ORIGINAL RESEARCH PAPER
VOLUME-6 | ISSUE-5 | MAY - 2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

Studies on Backward and Forward feed in combing processes and its impact on the Quality of Extracted sliver & noil

Science

S.Venkatakrishnan Central Institute for Research on Cotton Technology, Coimbatore

S.Mukundan Central Institute for Research on Cotton Technology, Coimbatore

ABSTRACT

In cotton spinning mills, generally combing is carried out to improve the quality of sliver obtained from the card, by eliminating short immature fibres and impurities in order to spun quality yarn out of it. The effect of combing depends on the type of feed and feed length. In the present study, the quality of combed sliver and noil extracted in backward feed & forward feed has been studied by analyzing the quality of combed sliver and noil using the latest Advanced Fibre Information System (AFIS PRO2). The results clearly indicate that for a definite length of detaching distance, the short fibre removed is higher in backward feed compared to forward feed and thereby an improvement in AFIS 5 % length (up to 3.5%) compared to forward feed (2.0%) due to more combing action because of short feed length. Further there is a good improvement in maturity, reduction in nep count & trash in backward feed compared to forward feed. This study will be more useful for the spinner to select a right type of feed in combing to achieve a desired quality with a minimum of loss of fiber in combing.

KEYWORDS:

Combing, Backward feed, Forward feed, Sliver, Noil, AFIS

Introduction

The process eliminates short fibres and remnant fragments of impurities present in the card or drawn sliver to give clean sliver, having more of a rectangular staple diagram, with the vast majority of the constituent fibres in a straightened and parallel state. Combing therefore, make possible the spinning of yarns of fine count with low irregularities and a cleaner appearance1. Carded sliver are combined into comber lap in a single continuous process stage further flat sheet of fiber which is get from comber lap is fed into the comber in an intermediate process (Fig.1). The wastage which is removed from the comber machine during processing is known as comber noil. It is mainly of short fibers and neps. The type of feed is decided on the basis of amount of noil to be extracted and the feed/nip length is selected as it affects the productivity2. The performance of a comber is influenced by both the production rate and the extent of waste extraction. Waste from combing generally varies from 12% to 25%. Higher noil % always improves the imperfections in the final yarn. But the strength and other quality parameters improve up to certain noil %, further increase in noil results in quality deterioration. To optimize the quality performance for a given production rate and the waste level the type of feeding in the combing processes are most important. In actual practice, the amount of noil% to be extracted at comber is decided on the basis of end use of the yarn and the marketable value[2].

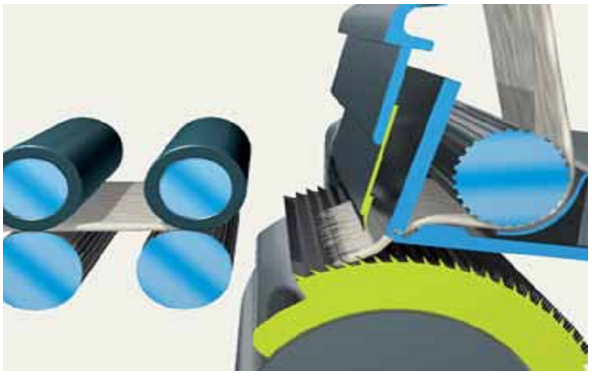

Fig.1- Intermediate process of combing action

Theory of Backward & Forward feed combing

In general, there are two types of feed are followed in the spinning industries:

1. Backward feed: The material is fed during the return of the nippers. The operational sequence is;

Combing ⟶ detachment ⟶ feed ⟶ combing

1. Forward feed: The material is fed whilst the nipper is rocking towards the detaching roller. The operational sequence is;

Combing ⟶ feed ⟶ detachment ⟶ combing

Noil extraction with backward feed

During the detaching stage the nippers are located at their closest spacing relative to the detaching rollers (Fig. 2), which draw off all fibers extending to the nip line, i.e. all fibers longer than E. This length E can be entered in the staple diagram (Fig. 3) as a line m-n. All fibers to the left of the line m-n pass into the combed sliver (hatched area AmnC).

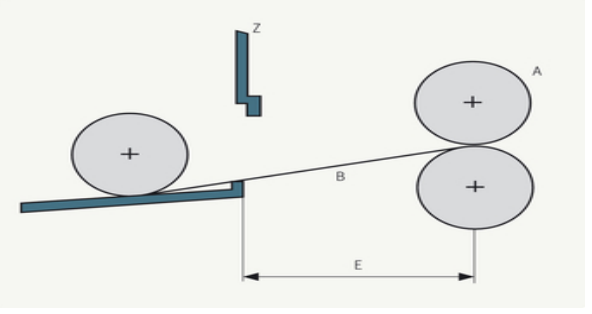

Fig. 2 – Position of the nippers relative to the detaching rollers at the closest approach

(Detachment setting E) during backward feed

The nippers retract towards the comb, the feed roller shifts the fiber fringe (initially with length E) forward through feed amount S. The fringe projecting from the nippers is now presented to the circular combs with length E + S (Fig. 4). All fibers shorter than E + S are carried away by the circular combs because they are not clamped. They pass into the noil. In the staple diagram (Fig. 3), this length can be entered as line q-r. In this stage all fibers to the right of the line q-r are combed out into the noil (area qBr). In the region qmnr it is therefore a matter of chance whether the fibers remain in the fringe or pass into the noil. Accordingly, a division can be made based on the

mean fiber length represented within this area, and it can be assumed that the trapezium AopC represents fibers transferred to the combed sliver and the triangle oBp represents those passing into the noil. The dividing line between these areas has length E + S/2. Since in similar triangles the areas are in the same ratio as the squares of the sides, and since the noil percentage is based on the ratio of weight of waste to weight of feedstock, the following relationship can be assumed3:

$$p\% = \frac{oBp}{ABC} \times 100 = \frac{(op)^2}{(AC)^2} \times 100 = \frac{(E + \frac{S}{2})^2}{M^2} \times 100$$

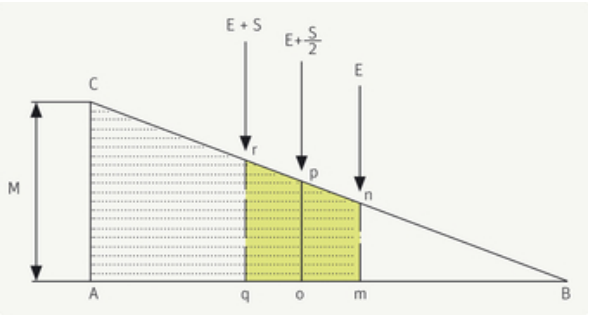

Fig. 3 – Combing out with backward feed

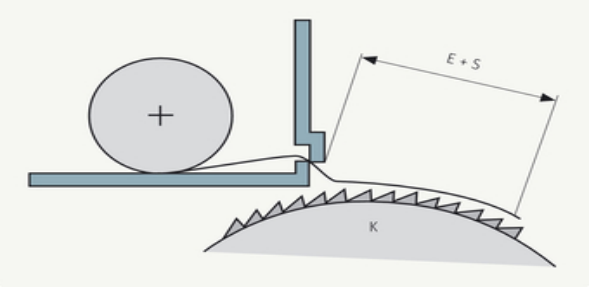

Fig. 4 – Combing out the fiber fringe

Noil extraction with forward feed

After the detaching stage has been completed, all fibers longer than E have been carried away with the web. Since there is no feed step during the return stroke of the nippers, the fringe is presented to the circular combs with length E. During the following combing cycle all fibers shorter than E pass into the noil; this is represented in the staple diagram (Fig. 6) by the area qBr. Feed occurs during the subsequent forward stroke of the nippers, during which the fringe is increased in length by the distance S. At the next stage, that of detaching, the detaching rollers take at least all fibers longer than E (Fig. 5) into the combed web.

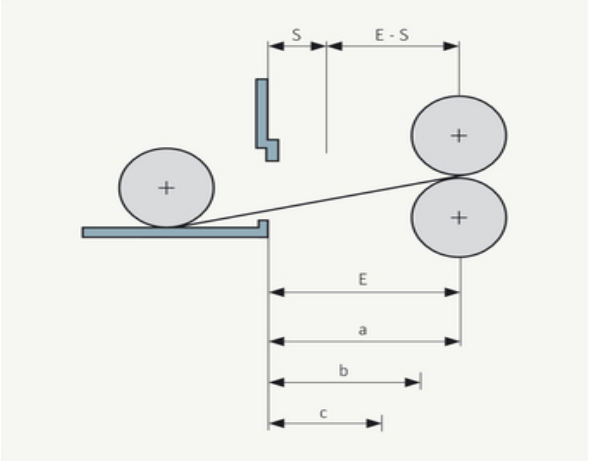

Fig. 5 – Position of the nippers relative to the detaching rollers at the closest approach during forward feed

However, as feeding occurs at this stage, fibers b of the original length (E - S), i.e. shorter than E by the feed amount, are now moved forward to the nip line by feed through distance S. That is why fibers longer than (E - S) are now carried away into the combed web, and trapezium AmnC represents these fibers.

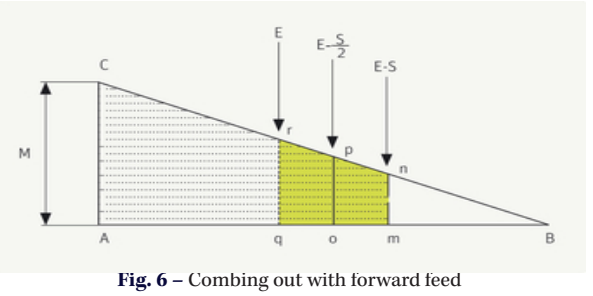

Fig. 6 – Combing out with forward feed

In this case also, the figure qmnr can be divided according to the mean fiber length by the line op (E - S/2), and thus the following relationship can be derived as:

$$p\% = \frac{oBp}{ABC} \times 100 = \frac{(op)^2}{(AC)^2} \times 100 = \frac{(E - \frac{S}{2})^2}{M^2} \times 100$$

Gupte and Patel4 reported that the % short fibre removal and % improvement in mean length are higher with forward feed as compared to that with backward feed at any level of noil. The increase in feed/nip increases the amount of fibre handled by the combing mechanisms and this reduces the combing efficiency and higher short fibre%2. For fibre of a particular length, whether it would go into noil or retain itself in the combed sliver is dependent on the modes of feed5. In processing of forward feed the noil reduces, but in a backward feed it increases with the increased length of feed length per nip6. Usually, a forward feed is selected for high production rates when quality demand is moderate, with the noil percentage kept between 5% and 14%. However, when a higher quality is necessary, a backward feed must be used, with a noil percentage in the range 14-25%7 the cleanliness of the combed sliver is also dependent on the feed mode. Steady improvement in yarn quality can be achieved with an increase in comber waste to a point where most fibres below 15 mm length are removed8. The backward feed always produces better sliver cleanliness than the forward feed7. This can be ascribed to the increased combing of fibre before they seized by the detaching roller. Essential features in which the two feeds difference with respect to the quality of the combing sliver are not discussed yet. The present paper reveal about the type of comber feed and the critical influence on noil and sliver quality are indicated.

Materials and Methods

Cotton with same quality attributes (Table.1) were used for this study to carried out the production process of combing sliver in Mill-A. The amount of noil to be extracted was about 16-19% which was performed in LK 64 comber. The hank of comber sliver was maintained at 0.160 throughout the processes. After lap former, two combed sliver were produced in both backward and forward feed in the same machine. The process flowchart for the production of combed sliver is shown below in (Fig.7).

Blowroom
(Opening and cleaning)
↓
Carding
(Fibre individualizer)
↓
Drawing
(Straightening and parallelization)

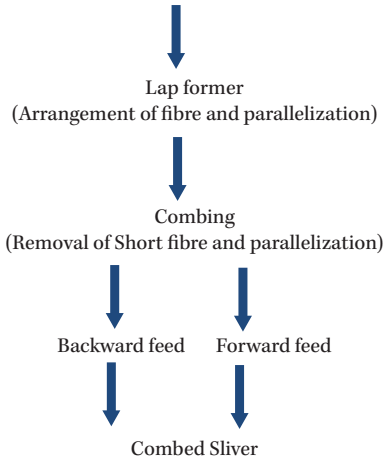

Fig.7- Process flow chart for the production of combed sliver

Table.1- Details of raw material quality and process parameters

Details	Backward feed	Forward feed
L(n) (mm)	19.8	19.8
5%L (n) (mm)	36.0	36.0
Fineness mtex	149	149
Maturity Ratio	0.86	0.86
IFC %	6.5	6.5
Detaching distance (Detaching roller to nipper at the foremost position) mm	6.2	6.2
Feed length/nip (mm)	3.9	4.4

To compare both feed methods quality characteristic of feed (lap), waste (noil) and delivery (combed sliver) of backward and forward feed samples were taken and analyzed in Uster AFISpro2 (Advanced Fibre Information System). Using the results of histogram of different parameters obtained from AFIS the comparison were made to differentiate the impact of backward and forward feed on noil and combed sliver.

Results and Discussion

The AFIS test results of sliver & noil obtained from backward and forward feed are shown in (Table.2).

Table.2 AFIS- Quality parameters of Lap, Sliver & noil in both backward & forward feed

Details	Length and Maturity module						Nep module		Trash module	
	L(n) (mm)	SFC(n) <12.7 (mm)	5%L (n) (mm)	Fineness mtex	Maturity Ratio	IFC %	Total Neps		Total Trash	
							Count/gm	Mean size (µm)	Count/gm	Mean size (µm)
Backward Feed - Lap	20.3	23.5	36.2	165	0.90	5.4	55	647	30	134
Backward Feed - Noil	8.6	80.3	18.3	139	0.69	17.3	343	690	75	175
Backward Feed - Sliver	22.6	11.4	37.4	174	0.94	4.0	12	668	19	102
Forward Feed - Lap	20.5	22.8	36.3	164	0.89	5.5	54	652	38	115
Forward Feed - Noil	8.1	83.0	18.0	138	0.67	15.1	251	684	63	173
Forward Feed - Sliver	22.0	14.1	37.0	171	0.92	4.3	14	606	26	93

Quality parameters of sliver and noil

1. Length distribution

The length distribution of sliver and noil obtained from backward & forward feed are shown in fig.8 (a & b). During combing process, backward feed process extracts more amount of noil (51%) compared to forward feed (38%). Due to short fibre extraction, the improvement in AFIS 5% length in backward feed is increased about 3.5% which is higher than forward feed (2.0%).

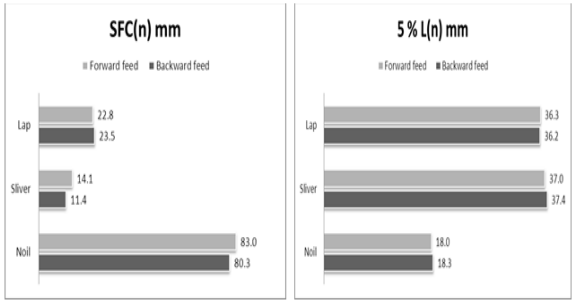

Fig.8- Length distribution of Sliver & Noil obtained from (a) Backward and (b) Forward feed

The presence of percentage of short fibre (<12.7 mm) length in the comber sliver is lower about 11.4% in backward feed when compared to forward feed as 14.1%. It has been observed that, fibre longer than 12.7 mm were also present in the noil up to 19.7% in backward feed, where as it was only 17% in forward feed. In backward feed, top comb penetrates into the fibre fringe which is already combed by the comber needle, therefore combing action done by the top comb will be more and it extracts longer fibres in the waste. In forward feed, during feeding of lap the nipper moves towards detaching roller thereby reducing the longer fibre entry into the noil and it is taken away by detaching roller. Better combing is backward feed due to short fed length of fibre fringes more combing action has been done.

2. Maturity distribution

The maturity distribution of sliver and noil obtained from backward & forward feed is shown in Fig. 9(a & b). After combing processes, there is reduction of immature fibre content in the sliver obtained from backward feed (35%) compared to forward feed (28%). Due to noil extraction, the improvement in maturity ratio obtained from backward feed is increased about 4% which is higher than forward feed (3.3%).

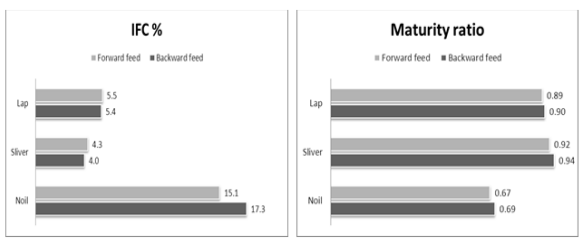

Fig.9- Maturity distribution of Sliver and Noil obtained from (a) Backward and (b) Forward feed

The matured fibre in the combed sliver obtained from backward feed is 96% and 95.7% in forward feed. It has been observed that, good fibre (cell wall thickness >0.25) were also present in the noil up to 82.7% in backward feed, where as it was only 84.9% in forward feed. Due to transfer of longer fibre into the noil, the maturity ratio of noil obtained from the backward feed is higher than forward feed.

3. Nep & Trash analysis

Nep and trash analysis of sliver and noil obtained from backward & forward feed is shown in Fig. 10(a & b). The comber waste also contains large number of neps and foreign matter. Combing, therefore, results in considerable reduction of nep and trash content. The total nep reduction efficiency in the backward feed is 78% higher when compared to forward feed 74%. Similarly, total trash reduction efficiency is 36.6% in backward feed and 31.5% in forward feed.

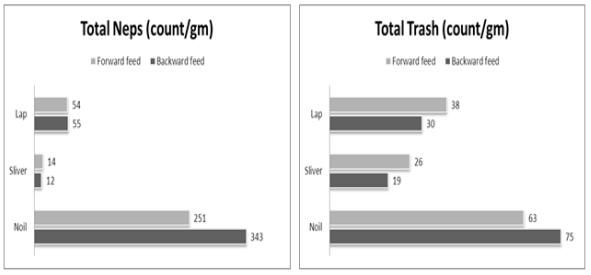

Fig.10- Nep & Trash count of Sliver and Noil obtained from (a) Backward and (b) Forward feed

With backward feed, the comb penetrates throw the fibre fringe more often than in the case of forward feed. Therefore the quality of the cleaning operation is increased in the case of backward feed.

Conclusion:

- The efficiency of removal of waste percentage by the backward feed is higher 51% and lower for the forward feed 38% were observed for the definite length of detaching distance.
- The improvement of 5% length in backward feed is about 3.5% which is higher than forward feed of 2.0%.
- The good fibres in the comber sliver are above 95% in both the feeds.
- The immature fibres are less in the noil and the possibility for the high matured fibre in the noil obtained from backward feed is due to the transfer of some longer fibre in to the noil.
- Higher the immature fibre content in the forward feed gives finer the micronaire value of combed sliver.
- Better combing action can be obtained from the backward feed

References

1. Carl A. Lawrence, Fundamentals of Spun Yarn Technology (CRC Press LLC), 2003,238
2. S Subramanian & N Gobi, Indian Journal of Fibre & Textile Research, 29 (2004)196-199
3. RIKIPEDIA, The noil extraction theory, www.Reiter.com
4. Gupte A A & Patel B A, Proceedings, 27th Joint Technological Conference of ATIRA, BTRA, SITRA & NITRA (NITRA, Ghaziabad), 1986, 8
5. Chattopadhyay R, Advances in Technology of Yarn Production. (NCUTE Publications), New Delhi, 2002.
6. A Majumdar, A. Das, R Alagirusamy, V K Kothari, Process Control in Textile Manufacturing (Woodhead publishing) , 2012
7. Klein, W. Short Staple Spinning Series. A practical Guide To Combing and Drawing, (Manchester, The Textile institute), 1987, Vol 3
8. Garde, A.R., Subramanian, T.A. Process Control in Cotton Spinning, 2nd Ed. ATIRA: Ahmedbad,1978