AFIS Driven Combing System – New Perspective to Spinning Profit and Quality

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One of the big challenges faced by the cotton spinners is consistency in spinning performance and finished yarn quality irrespective of inconsistent natural raw material (cotton) quality. To improve the yarn quality, it is a must to improve the raw material quality. In this process, we are all aware that comber is the only machine in eliminating the selected short fiber in the spinning process sequence.

To utilize this machine optimally one should think "Are we using this machine in the right perspective! Did the noil extracted is correspond to the quality achieved! Are we getting consistency in yarn quality in combed count throughout the year at the minimum cost of quality?"

But in reality, most of the spinners experienced for sure that the quality is inconsistent and struggling to maintain it on many occasions. They experience a lot of surprises in spinning performance and quality. However, the 'Right first time and every time' concept is possible with cotton spinning! This article explains a new perspective on the comber process assuming that other machines in the flow are set alright. Many spinners are fixing stringent standards from raw material to finished products and try to ensure it within standard limits.

In practical fails several times when the cotton lots are replaced. In this article, the author shares the global experience in various mills based on a comprehensive study on how to maintain consistent yarn quality in combed counts throughout the year practically through "AFIS driven combing system".

Basics of Combing Process

Combing is an additional process to produce finer, smoother, lustrous yarn by way of upgrading the quality of raw material, at the cost of additional expenditure on machines, floor-space and personnel, together with a loss of raw material.

Comber eliminates precisely pre-determined quantity of short fibers, fiber hooks, remaining impurities, foreign materials, neps and produce a sliver with maximum possible evenness with more straight and parallel fibers.

Current Industry Practices

In the general mill practices, as a part of the "in-process quality assurance system," the comber noil% is checked in a predetermined testing schedule. It is maintained within a specified tolerance limit say +_ 0.5% between combers.

Whenever Comber noil% goes beyond mill tolerance limit the same will be brought to mill standard level. To bring the comber noil to standard level, mill technician normally readjusts the noil index, top comb setting, etc., in individual combers.

This results in deviation of the setting uniformity between combers to maintain standard noil%. Thus various combers in the same process have widely varying noil index setting to maintain standard noil%.

Guidance for Process Engineering

In a normal mill practice, set the comber parameters based on raw material specifications and finished product quality requirements while introducing new cotton mixing. The extraction of comber noil% was also fixed with this

baseline. But eventually, the comber noil % varies in R&D tests after some time. There are two types of noil variations in the modern comber shed:

a) Shed Average Comber Noil%

b) Noil Variations Between Comber

First of all, let us find the reason behind the noil variation in each type. Probable causes for variation in Overall shed average comber noil% beyond tolerance limit are Lap weight variations and Variation in feed lap short fiber% (SFCn).

Certainly lap weight variations can be narrowed down by process control in carding, pre comber drawing and lap former. Overall average Comber waste shall be maintained within the tolerance of ± 0.2%

The progressive wear of comb components, such as the pins in the circular and top combs, or a decrease in the pressure between the drawing-off rollers or nipper jaws, non-uniform setting, shortened unicomb brush height, condition of the nipper, mechanical conditions and process parameters can each significantly affect noil produced during combing between combers in the identical process.

Waste variation between comber could contribute to Yarn Imperfections and strength variations. Comber waste variation between combers should be maintained within the tolerance of ± 0.5%. Inadequate knowledge and skill lead to not following standard-setting procedures, use of standard tools and sometimes constraints of time results in the low level of setting accuracy.

The waste at comber can be reduced by increasing pre comber draft up to a certain limit without affecting the resultant yarn quality. It is often more economical to run the card at a somewhat low production rate than to take out extra comber waste. The noil is a sensitive variable of the combing configuration and is also influenced by comb speed variation, fiber alignment and the incidence of hooks, variations in sliver linear density, pre-carding conditions, different mean fiber lengths and a back draft applied at the first operation after carding.

The process parameters which decide the amount of noil% are the type of feed, feed amount/nip, detaching distance (the distance between the detaching roller nip to the bottom nipper nip), type of top comb and amount of top comb penetration.

AFIS Driven Quality System

If the comber and back process is set precisely (i.e. the similar detaching distance (Noil index), Uni comb & top comb setting, comber speed, feed/nip, type of feed and lap weight), the comber machine delivers consistent sliver quality. But the noil % may increase or decrease according to infeed short fiber variations.

Comber noil going down in the same preset conditions represents identical yarn quality with noil savings. Likely, comber noil is going up in same preset conditions represents same yarn quality with higher noil% due to increase in input lap short fibers or process deficiency.

The feed short fibers may go up due to raw material quality variations and incorrect process engineering. The back process shall be checked and corrected before fixing on a comber. AFIS-driven quality system supports yarn quality sustenance, process reengineering, machine setting accuracy and improves yarn recovery. Quality sustenance ultimately pays a premium price and repeat orders. AFIS driven quality system is the only way to achieve this milestone in the competitive market.

How Can We Control the Combers on Day to Day Basis

The following parameters are tested in AFIS – driven Quality system in combing process to monitor and control the process on day to day basis:

Comber Sliver Short Fibers (SFCn)
Comber sliver shall be tested in AFIS instrument and AFIS standards shall be fixed against current practice of fixing standard comber noil%. Readjusting the comber noil unknowingly to maintain standard noil level leads to yarn quality variations. Fix standards for neps, 5% length and SFCn for each process according to the finished yarn quality requirements and customer acceptance level. Fix tolerance limit for Go and No Go.

The proper place for controlling neps is carding and not combing. There is a limited scope of reducing neps in comber. 5% length varies according to raw material variations and can be controlled with the best quality management system in raw material procurement and bale/lot management.

Although Comber feed lap SFCn is affected based on raw material quality management system, comber being a short fiber removal machine is ensuring uniform output sliver SFCn by readjusting the noil level automatically. Focus on raw material SFCn and uniformity index helps to narrow down the variation in comber noil to the maximum extent. Practically in most of the mills, the neps and 5% length are under control.

But short fibers are varying widely in cotton from a few stations/varieties which shall be monitored and maintained within industry-standard acceptance level. The mixing issue shall be done with a comprehensive analysis of cotton lots, stations, varieties and of course cotton specifications to average out quality as well cost.

Despite all our sincere efforts for consistent raw material quality, cotton is a natural fiber that will have variations. Mills are testing around 0.001% of a representative sample in every cotton lot. Best sampling system and standardized testing procedures shall be formed to match the sample results with bulk cotton supply.

Comber Noil Short Fibers (SFCn)
Short fibers in comber noil shall be tested at fixed intervals. Comber waste

should contain at least >80 % short fibers (SFCn) to minimize good fiber loss. In the study, it is observed that few mills are maintaining even 60% Short fibers in comber noil and losing considerable good fibers. The loss amounting to INR 0.5 to 2/kg @ raw material cost of INR 130/kg. The waste at comber needs to be checked and controlled due to the following reasons: More waste than the nominal means financial loss. Less waste than the nominal could lead to unacceptable yarn quality performance.

More removal of short fibers and neps may not always contribute to yarn quality or performance. The high cost of removing even one percent extra comber waste makes it vital that a mill should carefully choose the optimum level of comber waste for each mixing and then exercise a strict control on all combers to maintain the waste at the desired level. During our study, it was observed that there is a good scope of minimizing the manufacturing cost for the required yarn quality with a perfectly set combing process.

Comber Short Fiber Removal Efficiency% (SFRE%)

The short fiber removal efficiency% is defined as the the percentage of eliminated short fibers (SFCn) compared to feed short fibers (lap SFCn) in the Combing process. To schedule testing of short fibers in comber lap, combed sliver and comber noil to improve combing performance. SFRE% in modern combers normally ranging between 55 to 70%. Process reengineering is the base to improve it dramatically. Surprisingly the data checked in mills is ranging between 35 to 50% only due to lack of awareness or testing facility. To compensate for such low values, the mills, encourage to extract higher comber noil by 1 to 4% to maintain the same quality.

Increasing the top comb penetration, disturbs the combed fringe though it increases the combing efficiency and reduces yarn imperfections, but the classimat long faults and unevenness of the fabric increases. The study reveals that short fiber removal% and % improvement in mean length are higher with forward feed as compared to that with backward feed at any level of noil.

Case Study

Trial 1 indicates accepted yarn quality in count Ne 40s Combed Weaving Compact where the combed sliver SFCn is 11% with yarn imperfections of 64. The comber noil is 18% and feed comber lap short fibers (SFCn) 26.1%. Trial 2 indicates the quality data when the noil was readjusted again from 19.6 to 18% after few weeks to maintain standard noil%. The combed sliver SFCn shoot up to 15.3% and comber lap short fibers

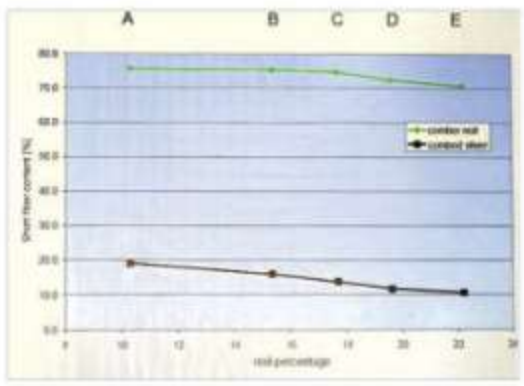

Fig. 1: Correlation between Comber Noil and Short Fiber Content% - Illustrative

(SFCn) is 28.3% and correspondingly the yarn IPI increased to 112.

Comber AFIS Results Vs Yarn Imperfections

Trial Results of Ne 40s Combed Weaving Compact are tabulated in table 1 to 4.

Conclusion

If in case of variation of short fibers in feed comber lap, the comber noil% is also varying up and down to deliver the same sliver quality. The increase or decrease in monthly average comber noil % is a real indicator of the variation in raw material quality. Comber setting

Table 1: Trial 1 Comber AFIS results with Comber Noil of 18% @ Feed Comber Lap SFCn 26.1%

Particulars	UQLW	SFCW	L(W)	SFCn	5% SL	Neps/ gm	SCN/ gm
Combed Sliver	31.3	4.2	25.9	11.0	36.7	15	0
Noil	13.8	65.7	11.1	82.8	17.1	323	40

Table 3: Trial 2 Comber AFIS Results with Comber Noil 18% after Re-adjusting it from 19.6% After Few Weeks @ Feed Comber Lap SFCn of 28.3%

Particulars	UQLW	SFCW	L(W)	SFCn	5% SL	Neps/ gm	SCN/ gm
Combed Sliver	31.1	6.0	25	15.3	36.6	12	0
Noil	14.5	61	11.7	79.3	18.7	415	33

Table 2: Trial 1 Yarn Results

U%	Thin (-50%)	Thick (+50%)	Neps (+200%)	Total Yarn Imperfections	Hairiness	RKM	Elongation	RKM CV%	Elongation CV%
9.8	0	17	47	64	4.0	22.9	4.3	7.8	7.7

Table 4: Trial 2 Yarn Results

U%	Thin (-50%)	Thick (+50%)	Neps (+200%)	Total Yarn Imperfections	Hairiness	RKM	Elongation	RKM CV%	Elongation CV%
10.3	2	27	83	112	4.6	21.9	4	8.2	9.3

and noil shall not be readjusted according to raw material variations. Either fiber rupture in the back process or the raw material quality variations may be the reason for occurrences of noil variations. The back process shall be reengineered to fix process parameters according to raw material characteristics. The cotton specifications such as Uniformity Index and Short fibers (SFCn) also shall be focused on in addition during cotton procurement. This will help to maintain consistent quality with minimum extraction of comber noil.

The continuing demand for top quality, all along the textile value chain, puts enormous pressure on spinning mills today. They have the challenge of meeting precise yarn specifications while also reducing their operating costs to protect business profitability. Spinners should take advantage of using external technical resources for Knowledge sharing and skill development of their team, to produce yarn at a competitive price. Spinners dreaming of quality sustenance and growing profit margins can practice the AFIS-driven quality system for sure.

Abbreviations

AFIS - Advanced Fiber Information System
SFCn - Short Fiber Content in Numbers
Noil - Comber Waste
Kg - Kilograms
INR - Indian Rupees