cleaning efficiency between 60% and 75% .

In addition to the great part of foreign matter can be eliminated away as in the blowroom, the card also removes impurities and dust. This contribution of carding machines are shown in fig. (17). The diagram shows an average cleaning efficiency for eight lots of cotton fibres. The computation based on the trash content of the cotton emerging from blowroom and not that of the raw cotton. In case of card sliver still contains a trash content between 0.06 and 0.6% .For most of egyptian cotton fibres, cleaning efficiency (65-90%) at carding resulting in a residual trash content in the ronge 0.3% and 0.06% in the card sliver

4. Conclusions :

The present study permits the following conclusions to be drawn :

i)- In terms of the effect of spinning preparation Line on running material characteristics, the experimental results led to :

- Trützschler blowroom Lines removes approximately 65% to 85% of the impurities and over 10% of dust from Egyptian cotton fibres.
- For egyptian cotton fibres: it has been found that a significant difference in initial trash content. Three levels of trash content has been observed, higher value for G31, medium value for G81 and G75(s) and lower trash content for G70, G77 and G75 .
- As a results of subsequent processes, trash content in cotton fibres changes and additional stages resulted in a little drop in the level of trash elimination .
- Fibre length at 50%, 2.5% and uniformity ratio tends to be lower for card sliver than those recorded for lap and raw cotton. Also number of beating during cleaning at blowroom and carding causes an increase in short fibre percentage.

ii)- The obtainable cleaning efficiency is affected by running material parameters and machine Installation as following .

- The initial trash content of feed stock affect significantly on the cleaning efficiency. The cleaning results are not the same for the initial trash content.
- The cotton fibres with a higher trash content can easily cleaned than a little.
- Raw cotton fibres with lower micronaire values the more difficult it is to eliminate impurities from fibres.
- A higher cleaning action obtained at the first three subsequent cleaning points of blowroom installation.
- A substantial differences in cleaning efficiences are observed when different "Trützschler" blowroom lines were employed for the same cotton fibres.
- For all Egyptian cotton fibres, a good running at carding operation resulted in a total cleaning efficiency between 88% and 97% .

iii)- With refrence to the residual trash content the experimental results led to the following conclusions :

Firstly, Residual trash content in lap or / and flocks :

- Residual trash content (1.5%) before the card could be achieved at different cleaning action 40%, 62% and 80% depends on cotton type and initial trash content .

- For cotton fibre (G31) with higher trash content a drop of trash from 1.5% to 1% required an increase of cleaning efficiency from 80% to 85% .
- For cotton fibres (G81 and G75(s)) has medium level of trash content, the residual trash content (1%) could be obtained at cleaning efficiency between 60% and 70%
- A drop in trash content from 1% to 0.5%, for cotton fibres G70, G75(n) and G77, required an increase of cleaning efficiency from 60% to 75% .

Secondly, Residual trash content in card sliver:

- For all Egyptian cotton fibres a significant reduction in trash content has been observed. residual trash content of card sliver varies between 0.6% and 0.06% .
- Most of cotton fibres shows a low level of residual trash content, between 0.3 and 0.06%. in the card sliver. This corresponding to cleaning efficiency at carding in the range 65% and 90%

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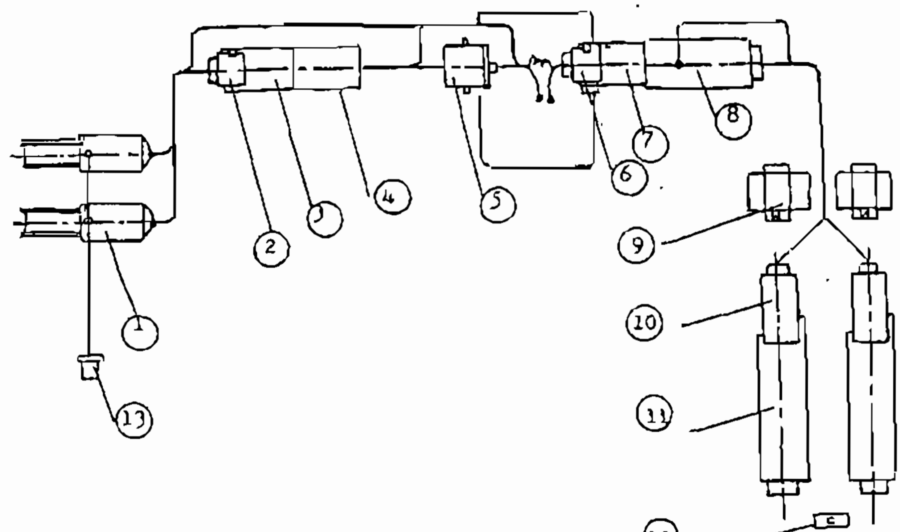

Fig.(1) Blowroom Line "A"

1)bale opener 2)condenser 3)hopper feeder 4)step cleaner 5)axi-flow 6)condenser 7)hopper feeder 8)double opener&cleaner 9)filter 10)hopper feeder 11)double scutcher&lap m/c 12)compressor 13)dust fan

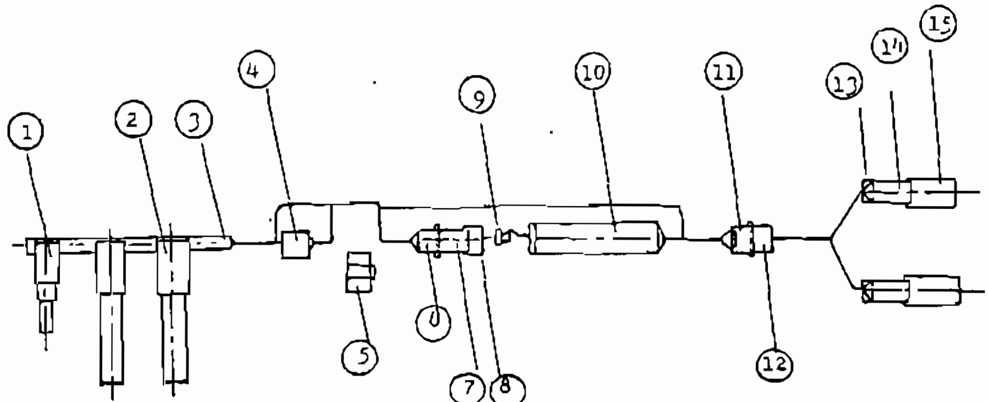

Fig.(2) Blowroom Line "B"

1)waste opener 2)bale opener 3)blending conveyor 4)axi-flow 5)air filter 6)condenser&feeding unit 7)step cleaner 8)cleaner 9)transport fan 10)M. mixer 11)condenser&feeding unit 12)cleaner 13)condenser 14)pneuma feeder 15)scutcher

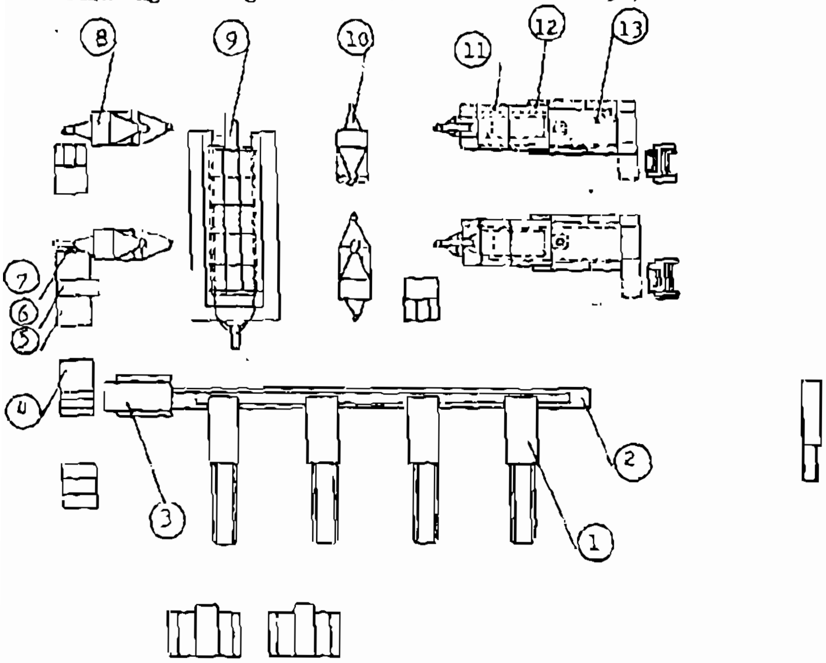

Fig.(3) Blowroom Line "C"
1)4 bale opener 2)coveyor belt 3)step cleaner 4)transfer fan 5)condenser 6) feeding trunk 7),8) 2 horizotal opener 9) multi-mixer 10) 2 H. opener 11)condenser 12)hopper feeder 13)scutcher lap machine

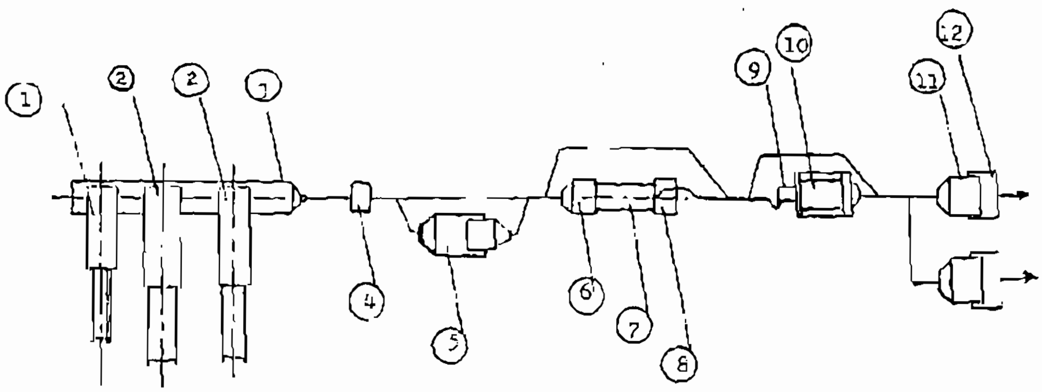

Fig.(4) Blowroom Line "D"
1)waste feeder 2) 2bale opener 3)blending conveyor 4)metal detector 5)metal separator 6)condenser 7)feeding unit 8)cleaner 9)transport fan 10)multi-mixer 11)condenser 12)feed trunk

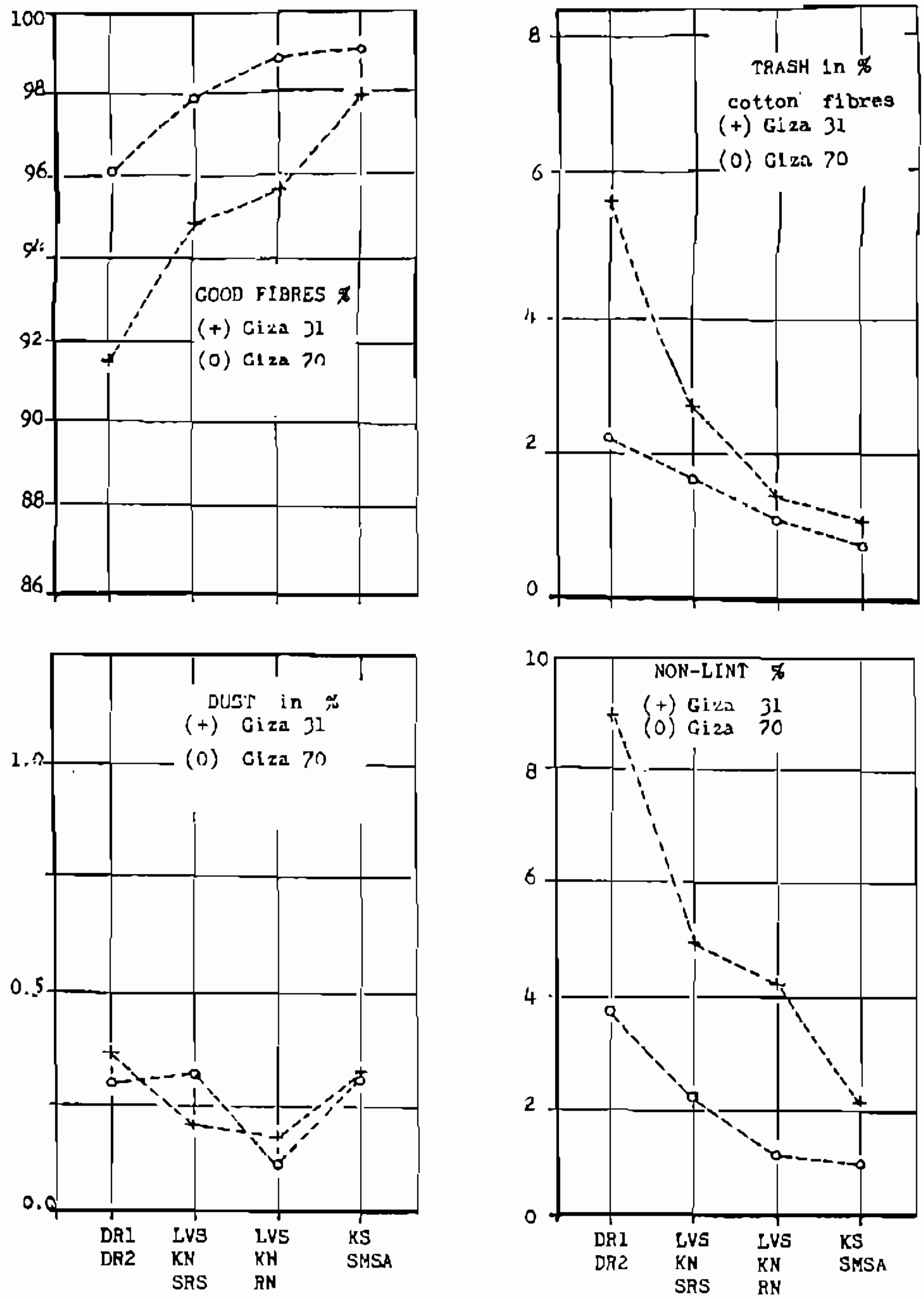

Fig.(5) Trash Analysis at Various Machines of Blowroom Line "A"

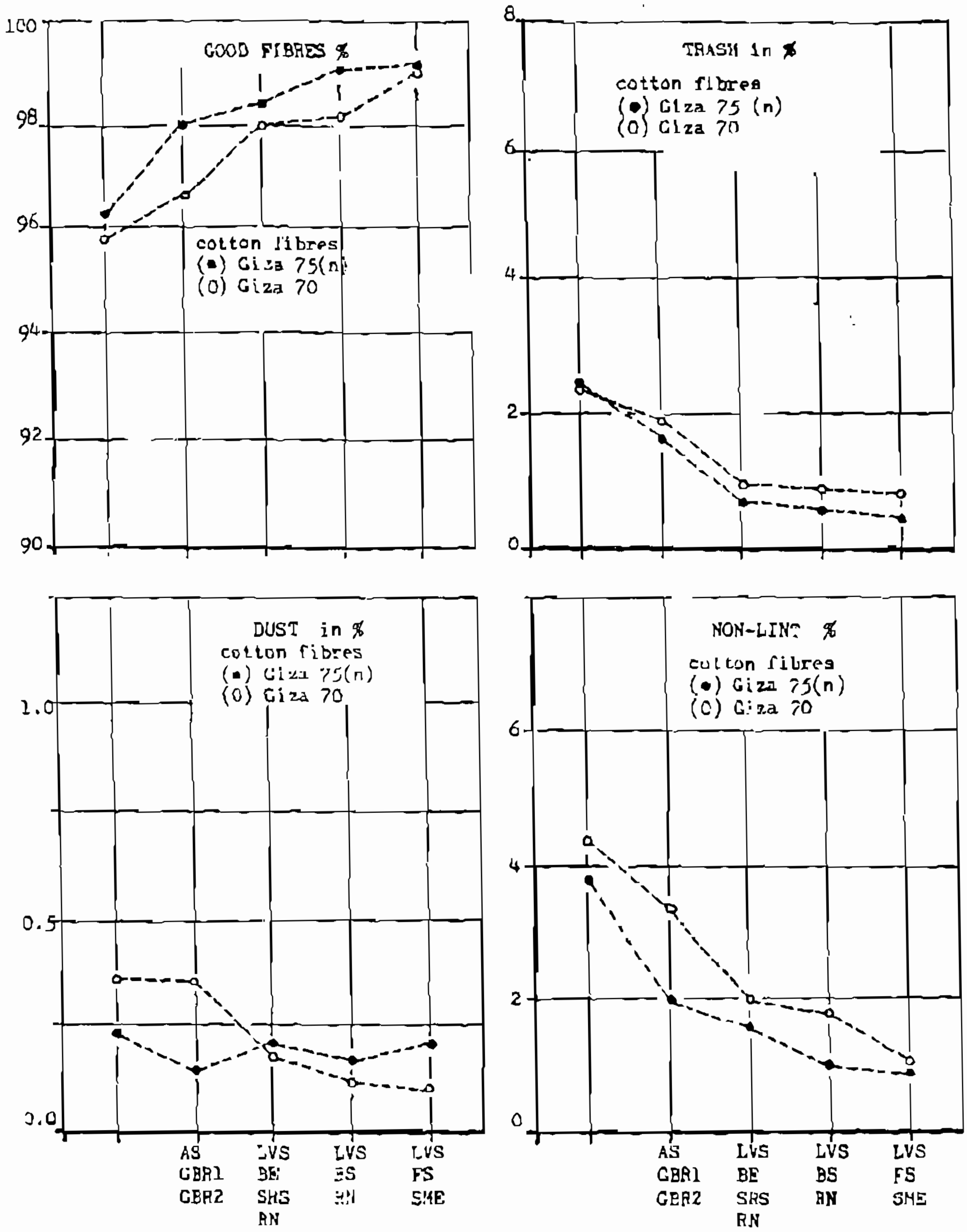

Fig.(6) Trash Analysis at Various Machines of Blowroom Line"B"

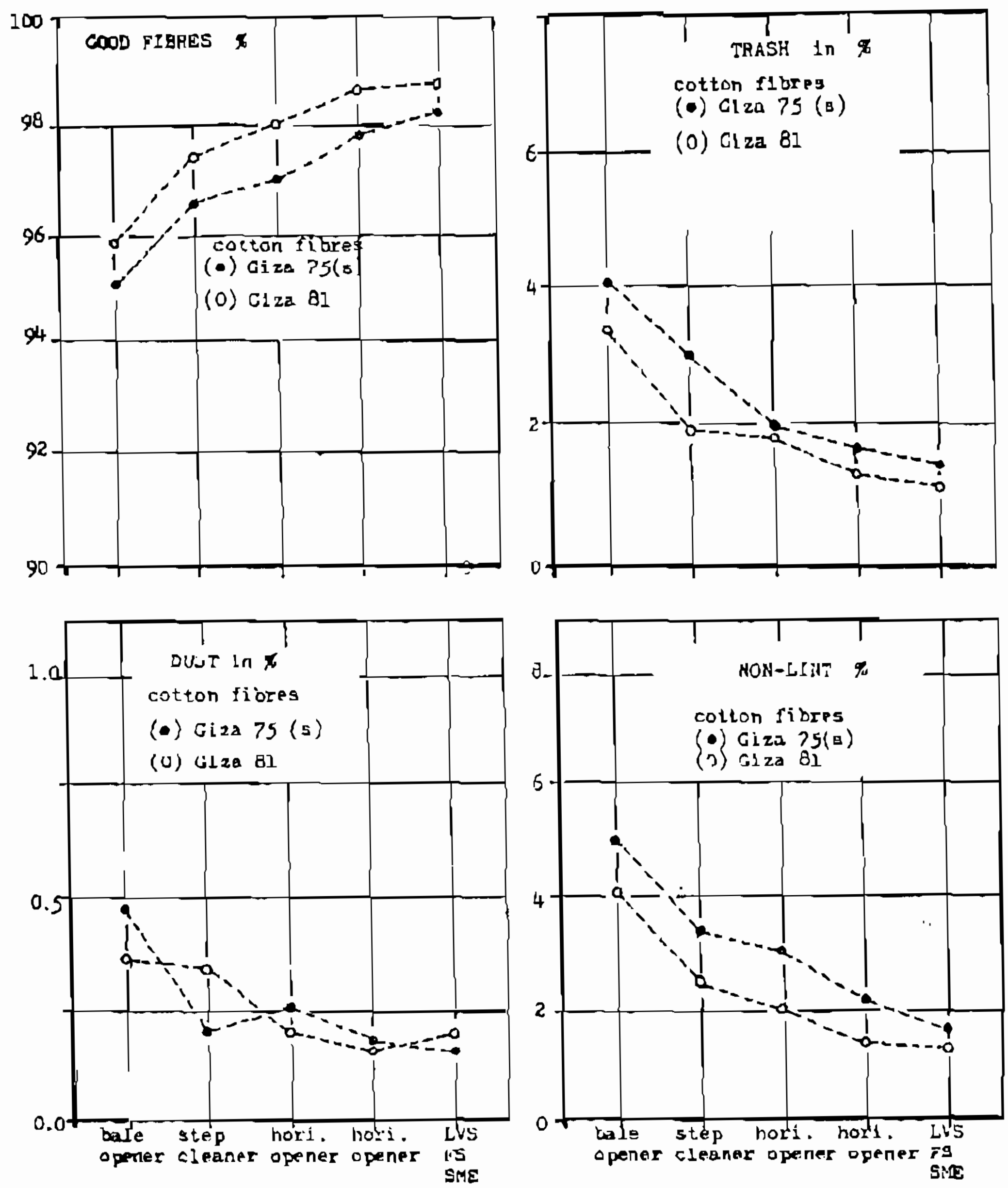

Fig.(7) Trash Analysis at Various Machines of Blowroom Line "C"

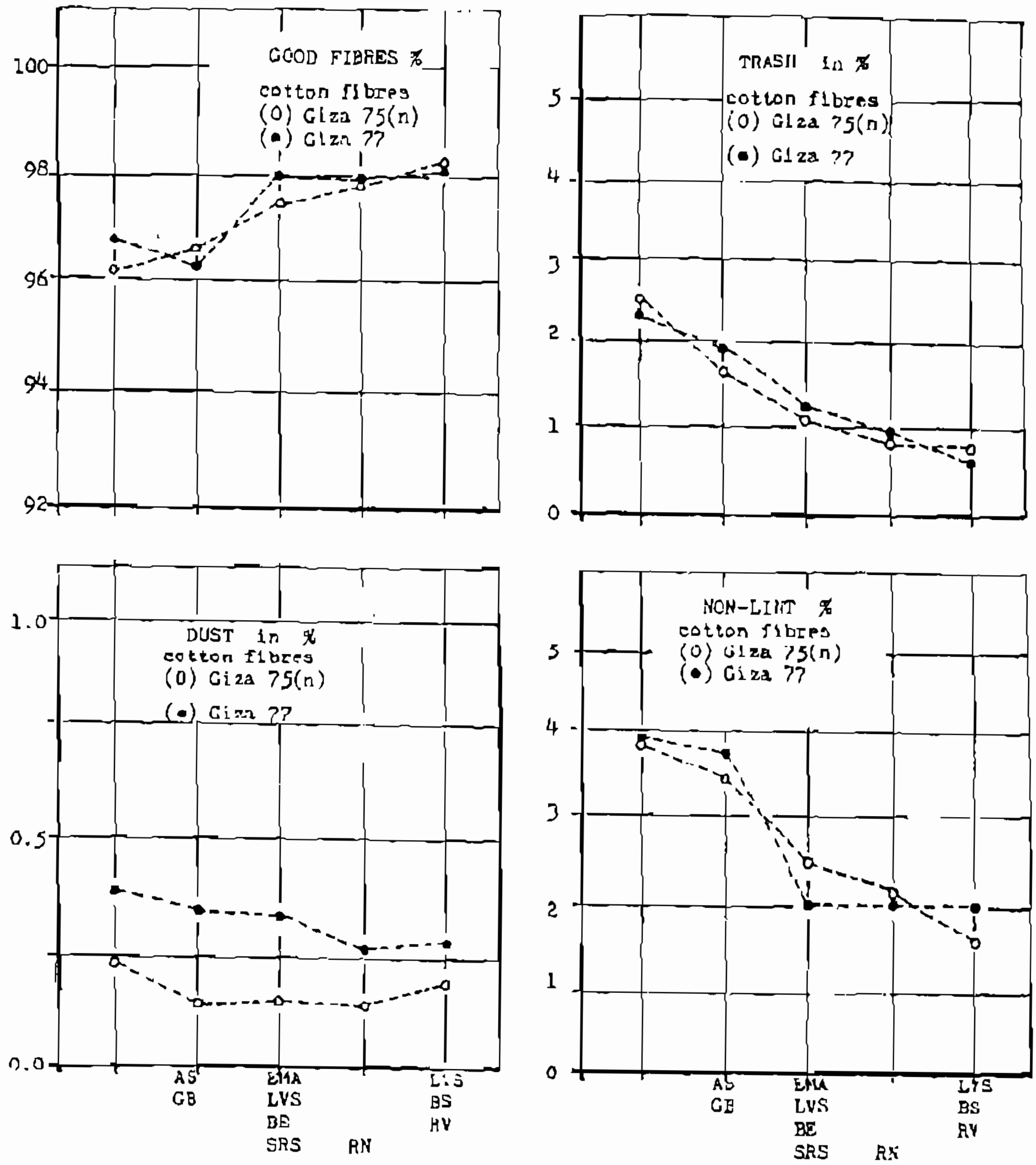

Fig.(8) Trash Analysis at Various Machines of Blowroom Line "D"

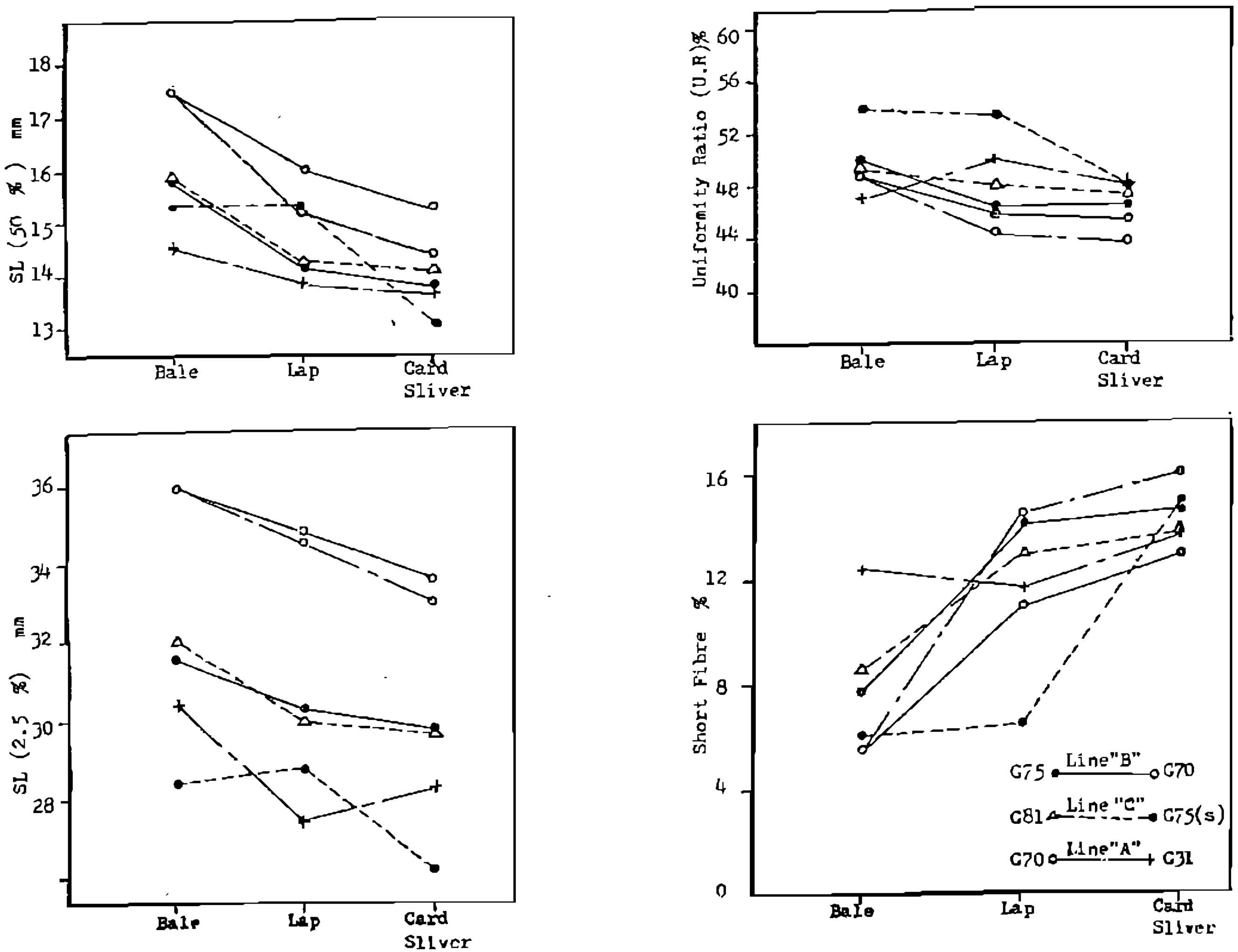

Fig.(9) Fibre Length Characteristics in Bale, Lap and Card Sliver

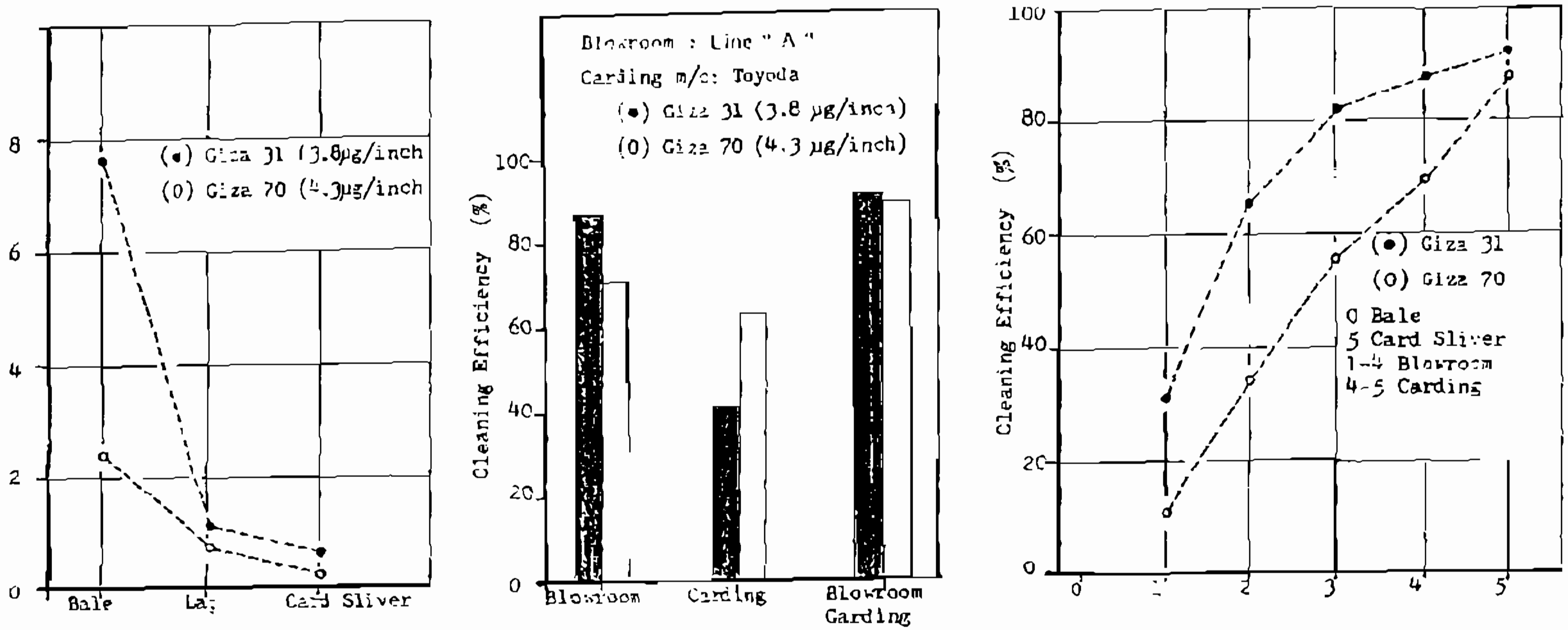

Fig.(10)Degree of Cleaning Efficiency as a Function of Cotton Fibre(G31andG70) Parameters at The Various Processing Stages

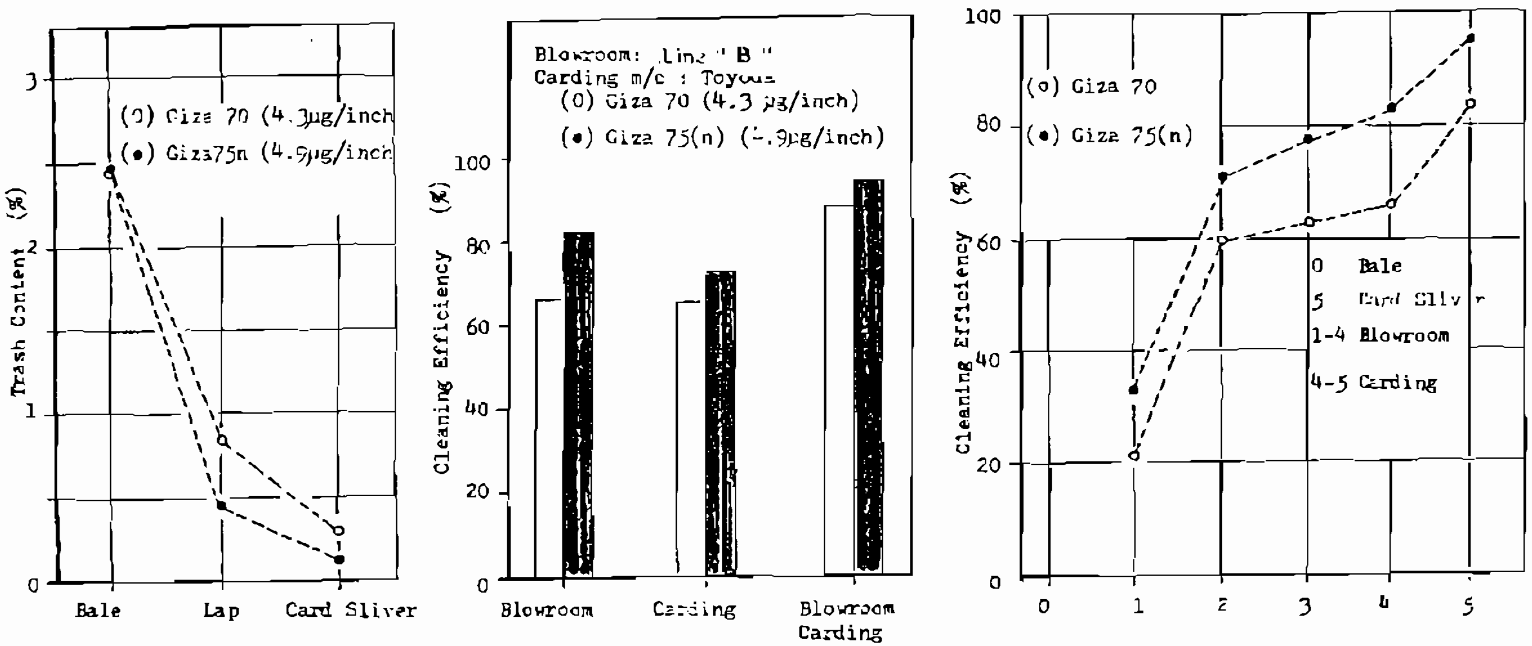

Fig.(11) Degree of Cleaning Efficiency as a Function of Cotton Fibre (G70 and G75n) Parameters at The Various Processing Stages

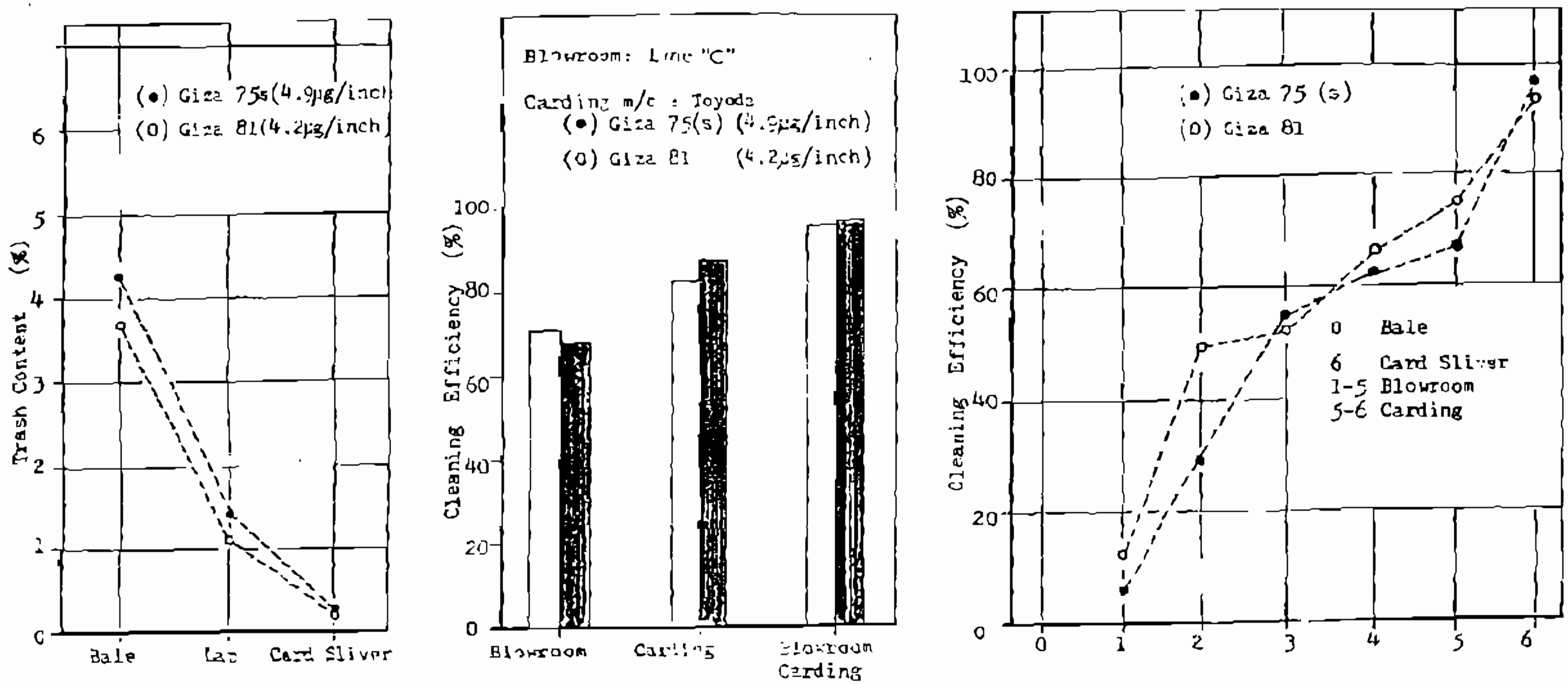

Fig.(12) Degree of Cleaning Efficiency as a Function of Cotton Fibre (G75(s) and G81) Parameters at The Various Processing Stages

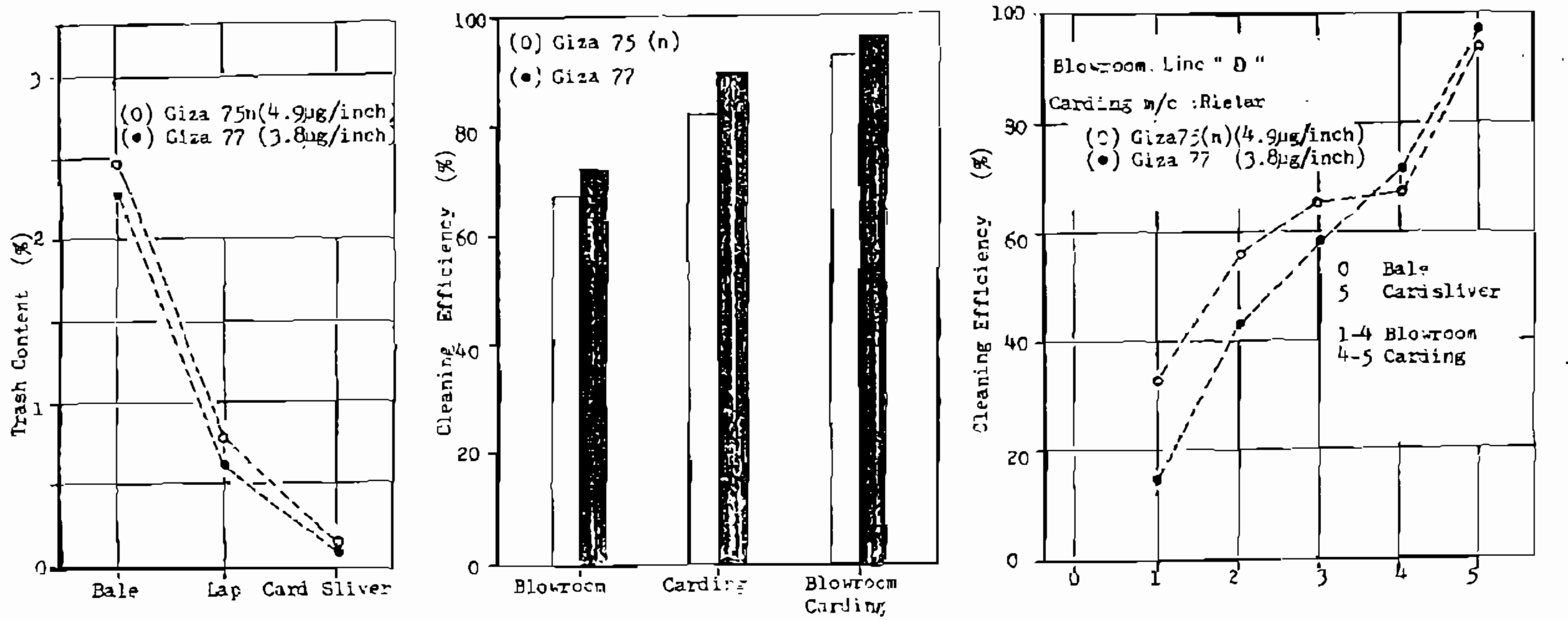

Fig.(13) Degree of Cleaning Efficiency as a Function of Cotton Fibre (G75(n) and G77) Parameters at The Various Processing Stages

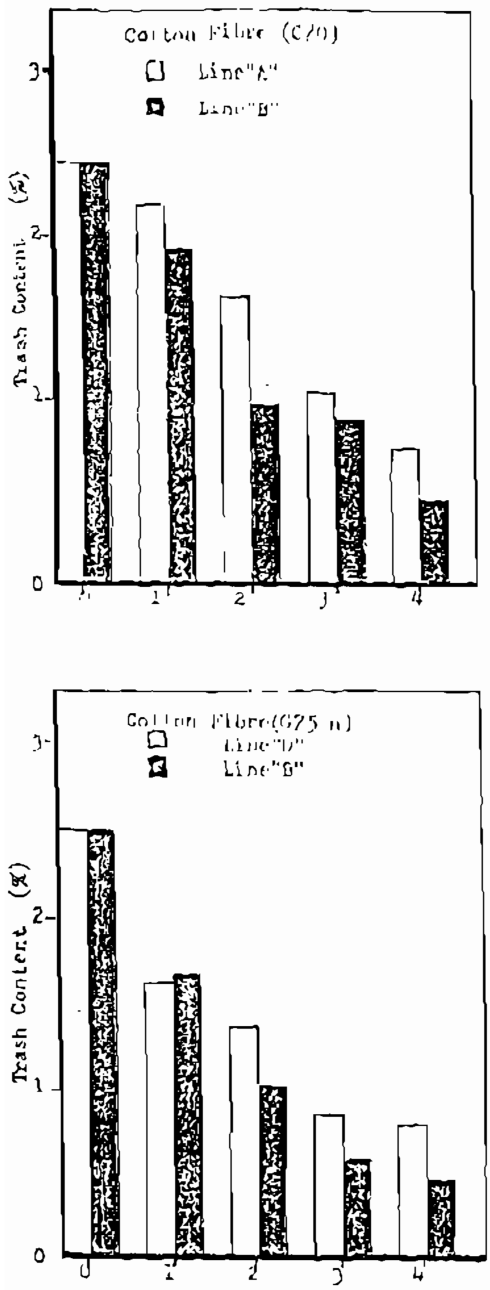

Fig.(14) Comparison of Percent Trash at Various Machines of Two Opening and Cleaning Lines

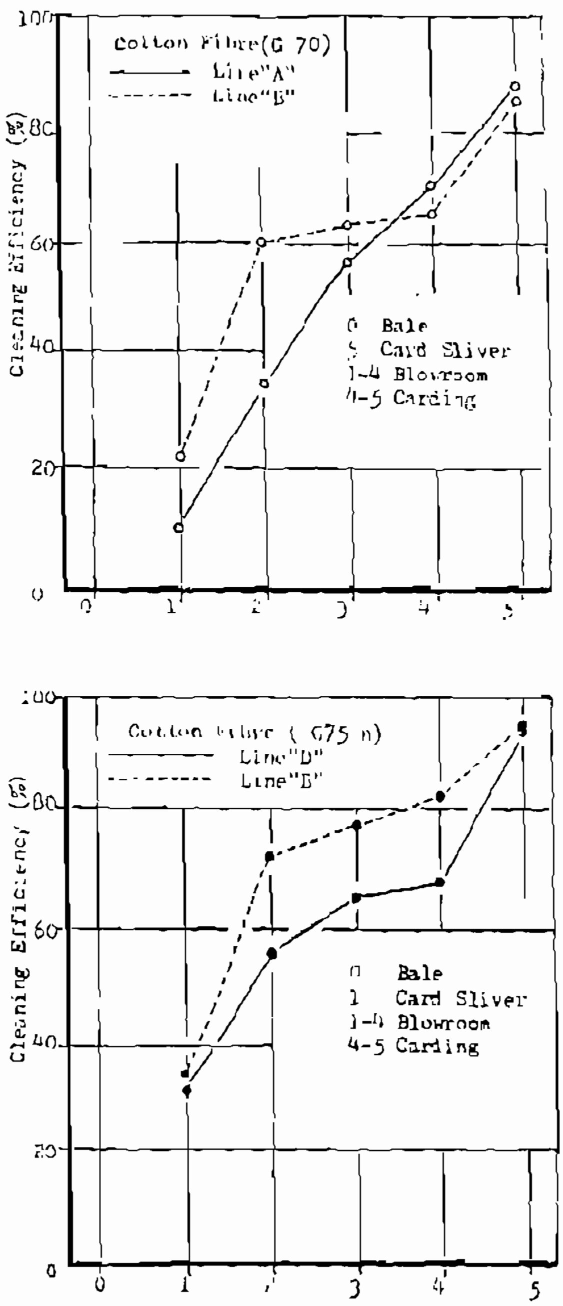

Fig.(15) Comparison of Cleaning Efficiency of Two Opening and Cleaning Lines

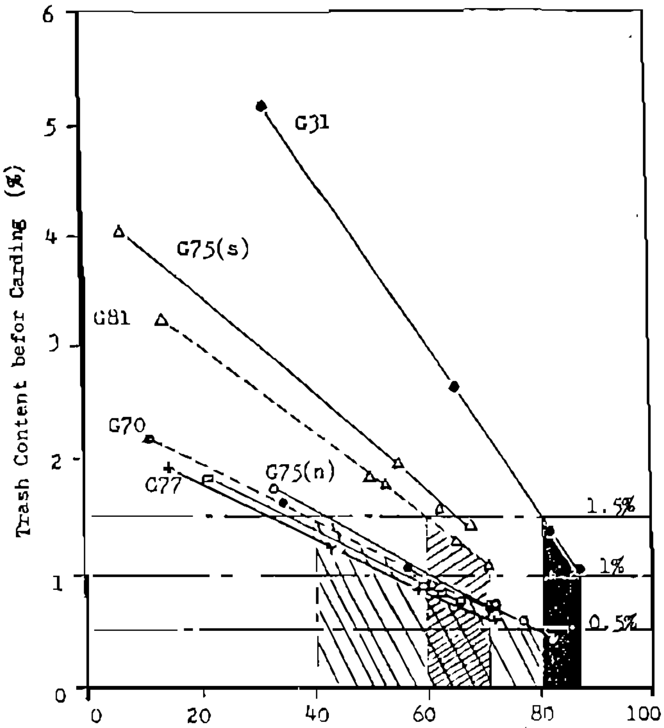

Fig.(16) Relationship between residual trash content of lap or/and flocks and cleaning efficiency (%)

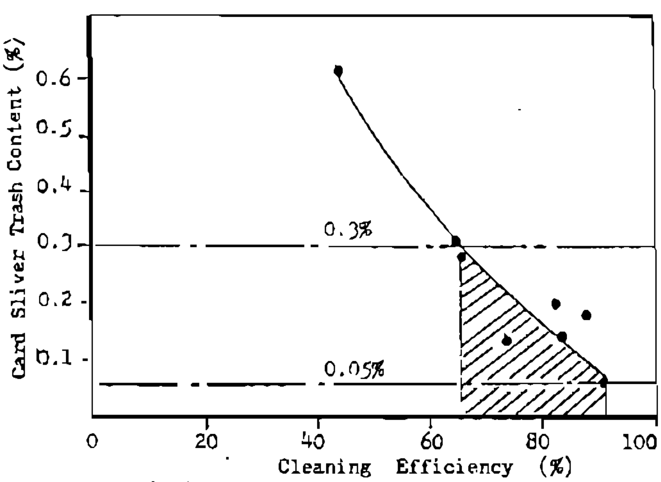

Fig.(17) Relationship between residual trash content of card sliver and cleaning efficiency