Study on Impacts of Spinning Process on Fiber Characteristics

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ABSTRACT

Total five samples were collected in opened cotton material form up to roving stage. Samples are collected at different stages they are mixed together and kept for testing. The spinning operations can affect the fiber properties in different ways, depending on the machinery line and adjustment etc. The fiber samples were tested for properties like Length, Strength and fibre fineness on Premier HFT 9000, it is observed that 2.5 % span length and 50 % span length shows a negative growth as the stages progresses, the uniformity ratio shows both positive and negative growth in collected samples, where as the other fiber properties like micronair, strength, and elongation shown the very good results as the spinning stages progresses.

I. INTRODUCTION

Cotton is a cultured, natural product and is always referred as a non-homogeneous raw material. It exhibits variation from fibre to fibre, bale to bale, area to area, and season to season due to climatic conditions, growing areas and harvesting methods etc. Quality parameters of cotton viz. fibre length and fineness have a vital influence upon the ultimate yarn strength. Fibre length is the most important cotton fibre character which determines the amount by which fibres can overlap with one another, greater the overlapping; the easier it would be for the fibres to bound together and better would be yarn strength. This means that fibre length have a direct influence on yarn strength and could be negatively affected by shorter span length. Fibre fineness is another important fibre character affecting yarn strength. It gives number of fibres in the cross-section of yarn. Better the fineness of cotton more would be the number of fibres per cross-section resulting in higher yarn strength. When other characteristics are same, fine fibres will produce a yarn of higher strength than coarse fibres.

The "length" of cotton fibres is a property of commercial value as the price is generally based on this character. To some extent it is true, as other factors being equal, longer cottons give better spinning performance than shorter ones. But the length of cotton is an indefinite quantity, as the fibres, even in a small random bunch of cotton, vary enormously in length. It influences spinning limit, yarn strength, yarn evenness, yarn hairiness and productivity is influenced by via end breakage rate the quality of waste, the required turns of twist and general spinning conditions. The long and short fibres both contribute towards the length irregularity of cotton. Here samples of various modern mills are collected and 2.5% staple lengths of fibre are tested at the various stages of spinning mill.

The uniformity ratio is the ratio between the two span lengths expressed as a percentage of the longer length. It determines the distribution of fibre length is uniform If it less than 47% there is increasing short fibres.

Fibre fineness is another important quality characteristic which plays a prominent part in determining the spinning value of cottons. If the same count of yarn is spun from two varieties of cotton, the yarn spun from the variety having finer fibres will have a larger number of fibres in its cross-section and hence it will be more even and strong than that spun from the sample with coarser fibres. The fineness determines how many fibres are present in the cross-section of a yarn of given thickness. Additional fibre in the cross section provides not only additional strength but also better distribution in the yarn. As the cross-sectional features of cotton fibres are irregular, direct determination of the area of cross-section is difficult and laborious. The Index of fineness which is more commonly used is the linear density or weight per unit length of the fibre. The unit in which this quantity is expressed varies in different parts of the world. The common unit used for cotton is micrograms per inch. fibre fineness influenced spinning limit, yarn strength, yarn evenness. Productivity is influenced by via end breakage rate the quality of waste, the required turns of twist and general spinning conditions. Fine fibre accumulate to a greater extent in the yarn core and coarse fibre at periphery.

Strength is a dominating characteristics. This can be seen from the fact that nature produces countless fibre most of which are not usable for textiles because of inadequate strength since the binding of the fibre into the yarn is achieved mainly by twisting thus explicit at most 30-70% of the strength of the material. Elongation is specified as a percentage of the starting length. The elastic elongation is the deceive importance since textile products without elasticity hardly usable. They must be
able to deform in order to withstand high loading but they must return to shape. The fibre elongation should be at least 1-2% and preferably slightly more. Here samples of various modern mills are collected and elongation of fibre is tested at the various stages of spinning mill.

Fiber maturity is an important character of cotton and is an index of developments of the fibers. The maturity of the cotton fibers varies not only between fibers of different samples but also between fibers on the same seed. The maturity of the fiber is concerned with development of cell wall. The cell wall thickening is highly sensitive to growing conditions. Adverse weather, poor soil plant, plant diseases and pests etc., will increase the proportion of immature fiber and lead to trouble in processing. The immature fibers are more prone to nepping effect. When fine cottons are being processed, the danger of nepping is even more acute, since even the mature fibers are likely to cause neps by faulty processing. In addition, the neps so formed are usually more prominent because of their size relative to the diameter of the yarn.

II. MATERIALS AND METHOD

The samples of cotton fibre are collected from following four different spinning Industries.
B). Indira Mahila Co-Operative Mills, Ichalkaranji, Maharashtra
C). Ichalkaranji Co-Operative Mills, Ichalkaranji, Maharashtra.
D). Shri. M.M.S.Sutgirini, Chikhali, Maharashtra.

The physical characteristics of cotton samples were determined with the help of High Volume Instrument using Premier HFT 9000 (H.V.I.) Testing System.

2.1 Sample Preparation

Blow room passage of each mill was set according to the type of cotton and properties of the cotton. Conditioning and mixing of cotton done manually before the blow room. Mixing done according to proportionately and thoroughly. Feeding of the cards was done by chute feed system and two passages of drawing were given after combing operation. Noil extraction at the comber was 20%, 19%, 18% for rich moderate and poor mixing. For each mill, a particular mixing was selected stage wise samples after each machine is collected starting from mixing to the finisher draw frame and in some up to ring frame. In this work, total five samples were collected in opened cotton material form up to roving stage. Samples are collected at different stages they are mixed together and kept in marked packet.

The spinning operations can affect the fiber properties in different ways, depending on the machinery line and adjustment etc. The entire machines were operating at full speed during the samples collection. Specially to find the correlation between fiber properties and Processing stages a MINITAB software was used.

2.2 Conditioning

All the collected samples are conditions for 24 hours under the standard testing atmosphere of 27°C±2 temperature and 65±%2 RH. The fibre properties like length, irregularity, etc. are measured by using HFT-9000. For each sample five readings are taken and average was noted.

2.3 Testing

The fibre of sample properties like Length, Strength and fibre fineness are measured on Premier HFT 9000. The following 3 modules of HFT 9000 measure all these properties.

- **LS Module** - Length and Strength measurement module
- **MIC Module** - Fibre fineness (micronaire) measurement module
- **Colour Module** - Colour measurement module

III. RESULT & DISCUSSION

3.1 Staple length

3.1.1. Process Impacts on 2.5 % Staple Length of Fibre

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Stage</th>
<th>Mill A</th>
<th>Mill B</th>
<th>Mill C</th>
<th>Mill D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mixing</td>
<td>30.20</td>
<td>29.94</td>
<td>28.57</td>
<td>29.97</td>
</tr>
<tr>
<td>2</td>
<td>B.R.</td>
<td>29.70</td>
<td>29.66</td>
<td>29.60</td>
<td>29.58</td>
</tr>
<tr>
<td>3</td>
<td>Card</td>
<td>28.82</td>
<td>27.65</td>
<td>28.61</td>
<td>28.20</td>
</tr>
<tr>
<td>4</td>
<td>D.F.</td>
<td>30.79</td>
<td>31.89</td>
<td>31.49</td>
<td>29.28</td>
</tr>
<tr>
<td>5</td>
<td>Comber</td>
<td>32.09</td>
<td>31.62</td>
<td>31.61</td>
<td>31.69</td>
</tr>
<tr>
<td>6</td>
<td>S.F.</td>
<td>31.20</td>
<td>31.42</td>
<td>31.67</td>
<td>31.87</td>
</tr>
</tbody>
</table>

From table 1 shows that at Mill A it was found that for 30S count at mixing stage the length of the fibre is 30.2mm and for 20S count it was 29.94mm and for Mill B it was 28.57mm and for Mill C line 1, line 2 and line 3 it was 29.97mm and for Mill D it was 27.04mm. and here at blow room stage it decreases and at card stages it was found that it was decrease drastically. It again increases at draw frame stage and combing stages it increases because of hook removal takes place. And at speed frame stage it was same. Even theoretically it is mentioned that the 2.5 % span length increases gradually from the carding. In draw frame and comber improvement in the staple length takes place. In comber it is highest. In speed frame and ring frame slight deterioration of the 2.5% staple length takes place. But as compare to ring frame deterioration in speed frame is
It is also observed that in most of the mill 2.5% span length showing negative correlation with the stages.

### 3.1.2. Process Impacts on 50% Span Length of Fibre

| Table 2: Impacts of Spinning Process on 50% Span Length |
|---|---|---|---|---|---|---|---|---|
| No. | Stage | Mill A | Mill B | Mill C | Mill D | Mill E |
| 4. | D.F. | 10.35 | 10.27 | 8.98 | 10.13 | 10.59 |
| 5. | Comb | 17.65 | 16.21 | 14.92 | 15.02 | 15.03 |

From table 2 shows that at Mill A it was found that for 30S count at mixing stage the length of the fibre is 15.33 mm and for 20S count it was 14.11 mm and for Mill B it was 13.67 mm and for Mill C line 1, line 2 and line 3 it was 13.35 mm and for Mill D it was 12.86 mm. It is less as compared to 2.5% staple length and here at blow room stage it decreases and at card stages it was found that it was decrease. It again increases at draw frame stage and combing stages it increases because of hook removal takes place. And at speed frame stage it was same. In comber and speed frame also upgrading of the 50% span length takes place. In speed frame it is highest one. Again in the ring frame it is deteriorate slightly. It is also following the same trend of 2.5% span length by showing negative correlation as the stages proceed.

### 3.2. Uniformity Ratio

#### 3.2.1 Process Impacts on Uniformity Ratio of Fibre at Different Stages

| Table 3: Impacts of Spinning Process on Uniformity Ratio |
|---|---|---|---|---|---|
| No. | Stage | Mill (30s) A | Mill (20s) A | Mill (Line1) A | Mill (Line2) A |
| 1. | Mixing | 30.80 | 4.79 | 4.96 | 4.60 |
| 2. | B.R. | 47.20 | 4.20 | 4.10 | 4.00 |
| 3. | Card | 47.05 | 4.75 | 4.75 | 4.65 |
| 4. | D.F. | 53.50 | 53.70 | 53.60 | 53.50 |
| 5. | Comb | 53.20 | 44.20 | 53.60 | 53.40 |
| 6. | S/F. | 53.50 | 44.24 | 53.60 | 53.40 |

From table 3 shows that at Mill A it was found that for 30S count at mixing stage the uniformity ratio of the fibre is 50.8 and for 20S count it was 49.4 and for Mill B it was 45.7 and for Mill C line 1, line 2 and line 3 it was 46 and for Mill D it was 47.6. Here at blow room stage it decreases and at card stages it was found that it was decrease. It again increases at draw frame stage and combing stages it increases because of doubling and removal of the short fibre in these processes. In speed frame it is highest and in ring frame it is deteriorate drastically. It is observed that the uniformity ratio is positive correlation in some mill and negative correlation in some mill.

### 3.3. Fineness

#### 3.3.1 Process Impacts on Fineness of Fibre
From table 4 shows that at Mill A it was found that for 30S count at mixing stage the micronaire of fibre is 4.12 and for 20S count it was 3.89 and for Mill B it was 4.15 and for Mill C line 1, line 2 and line 3 it was 4.29 and for Mill D it was 3.28. Here at blow room stage it decreases and at card stages it was found that slight changes are takes place. It again increases at draw frame stage and combing stages it increases because of doubling and removal of the short fiber in these processes. In speed frame it is highest and in ring frame it is deteriorate drastically. It is observed that the uniformity ratio is positive correlation in some mill and negative correlation in some mill. Theoretically also it mentioned that there is no much variation of the micronaire value during processing of the cotton. It is also observed that micronaire values showing positive correlation with the stages used in spinning processes.

3.4 Strength

3.4.1 Process Impacts on Strength of Fibre

From table 5 shows that at Mill A it was found that for 30S count at mixing stage the strength of fibre is 24.4g/tex and for 20S count it was 22.6g/tex and for Mill B it was 21.7g/tex and for Mill C line 1, line 2 and line 3 it was 23.2g/tex and for Mill D it was 21g/tex. Here at blow room stage and at card stages it was found that slight changes are takes place. It again increases at draw frame stage and combing stages and it is observed that the strength property is showing very good positive correlation with the stages used in mill.

3.5 Elongation

3.5.1 Process Impacts on Elongation of Fibre

From table 6 shows that at Mill A it was found that for 30S count at mixing stage the elongation of fibre is 6.5 and for 20S count it was 6.3 and for Mill B it was 6.2 and for Mill C line 1, line 2 and line 3 it was 5.6 and for Mill D it was 6. Here at blow room stage and at card
stages draw frame, combing and speed frame stages it was found no drastic increase or decrease of the elongation takes place in processing of the cotton. And it is observed that positive correlation is observed between the elongation property and stages used.

From table 7 shows that at Mill A it was found that for 30S count at mixing stage the maturity ratio of fibre is 0.84 and for 20S count it was 0.83 and for Mill B it was 0.83 and for Mill C line 1, line 2 and line 3 it was 0.84 and for Mill D it was 0.8. Here at blow room stage and at card stages drawframe, combing and speedframe stages it was found no drastic increase or decrease of the maturity ratio takes place in processing of the cotton. In most of there was no correlation observed between the maturity ratio and stages used.

From table 8 shows that at Mill A it was found that for 30S count at mixing stage the short fibre index of the fibre 6.1 and for 20S count it was 8.5 and for Mill B it was 9.5 and for Mill C line 1, line 2 and line 3 it was 10.1 and for Mill D it was 11.5. There is much more fluctuation in the readings of the short fiber index observed. But the reading shows that short fiber index is lowest in comber machine. It also mentions theoretically, this is due to the removal of the short fiber in comber. Also the reading shows that short fiber index of blow room are highest. When statistically correlation method is applied the short fiber index shown negative correlation.

### IV. CONCLUSION

- From above study it is concluded that, 2.5% Staple Length is decreasing at blow room stage and decrease drastically at carding. But it increases at draw frame and combing stages because of hook removal. Later on shows consistent staple length at speed frame.
- 50% Span Length of fibre is showing same kind of trend shown by 2.5% Staple Length.
- Uniformity Ratio is decreasing at blowing and carding stage. While it increases at draw frame and combing stage because of doubling and removal of the short fiber in these processes. Uniformity ratio is highest at speed frame but deteriorate drastically at ring frame.
- Hence blowroom & carding has significant effect on 2.5% staple length, 50% span length and uniformity ratio.
Micronaire is changing at draw frame and combing stages due to doubling and removal of the short fiber from the material.

REFERENCES