ABSTRACT: The aim of the present work is to study the cleanliness of most Egyptian cotton fibres. Five different cottons, 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 were 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 throughout. 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 and speeds of the opening element.

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

(i) Degree of opening: Ataei et al. 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 cause stress to 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 dependant on material, machines and the environmental condition. Also, dust removal is an easy operation. Mandl found that it is mainly the suction units removes percentage of dust. The cleaning efficiency of a cotton blowroom line depends to a large extent on the opening of the bale material at an early stage. Rohde describes the effect of sp and setting 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\(^3\) 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. Tenas\(^6\) 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 blowroom on the yarn characteristics. The cv\% 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 attention during operation.

Looking over the spinning preparation lines of the different Egyptian cotton mills, a wide variety of machine organizations 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 limits. 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 nepness of the raw stock is important variable in the area of silver 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 silver 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\(^3\).
- 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 73, Giza 77, Giza 81 and Giza 31, with different characteristics were selected. In case of cotton type "Giza 73" there are two lots with regard to the original plant "Delta and Upper Egypt". The main fibre
properties of all cotton are given in Table (2). For most cotton fibres, non-lint varies between 3.8% 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 a 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 flake 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 of flake and carded sliver. Fibre fineness by shifield micronaire and fibre strength by breaking determination was made for a samples of cotton from bale.

<table>
<thead>
<tr>
<th>Raw cotton</th>
<th>Fibres</th>
<th>Trash analysis (%)</th>
<th>Fibrograph</th>
<th>Micronaire precisely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>good fibres</td>
<td>non-lint (%)</td>
<td>span length</td>
<td>value index</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trash</td>
<td>dust</td>
<td>i nv.</td>
</tr>
<tr>
<td>Giza 31</td>
<td>57.96</td>
<td>7.60</td>
<td>0.38</td>
<td>4.06</td>
</tr>
<tr>
<td>Giza 75 (n)</td>
<td>96.15</td>
<td>2.48</td>
<td>0.23</td>
<td>1.13</td>
</tr>
<tr>
<td>Giza 75 (s)</td>
<td>94.00</td>
<td>1.28</td>
<td>0.23</td>
<td>1.14</td>
</tr>
<tr>
<td>Giza 81</td>
<td>95.12</td>
<td>3.76</td>
<td>0.12</td>
<td>4.00</td>
</tr>
<tr>
<td>Giza 77</td>
<td>97.13</td>
<td>2.23</td>
<td>0.34</td>
<td>1.26</td>
</tr>
<tr>
<td>Giza 70</td>
<td>95.57</td>
<td>2.46</td>
<td>0.37</td>
<td>1.60</td>
</tr>
</tbody>
</table>

Table (2) spinning preparation lines

(i) Blowroom Line "A"
- 2 Bale opener
- Condenser
- Hopper Feeder
- Step Cleaner
- Axi - Flow
- Multi-mixer
- Condenser
- Hopper Feeder double opener and cleaner
- Hopper Feeder double scutchet lap m/c.

(ii) Blowroom Line "B"
- Waste opener
- 2 Bale opener
- Axi-Flow
- Condenser
- Multi-mixer
- Condenser
- Condenser pneumatic cleaner

(iii) Blowroom Line "C"
- Aisle opener
- Conveyor belt
- Condenser Feeding blend conveyor unit
- Step cleaner
- Multi-mixer
- Transfer fan, condenser, step cleaner, feed trunk cleaner
- Condenser
- Hopper Feeder
- Condenser

(iv) Blowroom Line "D"
- Waste opener
- (2) Bale opener
- Condenser Feeding blend conveyor unit
- Condenser
- Multi-mixer
- Transport Fan
- Condenser
- Hopper Feeder
- Condenser
- Feed trunk cleaner
- Transport Fan
- Chute feeding
Results and Discussions:

3.1 Effect of blowroom stage on:

(i) Trash Analysis:

Figures (3-8) shows a comparative 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 before 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 Trutzschler 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 silver 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 as follows:

(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.3) and G.70, G.81 and G.73(s), G.70 and G.75, G.73 and G.77) has an appreciable difference in fibre fineness (µg/inch).

For cotton fibres G.31 and G.70, as shown in Fig. (10), appreciable difference between fibre fineness has been observed, also the test results show an extreme difference in trash content. For G.31, the initial trash content (7.6%) is higher than that for G.70 cotton fibres (2.46%).

The experiments indicate that a higher cleaning efficiency is required for G.31 than that for G.70 (86% against 71%) at blowroom Line "A". In addition, the carding operation resulted in a total cleaning efficiency 92% for G.13 and residual trash content 0.6% in the card sliver. While a 95% cleaning action for G.70 with 0.28% residual trash content.

The experimental results (for running material G.81 and G.75(s) in Line "C" are shown in Fig. (12). It can be noticed that a cleaning action of 71% obtained with G.81, has 3.76% trash content and its micronaire value 4.2µg/inch, against a cleaning efficiency of 67% for G.75 which has 4.78% trash content and fibre fineness 4.9µg/inch. Also, more efficient cleaning is achieved through carding machine. Finally, for both cotton fibres the total cleaning efficiency is almost the same 93% and residual trash content in card sliver is 0.2%.

In figures (11) and (13), raw cotton fibres with an appreciable differences in micronaire value and with similar initial trash content were processed through Line "B" and Line "C".

The results, Fig. (11), indicate that a lower cleaning efficiency associated with G.70 (49% at blowroom and 56% at carding) than those obtained for G.75 (82% at blowroom and 73% at carding), consequently the trash content in card sliver is 0.3% for G.70 against 0.12% for G.75.

As shown in Fig. (13), for blowroom Line "D", it can be noticed that a cleaning efficiency of 68% obtained with G.75 has a trash content 2.48% against 72% for G.77 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) compare 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 G.75 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 83% is obtained on Line "D". However a good running condition at carding machine results in a better cleaning (82% against 73% respectively) which finally show a similar 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, in each blowroom lines "A" and "B" a similar cleaning action 63% is obtained and total cleaning efficiency 88% was reached for G.70 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 1.3% 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 0.5% and 0.6%. For most of Egyptian cotton fibres, cleaning efficiency (50-90%) at carding resulting in a residual trash content in the range 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(n) and lower trash content for G73, G77 and G79.
- As a result 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 tap 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 efficiencies 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 reference to the residual trash content the experimental results led to the following conclusions:

Firstly, Residual trash content in uppers and slacks:
- Residual trash content (1.3%) before the card could be achieved at different cleaning action 40%, 62% and 85% 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)) with 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 0.3%, 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 show a low level of residual trash content, between 0.3 and 0.06%, in the card sliver. This corresponds to cleaning efficiency at carding in the range 65% and 90%.

References:
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4. Röder, L., Magyar Textiletech., 1959, 11, 436
6. Temas, H., Melland Textilberichte, 9/77, 701 - 705
7. Hartenhauer H.P., Deutsch Textiltech., 1962, 12, 146
Fig. (1) Blowroom Line "A" (2)
1) bale opener 2) condenser 3) hopper feeder 4) step cleaner 5) air-flow 6) condenser 7) hopper feeder 8) double opener/cleaner 9) filter 10) hopper feeder 11) double scuffer/diap n/c 12) compressor 13) dust fan

Fig. (2) Blowroom Line "B"
1) waste opener 2) bale opener 3) blending conveyor 4) air-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) scuffer
Fig.(3) Blowroom Line "C"
1) Bale opener 2) Conveyor belt 3) Jute cleaner 4) Transfer fan 5) Condenser
6) Feeding trunk 7), 8) 2 Horizontal openers 9) Multi-mixer 10) 2 A. opener
11) Condenser 12) Hopper Feeder 13) Scutcher belt machine

Fig.(4) Blowroom Line "D"
1) Waste Feeder 2) Bale 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 Fiber Parameters at Various Processing Stages.
Fig. (11) Degree of Cleaning Efficiency as a Function of Cotton Fibre (G70 and G75n) Parameters at Various Processing Stages
Fig. 12) Degree of Cleaning Efficiency as a function of Cotton Fibre (G75(5) and G81) Parameters at The Various Processing Stages.
Fig. (13) Degree of Cleaning Efficiency as a Function of Cotton Fibre (C75(n) and C77) 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 card flecks and cleaning efficiency (%)

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