Analysis of Impacts of Spinning Processing on Fibre Length

By: Dr. P. V. Kadole & Sandip Kidile

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If the machinery used is at par with the prescribed norms, the cotton fiber suffers no mechanical damage in the blow-room stage. The card is the heart of spinning mill demonstrates the immense significance of carding in the spinning operation. It has been established that the neps removal efficiency of card I considerably influenced by the condition of card clothing.

Cotton is the king of textile fiber the warmth, comfort and feel offered by cotton can not be matched by any of the synthetic fiber. Among the characteristic of cotton fiber Length, Strength, Micronair and elongation is of utmost importance to the spinner. Fiber length has excellent correlation with yarn breaking extension and correlation with yarn evenness, imperfection and hairiness.

Raw cotton fiber, irrespective of quality, contains impurities. The blow-room which is the first stage of cotton processing, performs the important functions of opening and cleaning. It is a common perception in the industry that cotton fiber can be damaged or broken during the blow-room processing. Proportion of short fibers is increases by over 10 %if the blow-room line contains one more cleaning machine than necessary. The fiber length degradation resulting from breakage during lint cleaning is less severe in cotton greater individual fiber strength (fiber tenacity (g/tex x fiber fineness).The potential of cotton fiber to form neps during lint cleaning is inversely related to maturity and directly related to non lint content.

Properties of cotton fiber

Length

Fiber length is one of the most important parameter in cotton selection. A comparison of all the world cotton reveals that fiber length varies from $^{3}/_{4}$" to 1 $^{3}/_{4}$" or even 2". We are generally using two types of length i.e. 2.5% and 50% span length. 2.5% span length is the distance 2.5% of the fibers extend from the clamp where they are caught at random along their length. 50% span length is a distance 50% of the fibers caught at random extend from the clamp along their lengths.

It can be assume that the fiber of under 4-5 mm will be loss in processing, fiber up to about 12-15 mm do not contribute to strength but only fullness of yarn, and only those fibers above these length produce the other positive characteristics in yarn.

Fiber length variation will cause the problems at every stages of processing.

- In Blow Room, the feed roller and the beaters have to be set at the appropriate level for maximum opening with minimum damage to fibers and deterioration in yarn quality.
- In Carding, as the setting between the feed plate and the licker-in and other setting are dependent on fiber length and its variability.

- When fibers varying widely in length are drafted, too many fibers may lie uncontrolled in the drafting zone leading to the formation of high amplitude drafting waves.

Standards of cotton for 2.5% span length values:	
Extra long staple	32.5 & above
Long Staple	27.5 to 32.0
Medium long staple	25.0t027.0
Medium staple	20.5 t024.5
Short staple	20.0 and below

Processing

I) Ginning

The main function of ginning is to separate the lint or long fibre from the seeds. Ginning is the basic important process, therefore it must be control. If it is not controlled strictly it creates many bad effects on raw cotton such as, excessive fiber cutting occur with damp seed cotton. This difficulty is pronounced with long staple cotton, whenever 8% of moisture content.

The cleaning of the cotton in the gin down to trash content of 1.5-2% could appear to benefit the spun yarn. The compression of cotton into bales only has little effect on cleaning in spinning mill and does not affect spinning results.

II) Blow-room

The proportion of short fibre is increased by over 10% of the blow room line contain one more cleaning m/c then is necessary. The increase in neps is also very noticeable in the blow room.

Blow-room eliminates only about 50% of the incoming impurities. Opening is the first operation required, carried out to the stage of flocks in the blow room and reduces the flock to about 0.1 mg.

Quantity of good fibre obtained from waste:	
Clean Waste	**Good Fibre (%)**
Broken ends of sliver & lap	100
Filter waste	95-98
Comber Waste	95-97
Dirty Waste	
From B/R m/c	35-55
From Card	35-55
Flat and Filter Stripping	65-80
Roving (Hard Waste)	95-97

Cleaning efficiency:

% trash in Cotton	No. of beating	Cleaning efficiency (%)
5.1 & above	5	60
3.1 to 5.0	4	55

100 to 3.0	3	50

The opening is more straining as far as trash and fibre damage are concerned than cleaning. Therefore opener should been well cleaner as well. In blow room clearer throughput is smaller which ensures careful cleaning.

III) Carding:

In carding there is a strong relationship between increase in production and reduction in quality. Production of carding is 80-100 kg/hr. cleaning efficiency of carding 80-95% card sliver contains about 0.05 to 0.3% foreign matters.

Card eliminates 1-2% striping waste and hank of sliver lies between 4.5.5 ktex.

% Trash content in card sliver:

% Trash in mixing	2-3.4	3.5 & above
Semi -high production card	0.2 -0.4	0.3-0.5
High production card	0.15-0.25	0.2-0.3
Very high production card	0.10-0.20	0.05 -0.1 0

Neps removal efficiency of card:

Type of Card	Efficiency
Semi-high Production	60
High Production	70
Very high Production	80

Unevenness % of card sliver:

Type of Card	Unevenness
SHP	4.5
HP	4.0
VHP	3.5

Materials & Methods

Material

The samples are collected from four different mills namely-

A] Amit Mills, Ichalkaranji.
B] Ichalkaranji Co-Operative Mills, Ichalkaranji.
C] Indira Mahila Co-Operative Mills, Ichalkaranji.
D] Shri. M.M.S. Sutgirini, Chikhali.

These all mills are modern spinning machines of different machine manufacturers. Maximum machines are of Lakshmi-Rieter which is best one in market.

Blow room passage of each mill set according to the type of cotton and properties of the cotton. Conditioning and mixing of cotton done manually before the blow room. Mixing is done according to proportion 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, a total of 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.

Sample Conditioning

All the collected samples are conditions for 24 hours under the standard testing atmosphere of 22°C temperature and 65% RH. Then samples are tested for their different characteristics E.g.:- length, irregularity, etc. using HFT-9000. For each sample five readings are taken and average was noted.

Experimental Methods

Fibre Properties

The spinning operations can affect the fiber properties in different ways, depending on the machinery line and adjustment etc. for the elimination of these effects fiber properties were measured by using premier HFT 9000 (H.V.I.) testing system.

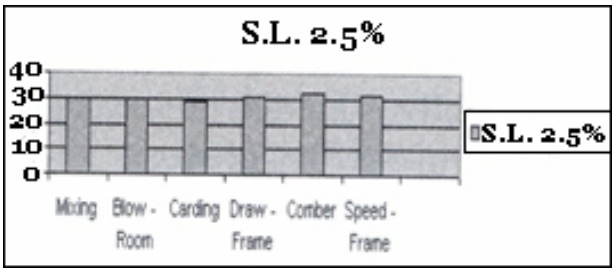
Specially to find the correlation between fiber properties and stages MINITAB software was used. The feed data to this software is tables collected from H.V.I machine.

Results and Discussion

2.5% Staple Length: (Mixing – 30^{s})

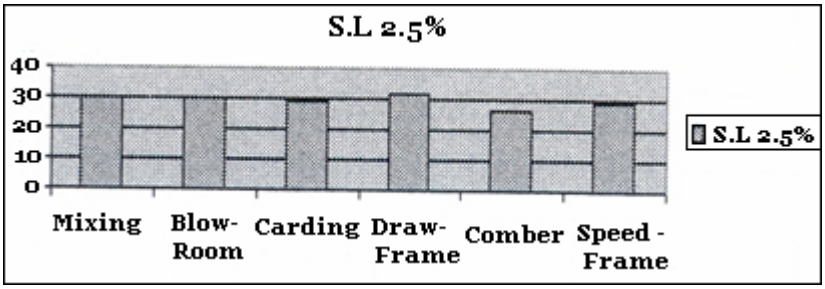
Mill A

Stages	S.L.2.5%
Mixing	30.2
B/R	29.37
Card	28.88
D/F	30.76
Comb	32.02
S/F	31.68



Mill C

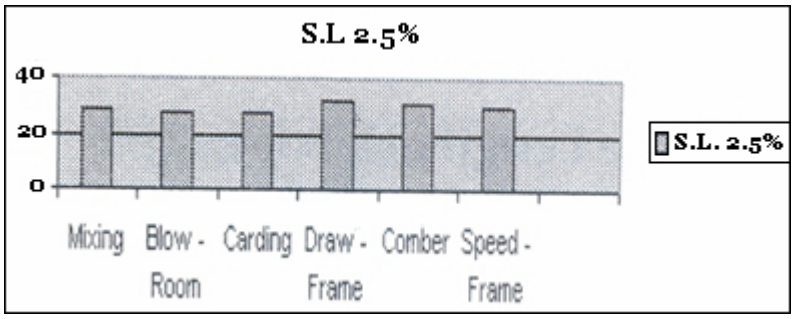
Stages	S.L.2.5%
Mixing	29.94
B/R	30.19
Card	29.32
D/F	31.78
Comb	26.25
S/F	29.42



2.5% Staple Length (Mixing – 20^{S})

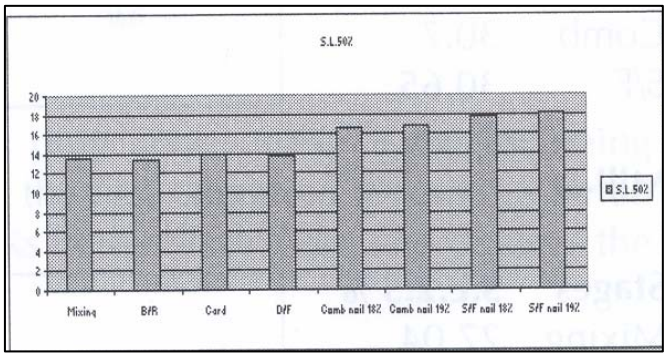
Mill A

Stages	S.L.2.5%
Mixing	28.57
B/R	27.66
Card	27.6
D/F	32.49
Comb	30.81
S/F	29.62



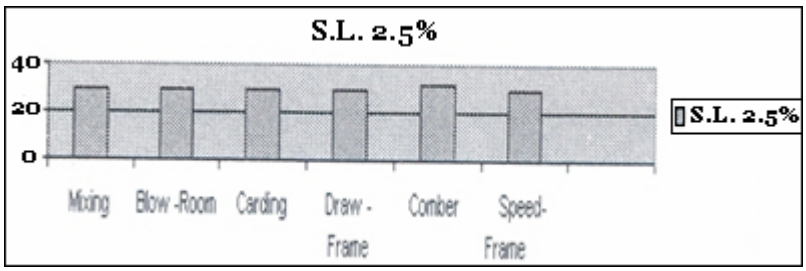
Mill B

Stages	SL (2.5%)
Mixing	29.27
B/R	29.03
Card	29.61
D/F	29.29
Comb noil 18%	30.91
Comb noil 19%	31.96
S/F noil 18%	31.85
S/F noil 19%	31.66



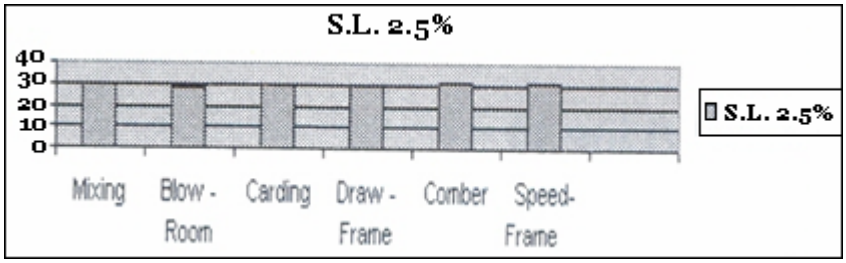
Mill B- (Line-2)

Stages	S.L.2.5%
Mixing	29.27
B/R	29.03
Card	29
D/F	29.6
Comb	31.5
S/F	29.39



Mill- B (Line-3)

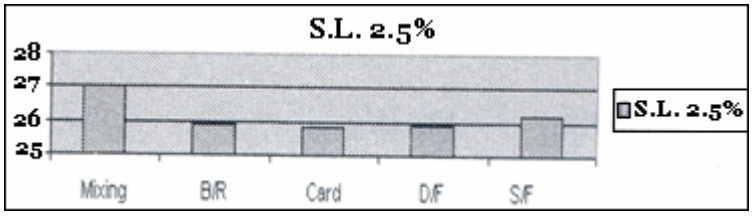
Stages	S.L.2.5%
Mixing	29.27
B/R	29
Card	29.5
D/F	29.23
Comb	30.7
S/F	30.65



Mill- D

Stages	S.L.2.5%
Mixing	27.04

B/R	25.89
Card	25.84
D/F	25.92
S/F	26.22



It is observed from the table 1 to 7 that in most of the mills 2.5% span length deteriorates at blow room stage. At the carding stage it is drastically deteriorate but it is less than in the blow room due to the mechanically stresses through which the cotton passes.

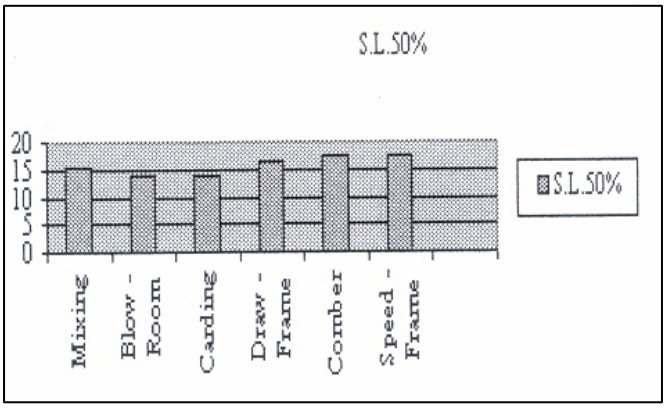
Even theoretically it is motioned that the 2.5 % span length increases gradually from the carding. In draw frame and comber improvement in the span length takes place. In comber it is highest. In speed frame and ring frame slight deterioration of the 2.5% span length takes place. But as compare to ring frame deterioration in speed frame is less.

It is also observed that in most of the mill 2.5% span length showing negative correlation with the stages.

50% Staple Length: (Mixing -30^{s})

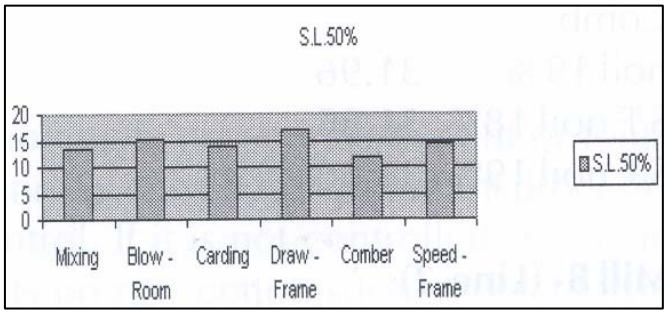
Mill-A

Stages	S.L.50%
Mixing	15.33
B/R	13.87
Card	13.66
D/F	16.59
Comb	17.68
S/F	17.68



Mill-C

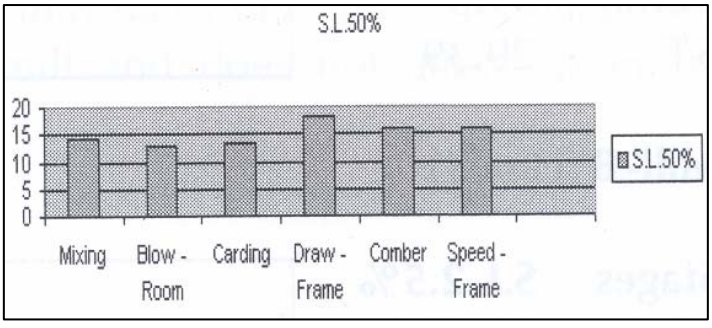
Stages	S.L.2.5%
Mixing	13.67
B/R	15.15
Carding	14.03
D/F	16.97
Comber	11.56
S/F	14.36



50% Staple Length: (Mixing – 20^{s})

Mill-A

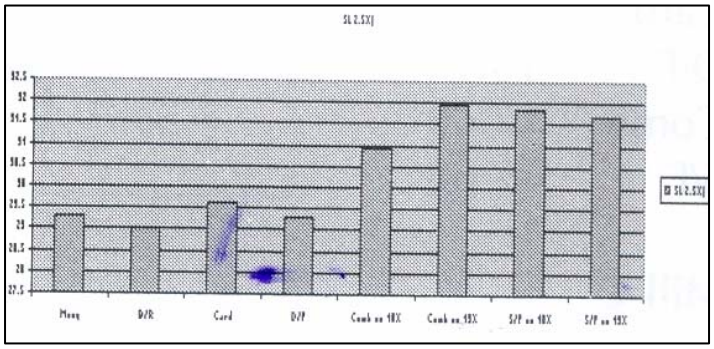
Stages	S.L.50%
Mixing	14.11
B/R	12.99



Card	13.29
D/F	18.06
Comb	16.21
S/F	15.99

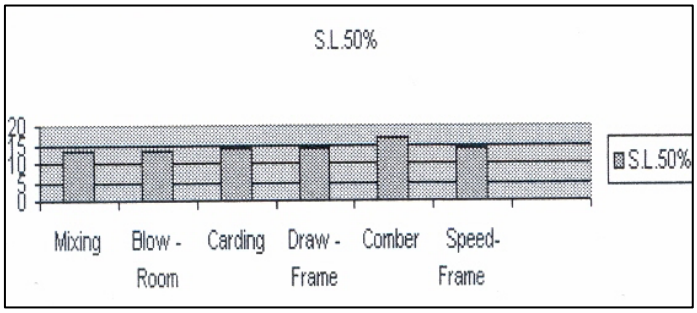
Mill-B (Line 1)

Stages	S.L. (50%)
Mixing	13.5
B/R	13.35
Card	13.99
D/F	13.83
Comb noil 18%	16.53
Comb noil 19%	16.85
S/F noil 18%	17.82
S/F noil 19%	18.06



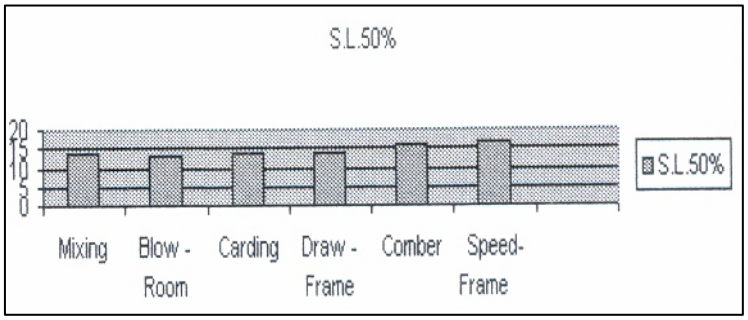
Mill-B (Line 2)

Stages	S.L.50%
Mixing	13.5
B/R	13.6
Card	13.8
D/F	14.19
Comb	16.47
S/F	13.81



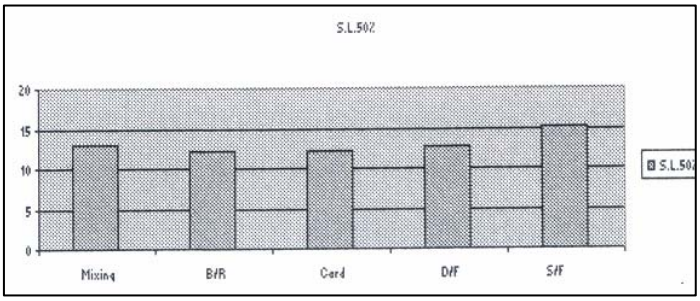
Mill-B (Line 3)

Stages	S.L.50%
Mixing	13.5
B/R	13.2
Card	13.5
D/F	13.5
Comb	15.6
S/F	16.44



Mill-D

Stages	S.L.50%
Mixing	12.86
B/R	12.08
Card	12.2
D/F	12.69
S/F	15.13



It observed from the table 1 to 7, in most of the mills 50% span length deteriorate in blow room and carding. But as compare to 2.5% span length this deteriorations very less

than in carding and draw frame, again same as the 2.5% span length upgrading of the 50% span length takes place.

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.

Conclusion

- ☞ Blow room significantly deteriorates the length characteristics of cotton fiber. Also there is the deterioration of the uniformity and micronair takes place. But the strength and short fiber percentage increases in the blow room stage. Rich mixing suffer maximum damage in the blow room in terms of length and short fiber content.
- ☞ Carding also deteriorate the length characteristics, increase short fiber content, and reduce uniformity due to the stresses in carding region. There is improvement in strength and micronair takes place.
- ☞ Draw frame exhibits minimum influence on the characteristics of cotton fiber. Length, short fiber content, uniformity and strength properties improves marginally 'whereas micronair does not show any change in drawing process.
- ☞ Comber, among all the spinning machines, shows maximum influence on the length characteristics of the cotton fiber. Improvement in length, strength, uniformity takes place in combed material. However the short fiber content reduces in the combed material.
- ☞ Speed Frame and Ring Frame not that much affects on the fiber properties during processing. Mainly the uniformity reduces in this process while the micronair and strength increases during these processes.
- ☞ Excluding strength property most of all properties shown negative correlation with the stages.

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