USTER® *AFIS PRO 2*

Application Report

Process control in spinning mills by single fiber testing

A field report

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Contents

1 Introduction

The measurement of cotton fiber characteristics has already started many decades ago. However, the measurements were time-consuming, and many tests were based on a visual methods with various limitations such as repeatability and operator-to-operator variability.

The counting of neps was also a visual test for many decades with all the challenges of operator instructions, nep interpretations, distinctions between fiber neps, and seed coat fragments etc.

With the introduction of the USTER® *AFIS* it was possible for the first time to establish worldwide statistics for nep, trash and dust counts, but also for fiber length, short fiber content and maturity based on single fiber testing
This paper deals with many practical tests which were carried out with USTER® *AFIS* in the textile industry. It explains what kind of detailed information can be generated by a single fiber testing system. These reports are the basics today for a process control in spinning mill.

2 Neps

Over the years the unevenness of yarns has improved greatly but during this same time period yarn imperfections have increased and afterwards decreased. Specifically yarn neps at +200% have increased in carded and combed yarn till 1989. Between 1998 and 2007 the neps have decreased. The reason for this is the fact that between this period more and more Asian mills participated at the USTER® *STATISTICS* round trials with machines of lower productivity of gins, opening/cleaning lines and cards. The values in Fig. 1 and Fig. 2 represent the 50%-values of the USTER® *STATISTICS.*

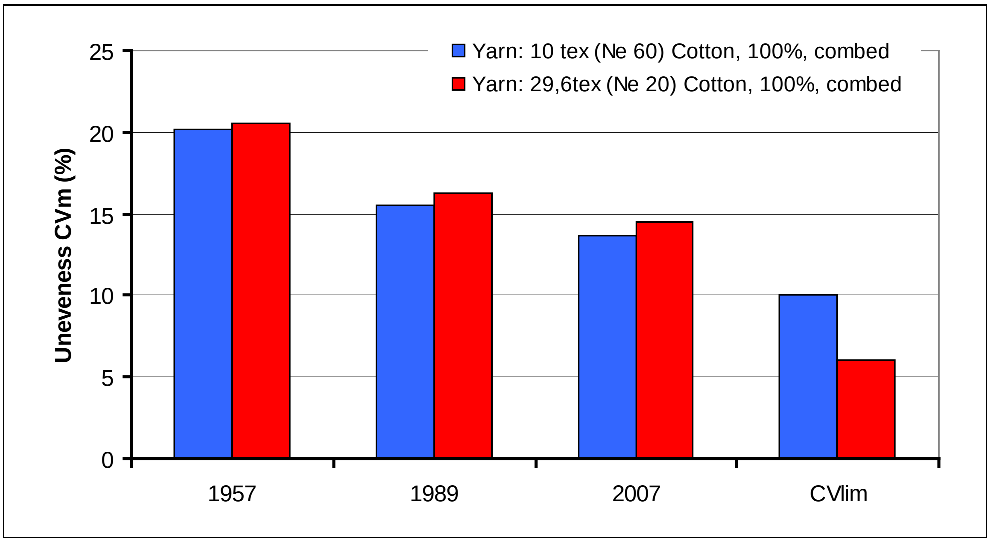


Fig. 1
Improvement of the yarn unevenness
CV_{lim} = Limit irregularity, yarn unevenness which has to be expected under best practices

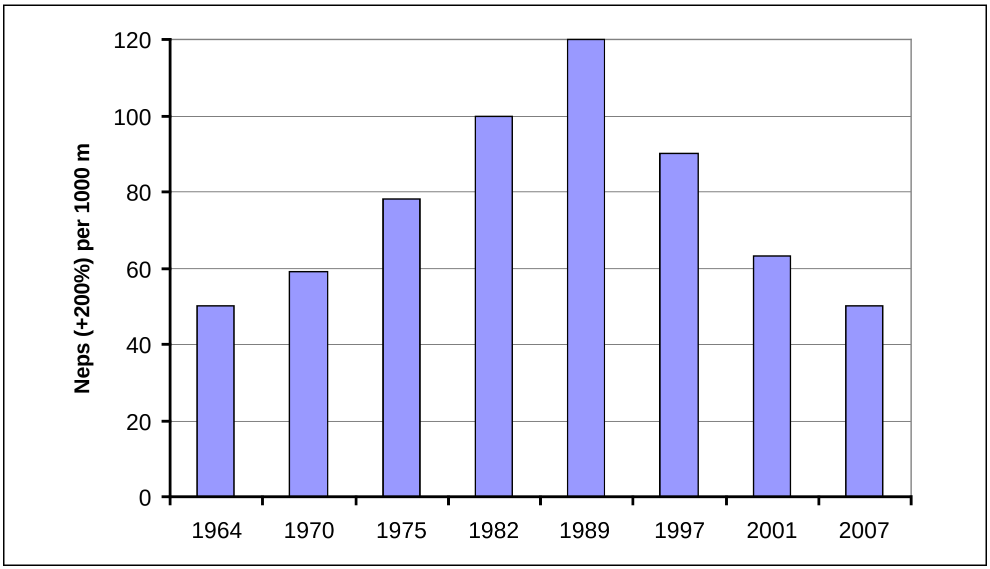


Fig. 2
Cotton 100% (combed)
Count 20 tex (Nec 30)
USTER® STATISTICS Percentiles, 50% line

Cotton fiber neps are not a genetically occurring property in seed cotton. Neps are created by the mechanical handling and cleaning of the cotton fibers. The neps increase throughout the ginning and opening and cleaning process. Carding and combing are designed to align fibers and remove imperfections such as neps (Fig. 3).

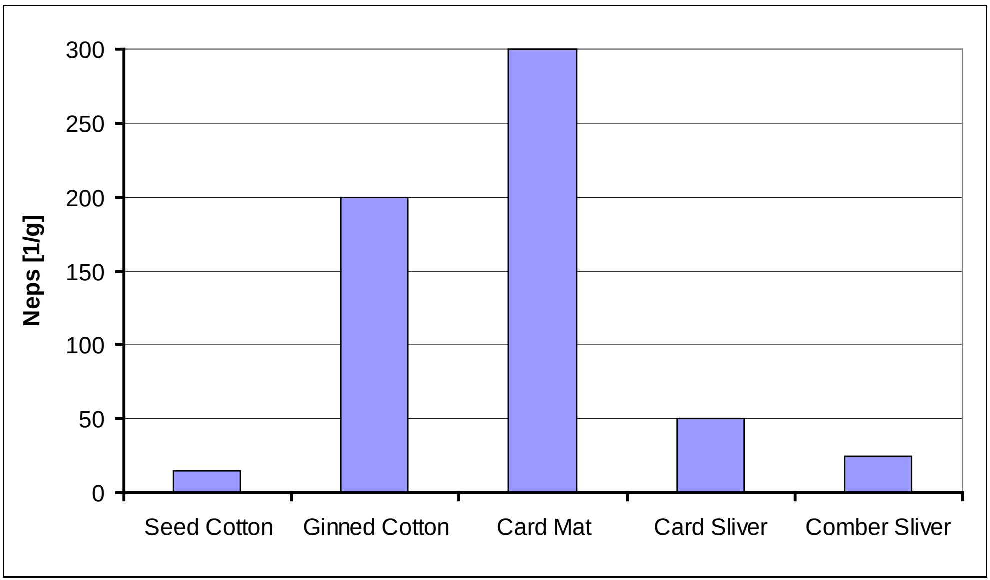


Fig. 3
Nep formation and reduction throughout the spinning process

In the spinning mill the process of opening and cleaning the cotton results in an overall increase in the number of neps in cotton. During this process the amount of trash in the cotton is being reduced (Fig. 4).

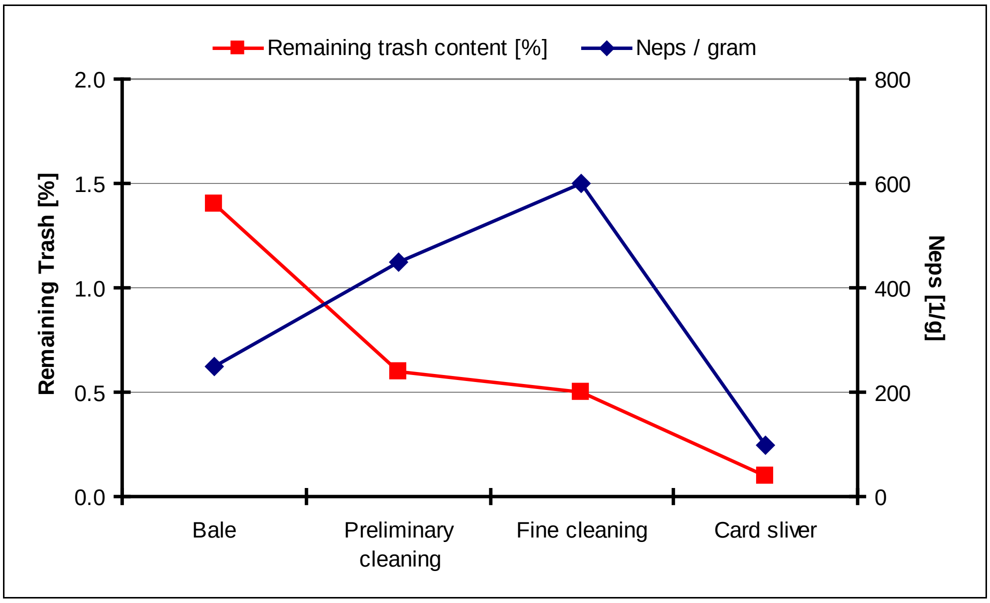


Fig. 4
Changes of neps and trash content in blowroom

Increase of nep levels in the spinning mill from bale to card mat vary depending on the aggressiveness of the cleaning equipment. Most opening and cleaning equipment doubles the number of neps that were in the bale material (Fig. 5).

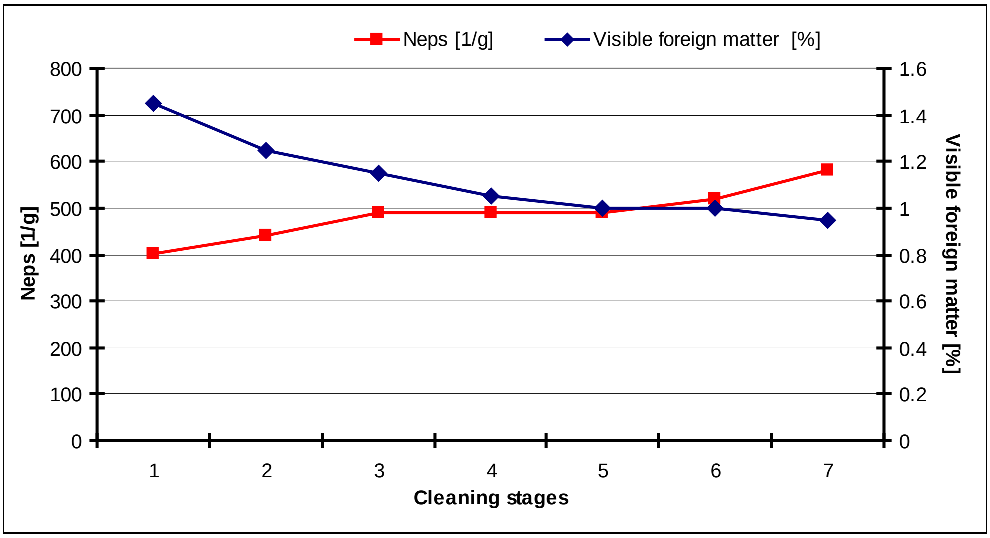


Fig. 5
Cleaning line analysis, Neps and VFM% (w). Low production, increase only about 50%.

Fig. 6 shows what kind of nep increase has to be expected in a modern, high production blowroom.

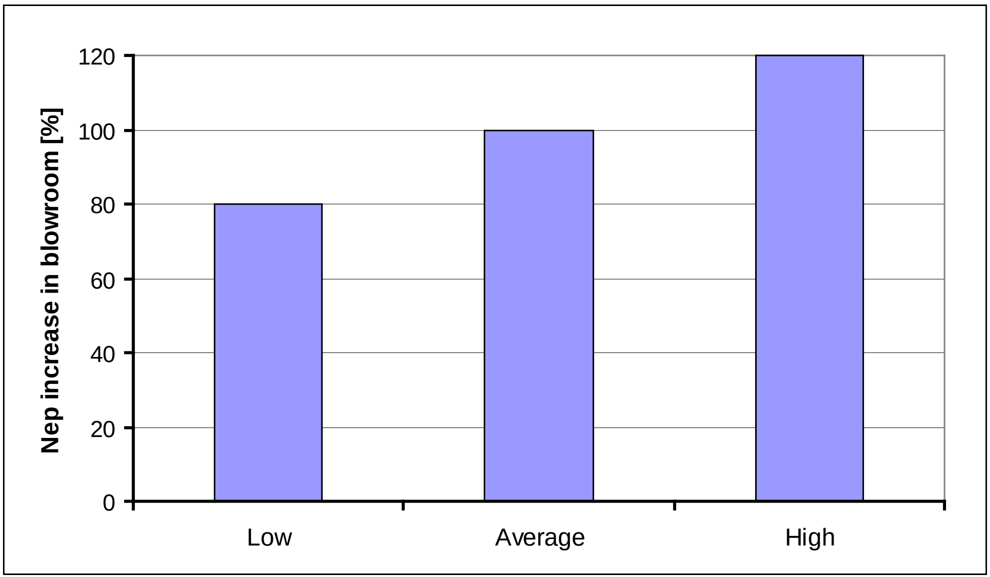


Fig. 6
Nep increase in blowroom

Nep removal efficiency is a good tool to use to analyze the carding process. The efficiency is calculated by taking the number of neps in the card mat and subtracting the number of neps in the card sliver. This amount is then divided by the number of neps in the mat and multiplied by 100, giving the % removal efficiency. 100% would be a perfect removal efficiency from card mat to card sliver or comber lap to comber sliver. The card (single cards) is designed to remove neps, trash and align the fibers. Mechanical design, speeds and throughput have an effect on the card removal efficiency.

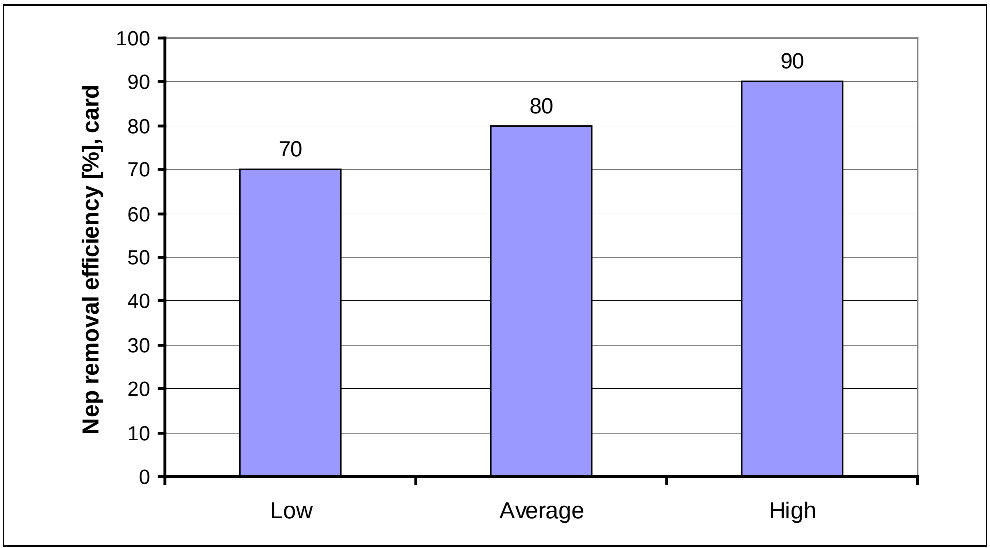


Fig. 7
Nep removal efficiency of the card

Opening and cleaning lines progressively increase the number on neps as they clean the cotton (Fig. 8). All cleaning equipment creates neps but the actual increase depends greatly on the aggressiveness of the machine's components. The results from the individual cleaning equipment should be graphed from beginning to end to evaluate the nep increase. The increase in neps should be in a relatively straight line. Any major change either higher or lower from the straight line trend means that the piece of cleaning equipment should be analyzed immediately.

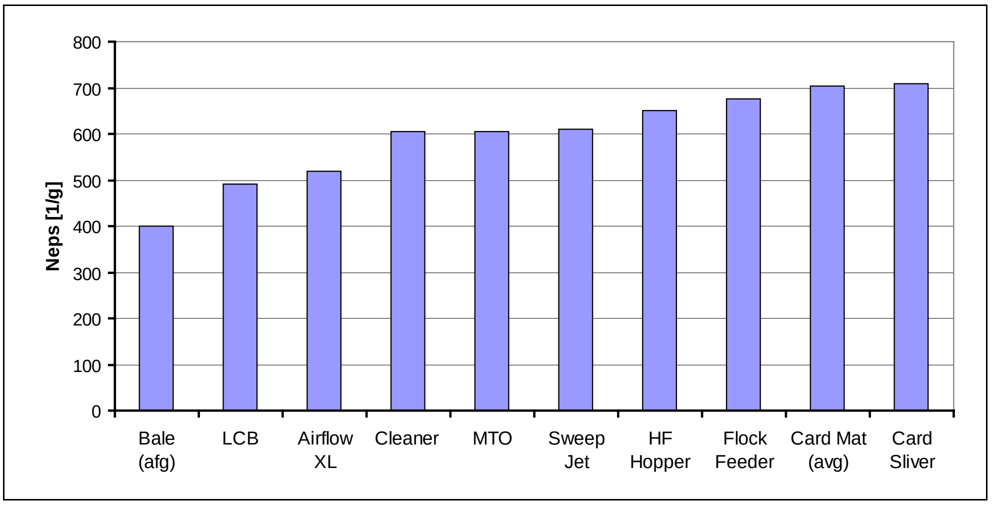


Fig. 8
Nep formation throughout the blowroom

Fig. 9 shows the nep formation from bale to the comber sliver.

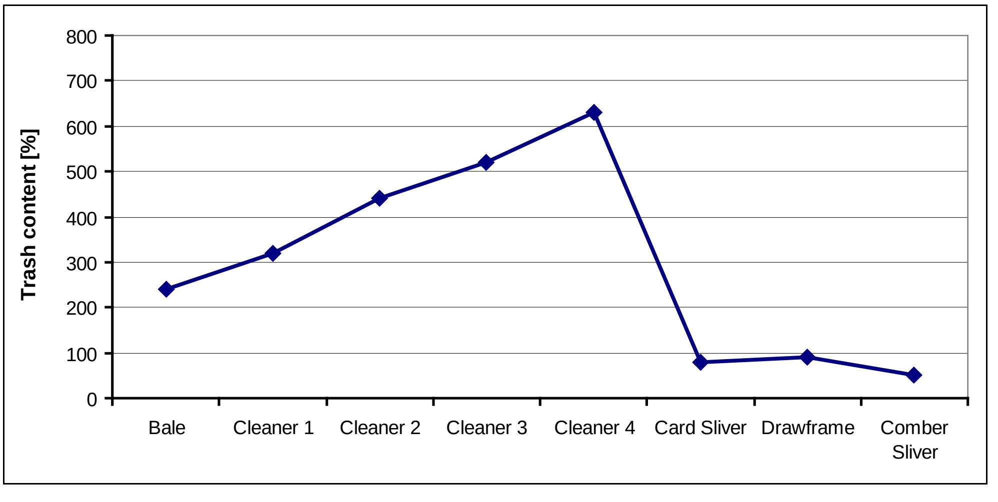


Fig. 9
Nep formation and reduction from bale to comber sliver

Cleaning equipment can also cause fiber damage if adjusted too aggressively. Nep and short fiber content can be analyzed at the same time to determine the extent of any fiber damage.

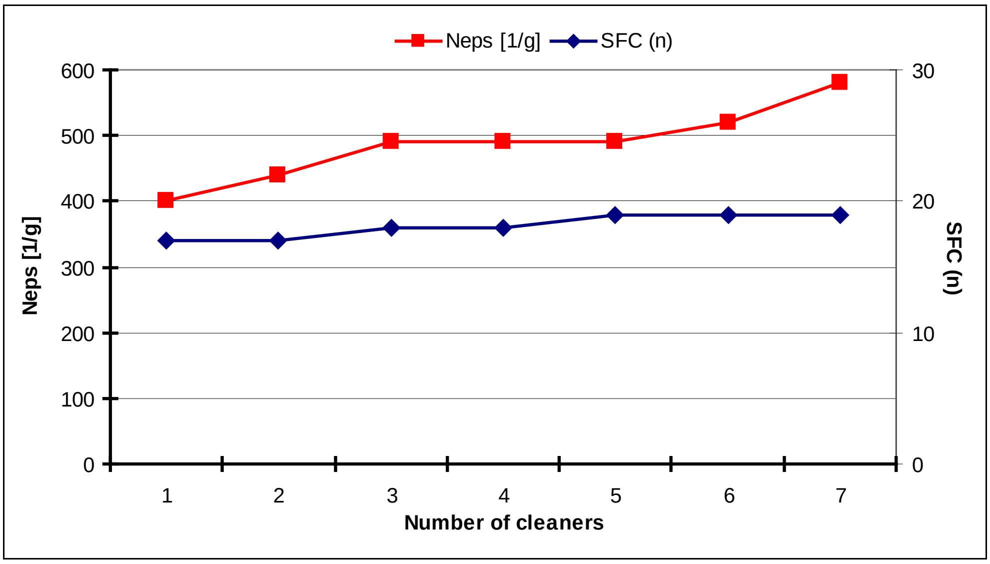


Fig. 10
Cleaning line analysis neps and short fiber content by number SFC(n)

There is a general correlation between neps in sliver and neps in yarn. This comparison can be shown using comber sliver with different noil removal levels that was spun into yarn (Fig. 11). Increasing the % noils removed results in a reduction of neps in the comber sliver as well as a similar reduction of neps in the yarn.

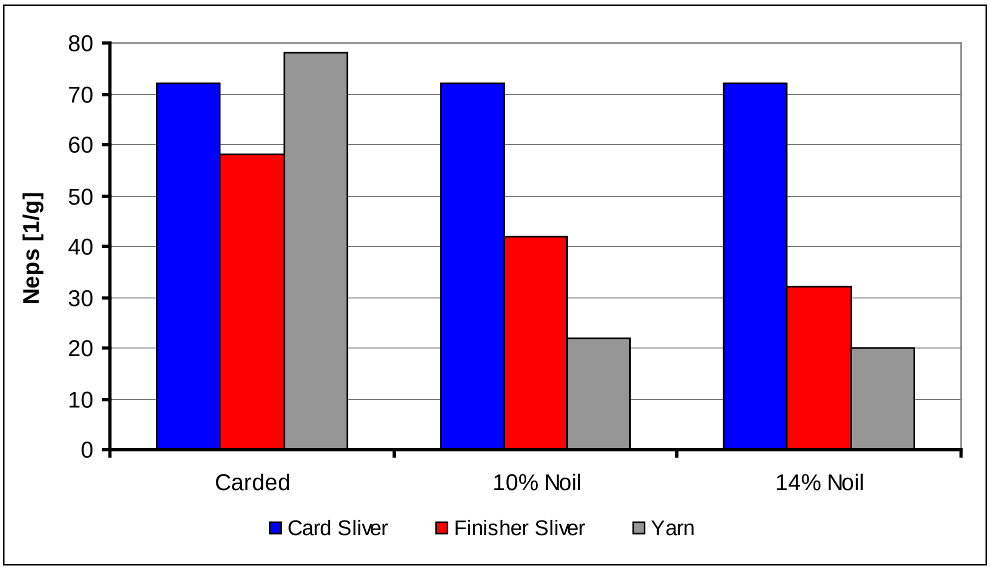


Fig. 11
Effect of combing on nep reduction

The schedule for grinding card wire is normally established by the amount of sliver produced or the length of time the wire has been in production. These traditional methods do not optimize sliver quality or reduce card wire expense. Quality levels can be established for nep levels in card sliver. These levels are based on the end product and spinning system. Once established, the sliver is tested regularly and wire is serviced only after the nep count exceeds the upper limit. Please note that grinding card wire cannot return it to its original condition.

Also the new nep levels after grinding will deteriorate faster with each additional grinding operation (Fig. 12).

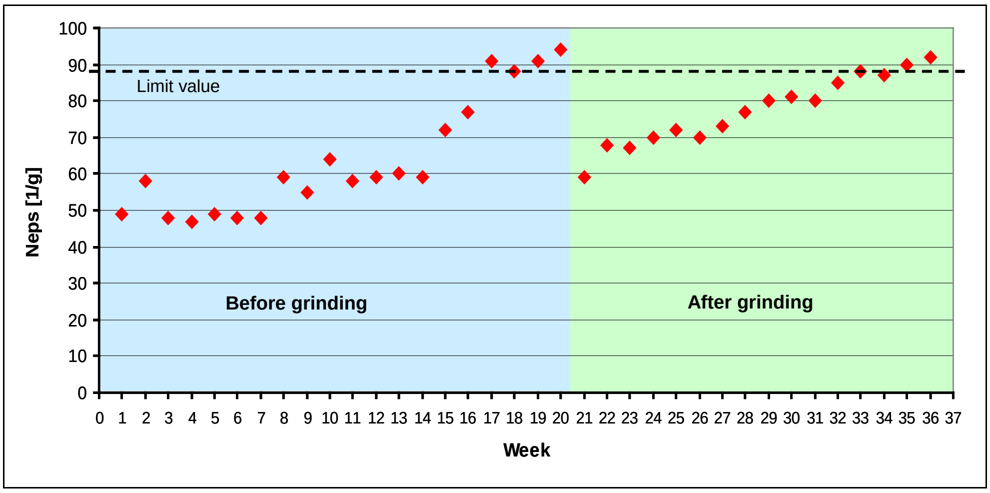


Fig. 12
Reduction of neps in card sliver after grinding

3 Neps and Trash

Nep and trash levels should both be monitored in the card sliver. The traditional thinking was that if a card had good nep removal then it must have good trash removal. Many experiments have proven this to be untrue. Cards monitored for nep count, trash amount, and efficiencies all show that neps and trash removal in the card are very independent.

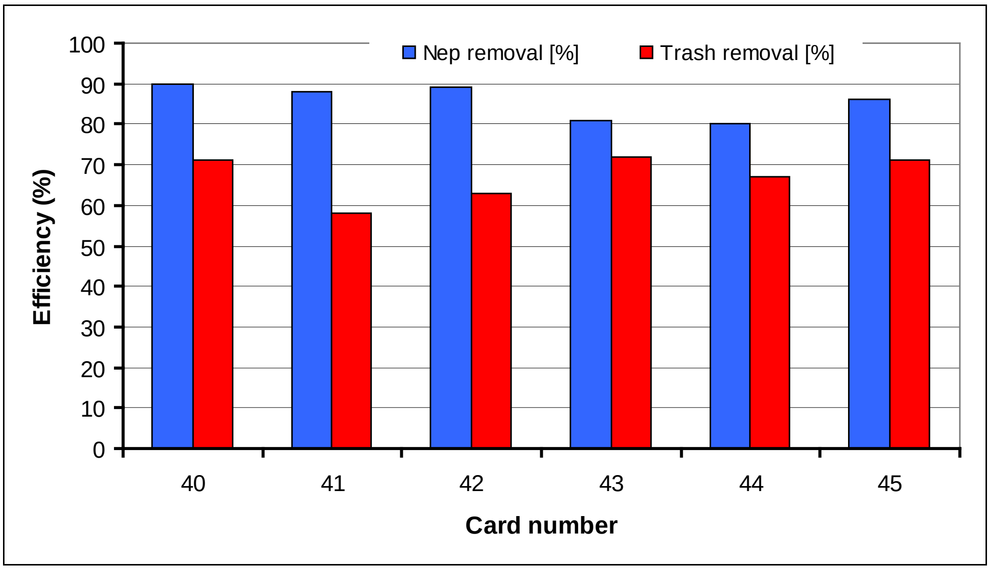


Fig. 13
Carding analysis

Fig. 13 shows the nep and trash removal efficiency of the six cards no. 40 to 45.

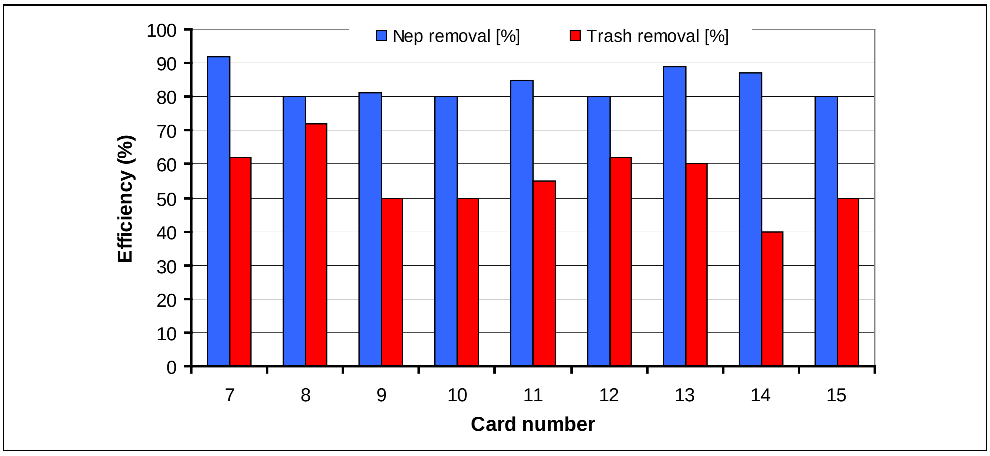


Fig. 14
Cleaning and nep efficiency

Fig. 14 is a second example of card removal efficiencies for neps and trash. Fig. 15 shows the efficiency of 10 cards including the short fibers in the card sliver.

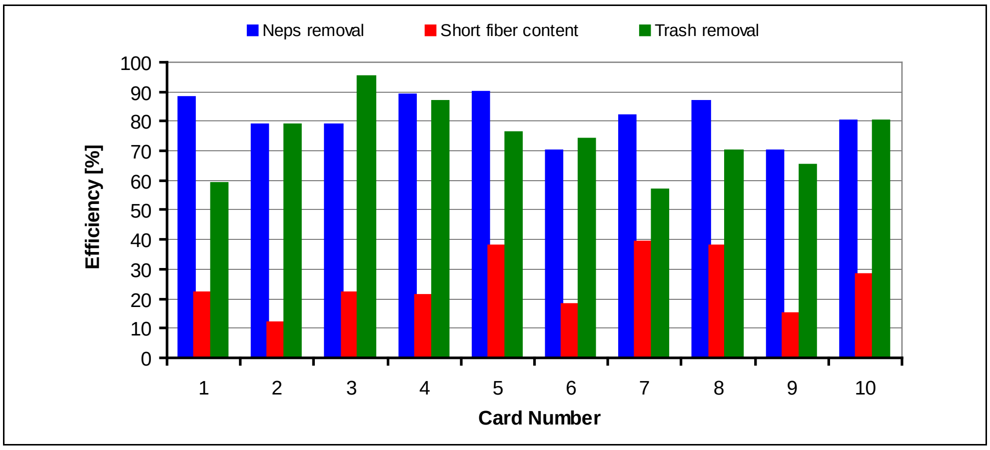
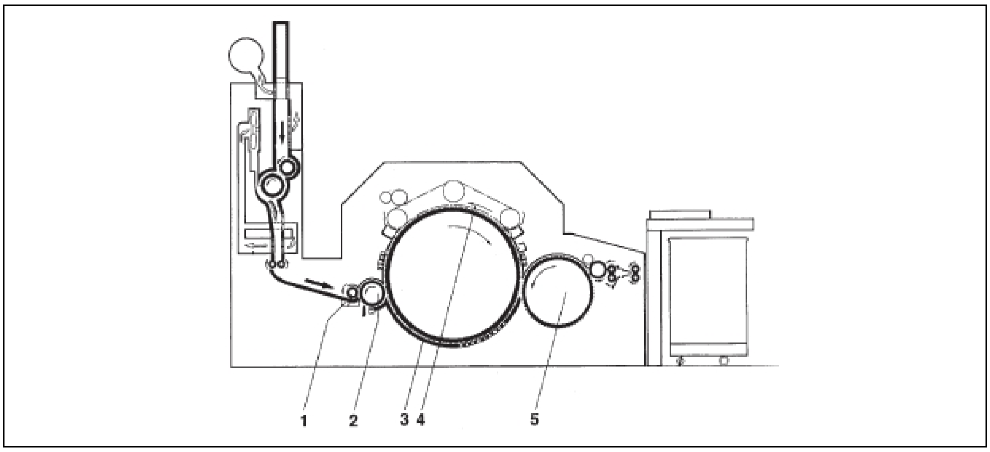


Fig. 15
Card efficiency for enps, short fibers and trash

The design of the card is such that different elements affect the removal of neps and trash differently. A schematic of the card illustrates this and clearly details these areas. Neps are greatly affected by the card flats and throughput speeds. Trash is greatly affected by the licker-in, feed plate, and cylinder wire. There is some interaction of these elements on both neps and trash but they are small (Fig. 16).



1 Feed plate: Trash
2 Licker-in: Trash
3 Cylinder Wire: Trash, Neps, Short fiber
4 Carding flats: Neps, Trash, Short fiber
5 Doffer

Fig. 16
Elements at card which can affect the nep formation and neps and trash removal

Optimizing the nep removal of cards is very important in the spinning mill. All cards should be tested by the AFIS for neps on a weekly basis. These results over a 4 to 6 week period will show a detailed analysis of the efficiency of each individual card. Once this analysis is complete it is very easy to determine which cards are causing the majority of the problems in the card line (Fig. 17 and Fig. 18).

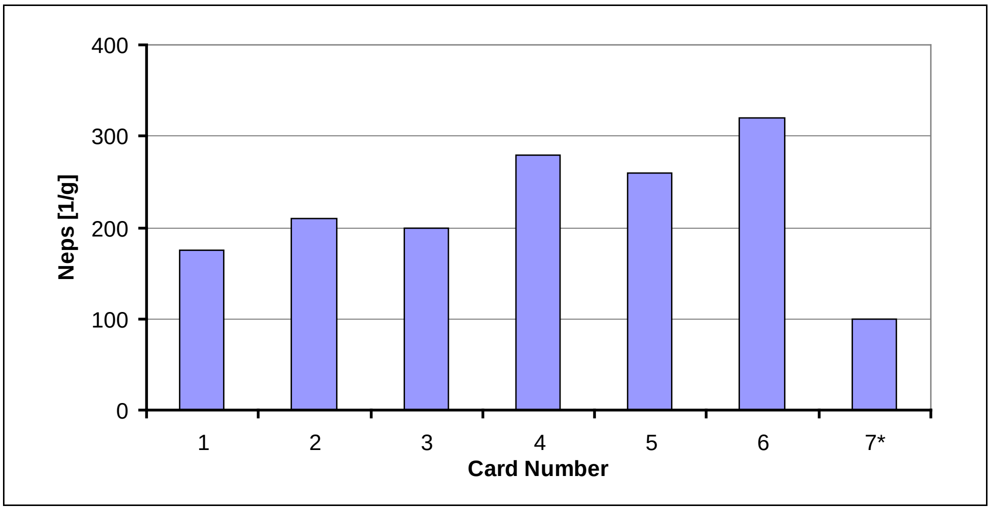


Fig. 17
Significant differences across card line

* New Card

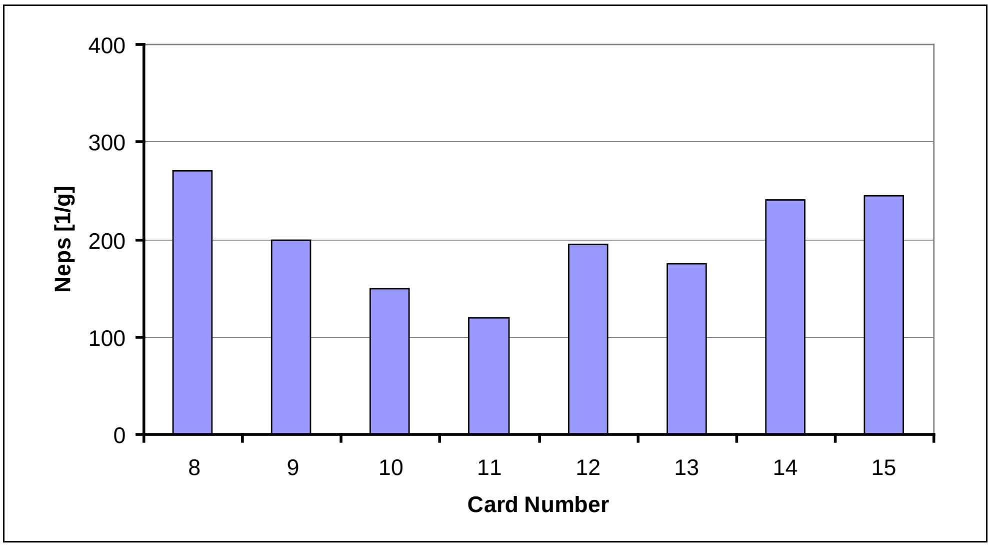


Fig. 18
Significant differences across card line

Analysis of the combing process can also be accomplished by using the AFIS Nep information. Comber sliver can be analyzed to determine which combers are not producing a consistent quality sliver. Maintenance and rebuilding schedules can be established using the AFIS Nep test results over several weeks (Fig. 19 and Fig. 20).

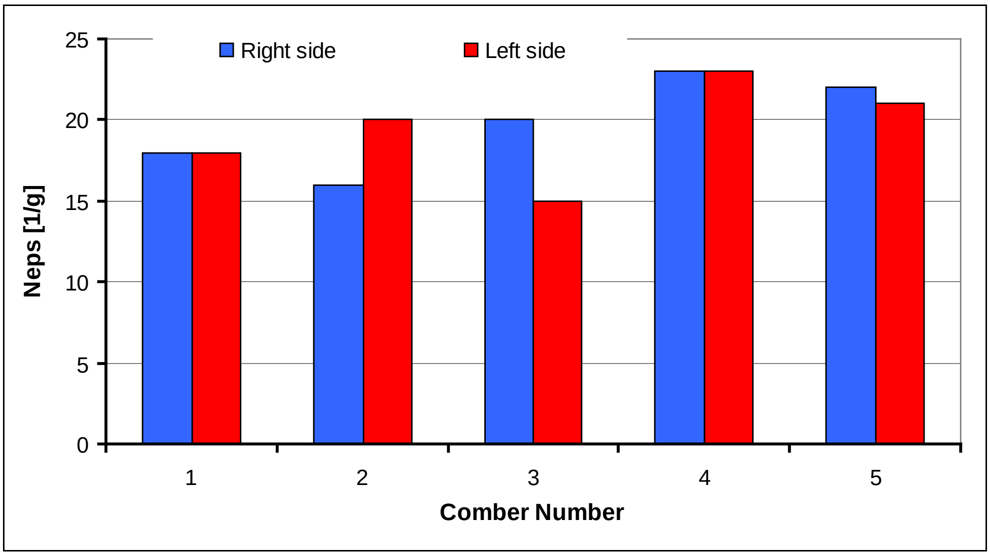


Fig. 19
USTER® AFIS comber analysis
Fiber properties, comber sliver

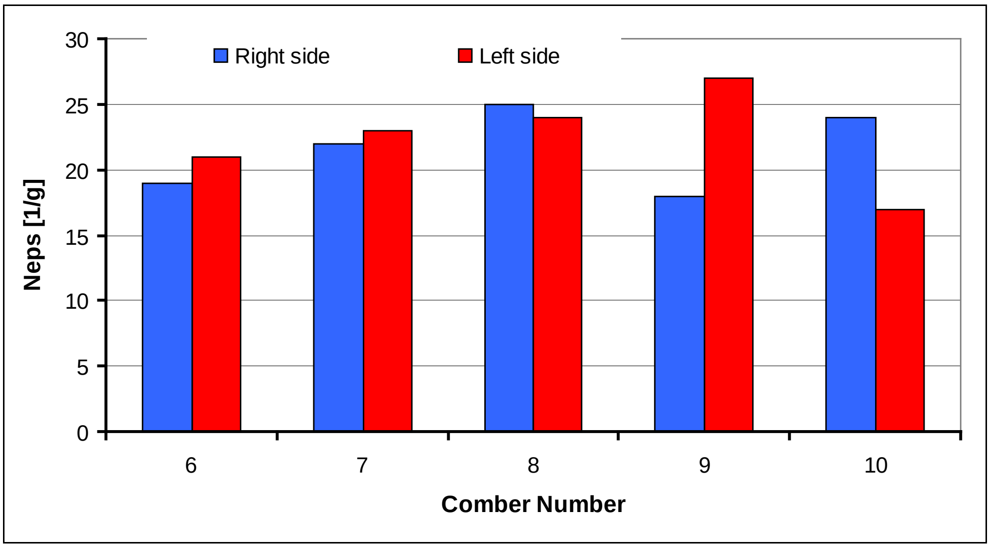


Fig. 20
USTER® AFIS comber analysis
Fiber properties, comber sliver

Fig. 20 shows that there are significant nep differences between the slivers on the right and left side of combers no. 9 and 10.

4 Length/Short Fiber Content

All equipment should be tested for fiber damage focusing on short fiber content. This is most critical in the carding and combing processes. Individual cards and combers should be tested on a weekly basis.

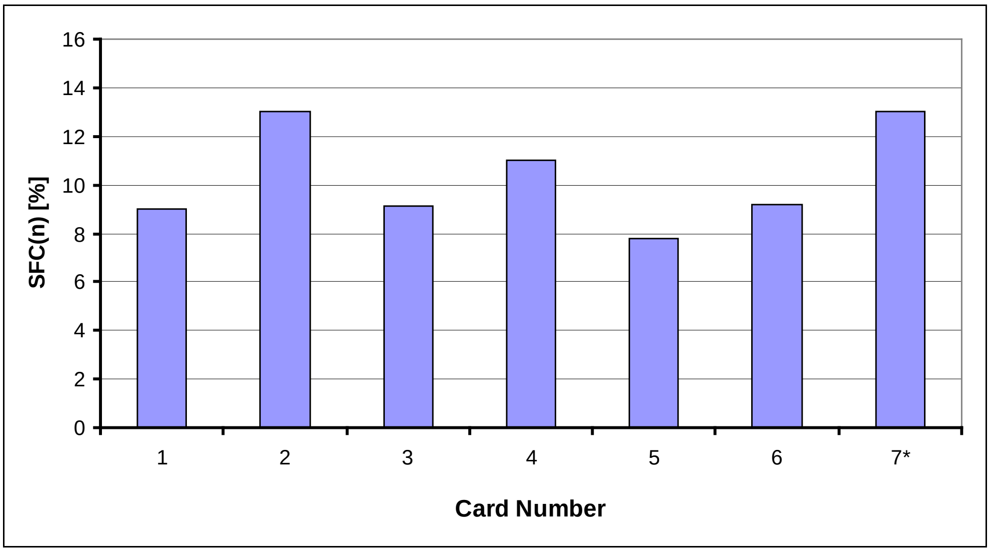


Fig. 21
Short fiber content by number SFC(n) in card sliver

* New Card

Fig. 21 and Fig. 22 shows Short Fiber Content by number in the card sliver of 15 cards. There are significant variations which also have consequences on the performance of the combers.

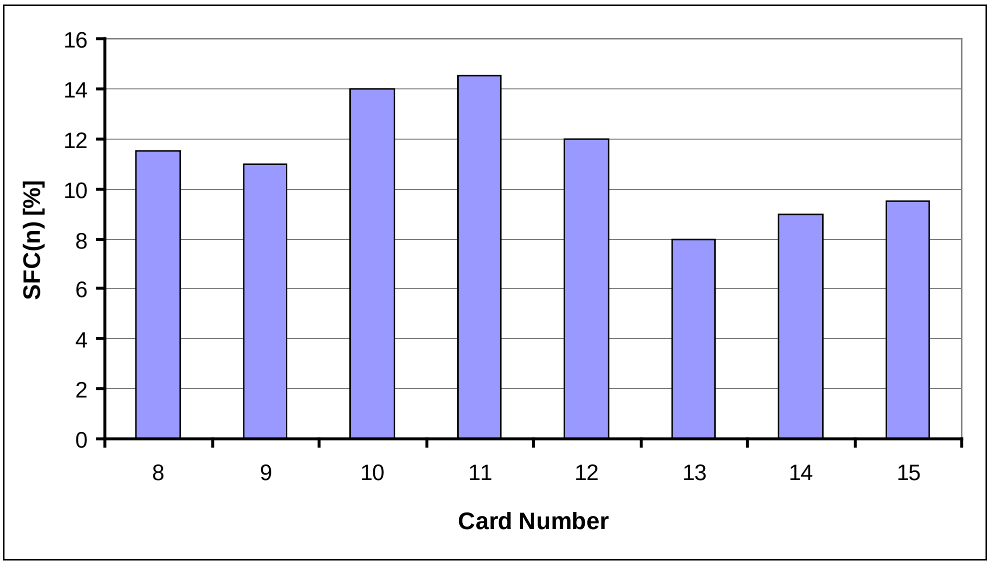


Fig. 22
Short fiber content by number SFC(n) in card sliver

Fig. 23 shows the Short Fiber Content by number in the card mat and in the card sliver which indicates that all cards produce additional short fibers.

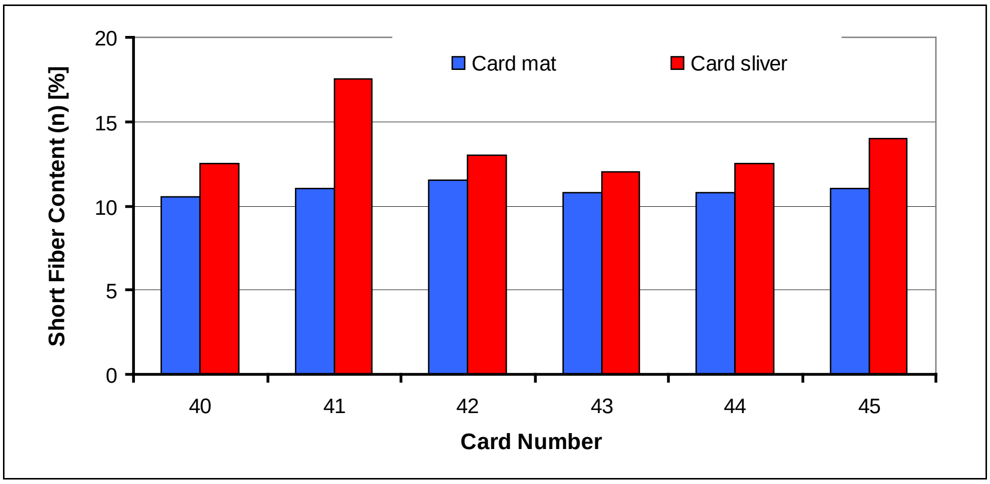


Fig. 23
Carding analysis
Short fiber content by number SFC(n)

In the combing process, once a comber with high or low short fiber content has been found, each individual delivery should be retested. Results from the individual comber deliveries will enable the mill to quickly correct the comber adjustment to maintain the sliver quality and waste removal percentage (Fig. 24 and Fig. 25).

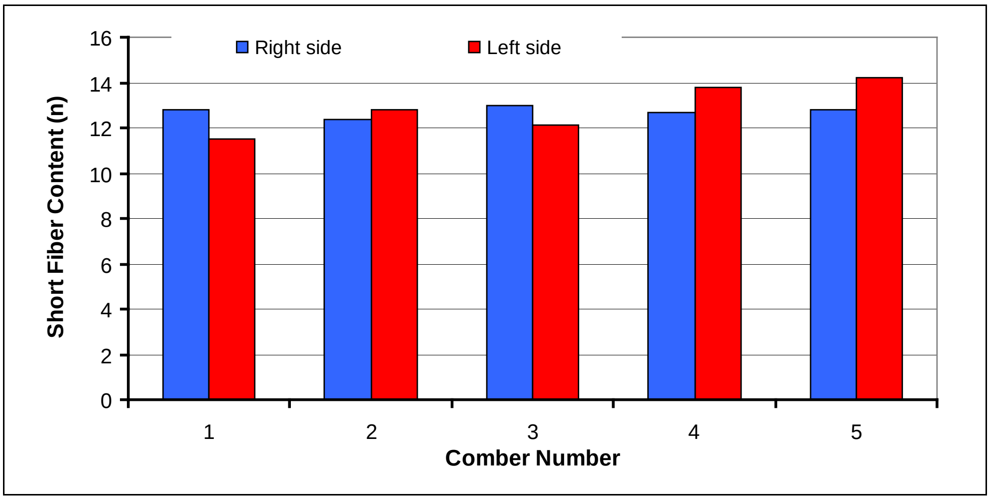


Fig. 24
USTER® AFIS comber analysis
Fiber properties, comber sliver
Short fiber content by number SFC(n)

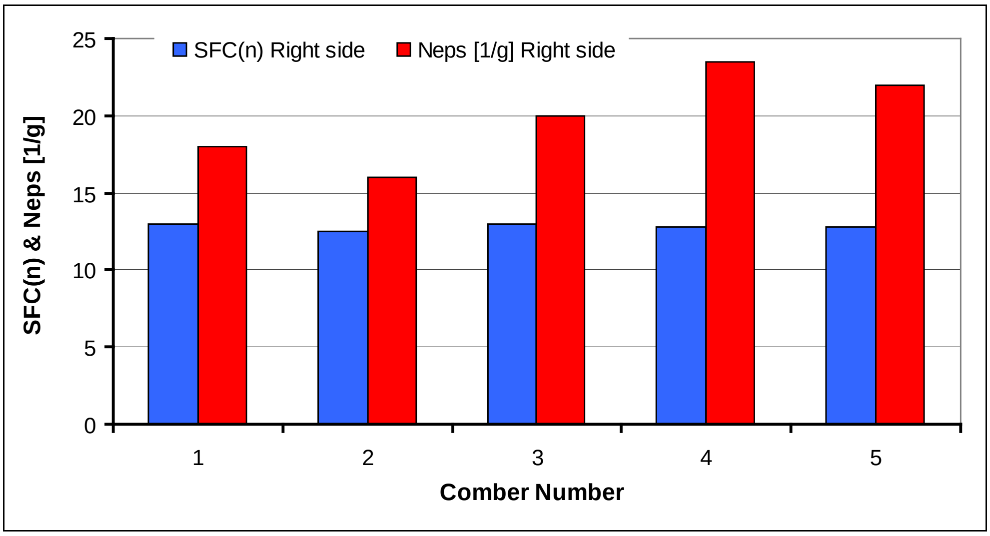


Fig. 25
USTER® AFIS comber analysis
Fiber properties comber sliver
Short fiber content by number SFC(n) and neps

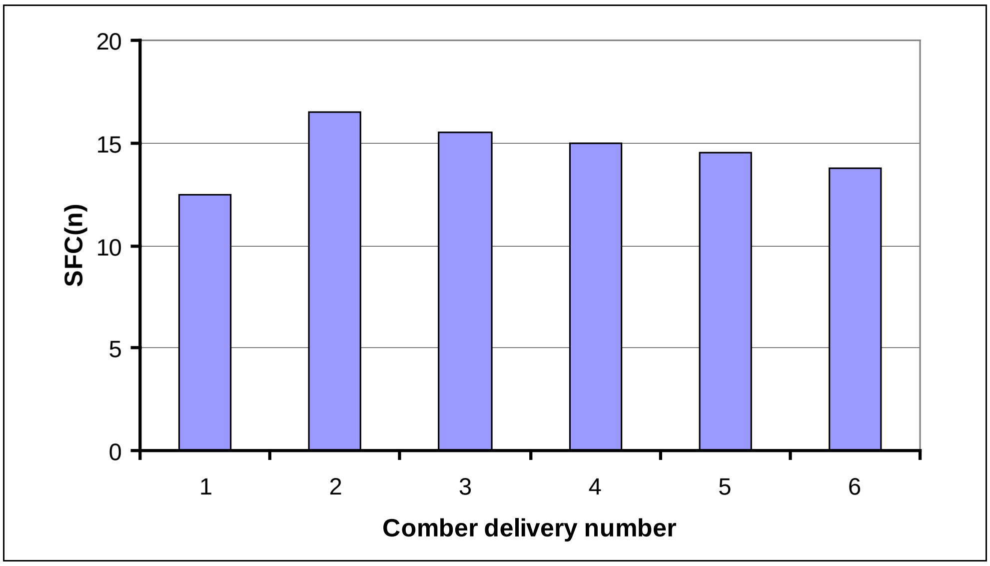


Fig. 26
USTER® AFIS comber 16 analysis
right side deliveries

Fig. 26 shows the 6 deliveries of a comber on the right hand side. Delivery 1 shows a significantly lower short fiber content.

5 Trash/Trash and Dust

Average trash values for raw material, card mat and sliver should be used to determine overall levels of cleaning efficiency. Please notice that the sliver values are very small numbers. Increases or decreases of 0.02% trash by weight are significant. This means a change in card sliver trash values from 0.15% to 0.17% will definitely cause problems in yarn quality and spinning efficiency.

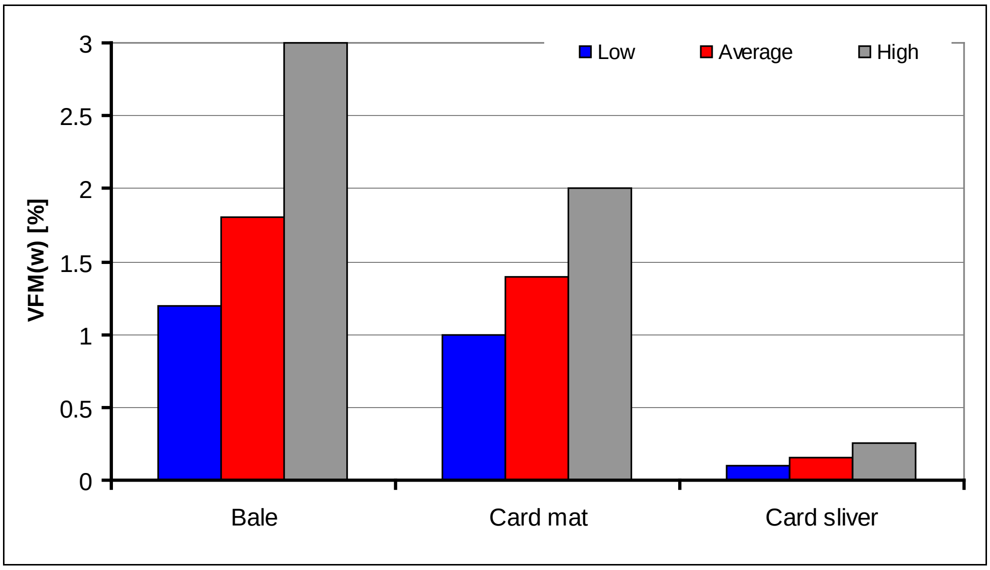


Fig. 27
Trash values in cotton

Monitoring the efficiency of cleaning and carding equipment is a good method of determining if the equipment is operating properly. The efficiency is calculated by the following formula:

$$\text{Trash removal efficiency } \varepsilon_T = \frac{\text{particles in - particles out}}{\text{particles in}} \times 100\%$$

This formula can be used for any piece of equipment. Cleaning efficiencies for opening and cleaning lines range from 20% to 40%. Some of the newer, more aggressive cleaning lines may have cleaning efficiencies approaching 50%. The cotton card is a very effective cleaner and the normal cleaning efficiency for a card room should be 70% to 75%. Tandem carding equipment may have significant increases in cleaning efficiency approaching 85% - 90% (Fig. 28).

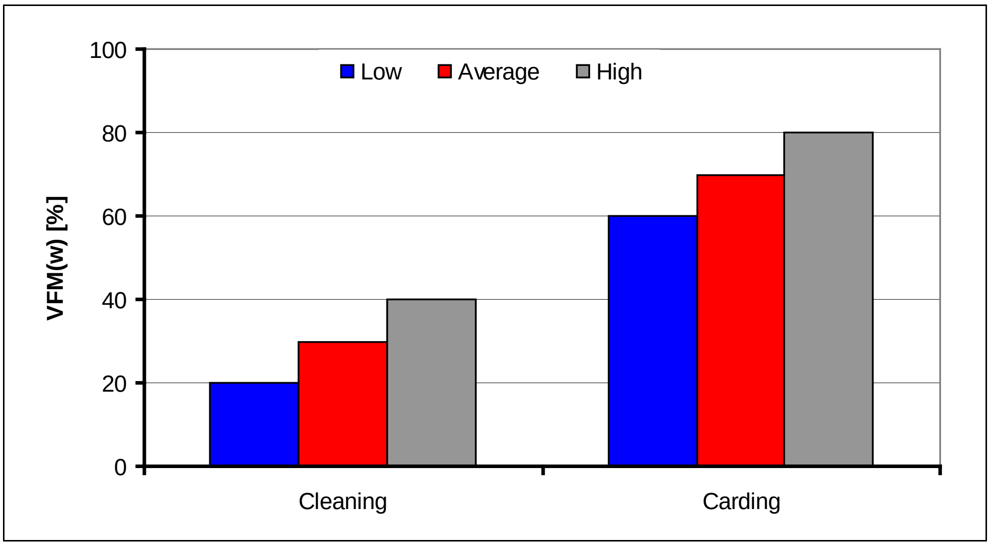


Fig. 28
Typical cleaning efficiencies, 100% cotton

Trash content from bale to sliver should decrease through the opening/ cleaning line and carding. This decrease should be steady when plotted on a graph from bale to card sliver (Fig. 29).

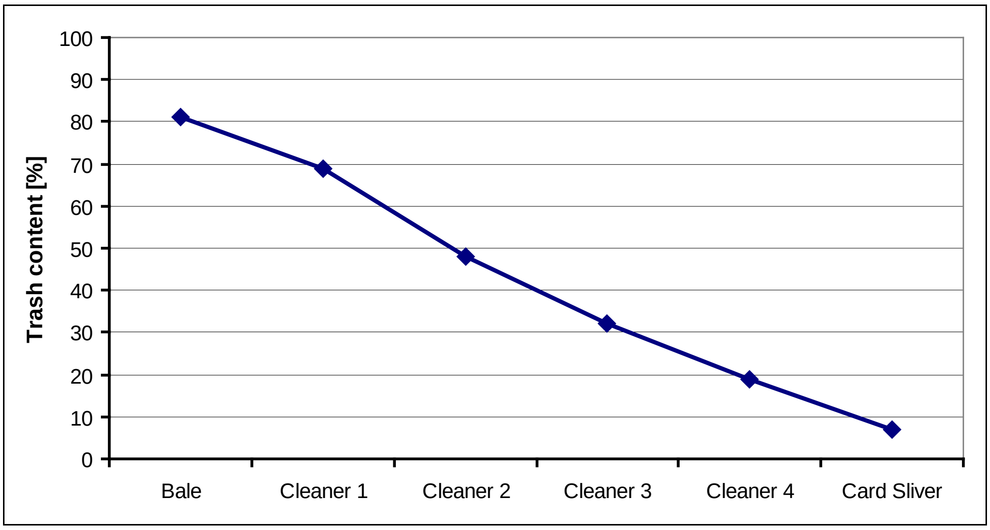


Fig. 29
Reduction of trash in the blowroom

Cleaning efficiency should increase from bale to sliver and the total efficiency should be above 90%.

When analyzing a line of cards there is a large variation in trash amounts from card to card. Not all cards wear the same even if they are rebuilt and rewired at the same time. This type of analysis helps to show which cards are the problem cards and which cards are working acceptably (Fig. 30).

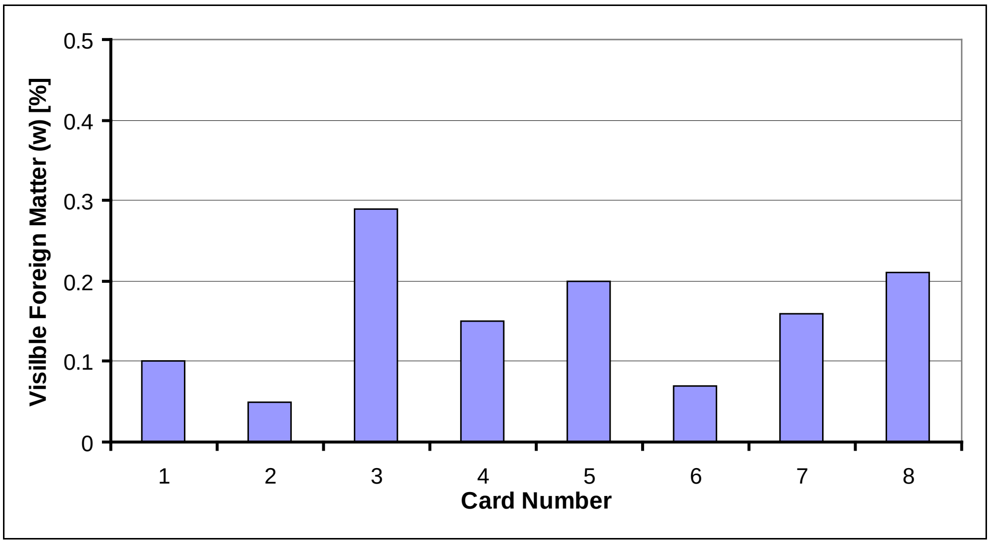


Fig. 30
Trash variation in card sliver Tandem carding, 100% cotton

Fig. 31 and Fig. 32 demonstrate the Visible Foreign Matter of 14 normal cards. The variations are also significant.

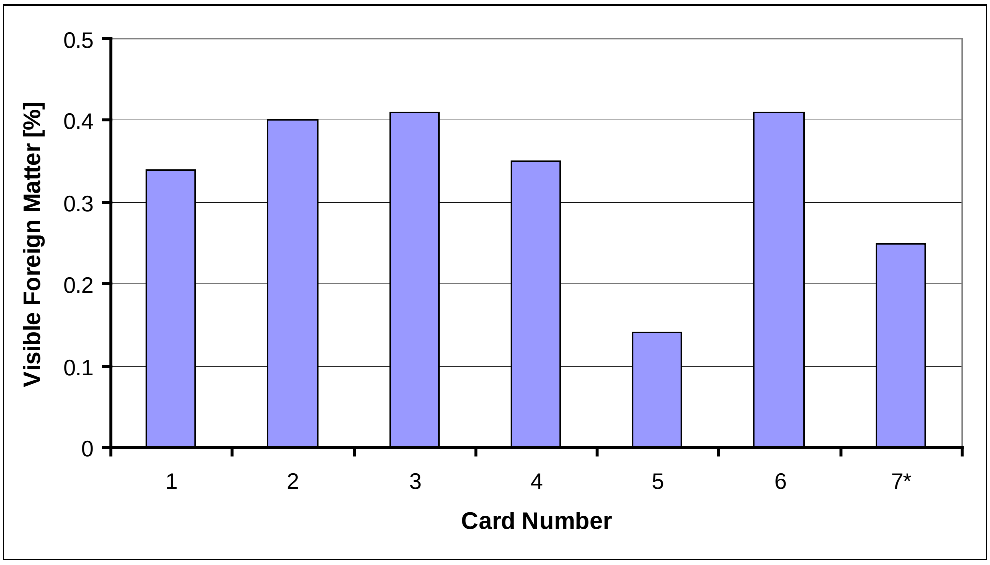


Fig. 31
Trash variation in card sliver

* New Card

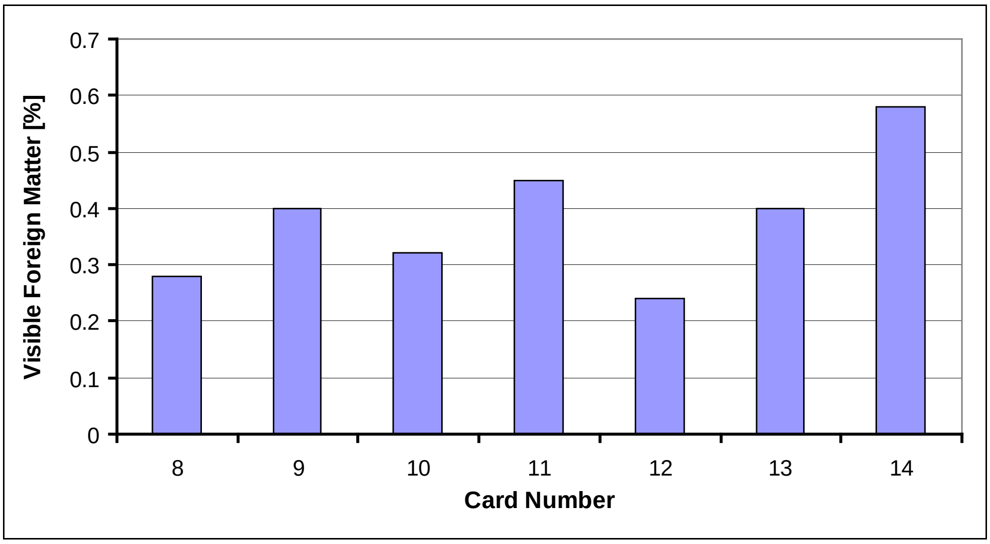


Fig. 32
Trash variation in card sliver

6 USTER® *AFIS* Application studies

6.1 Card room neps

AFIS Nep analysis of a card room was done in a spinning mill producing medium count sales yarn. After a six week test period two cards were chosen for the trial. These cards were fed from the same laydown and opening and cleaning line. One card had a low nep count and the other card had a high nep count. Sliver from these two cards was isolated and taken to drawing, roving, and ring spinning. Ne 20 ring spun yarn was produced by both high and low nep count slivers (Fig. 33).

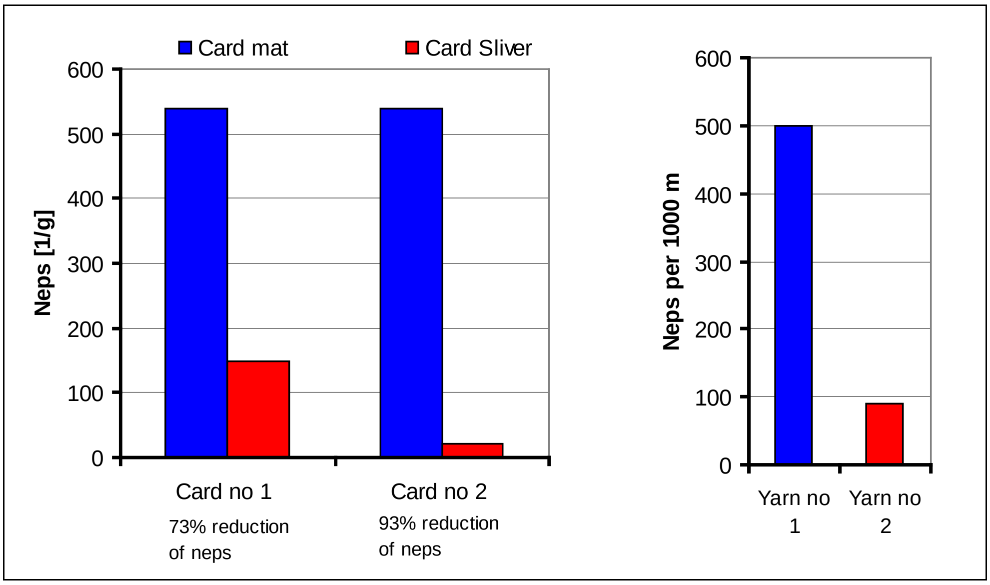


Fig. 33
Significant nep removal efficiencies and effect on yarn neps

The nep count in the yarn was drastically higher in the high nep sliver as compared to the low nep sliver. Additional test results from the Uster Evenness Tester shows that all imperfection levels are statistically higher in the high nep sliver yarn. This is not the effect of additional neps since neps only contribute little to yarn evenness or thick places and thin places. It is the result of a bad spinning process.

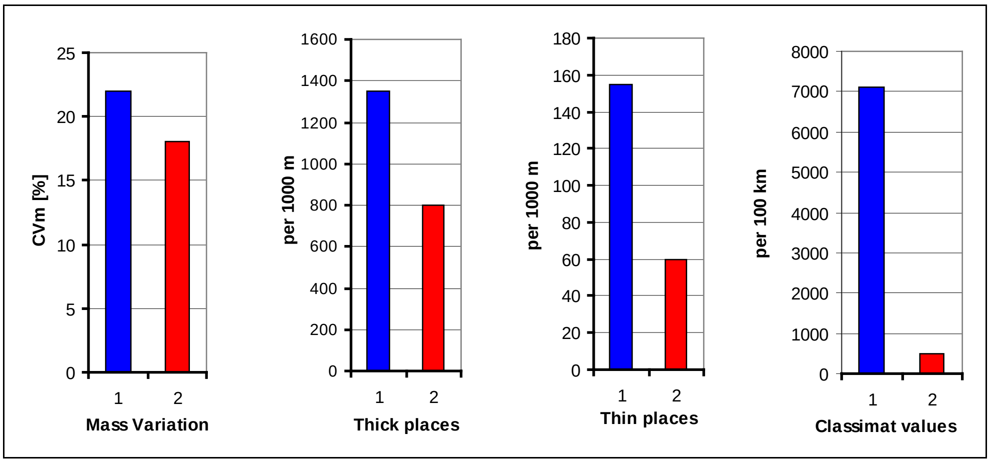


Fig. 34
Effect of card efficiency on yarn unevenness, thick places, thin places and Classimat values A1 to D1, cumulative

This yarn was taken and knitted into a single jersey knit fabric. The fabric was dyed with a dark color to highlight as many of the imperfections as possible. The fabric knitted from the low nep sliver and yarn was very high quality with few if any visible imperfections. Also no undyed white specks were visible in the low nep fabric. The fabric produced by the high nep sliver and yarn was of very low quality. Visible imperfections were consistent throughout all of the fabric. In addition many white specks or undyed neps were visible in this high nep fabric.

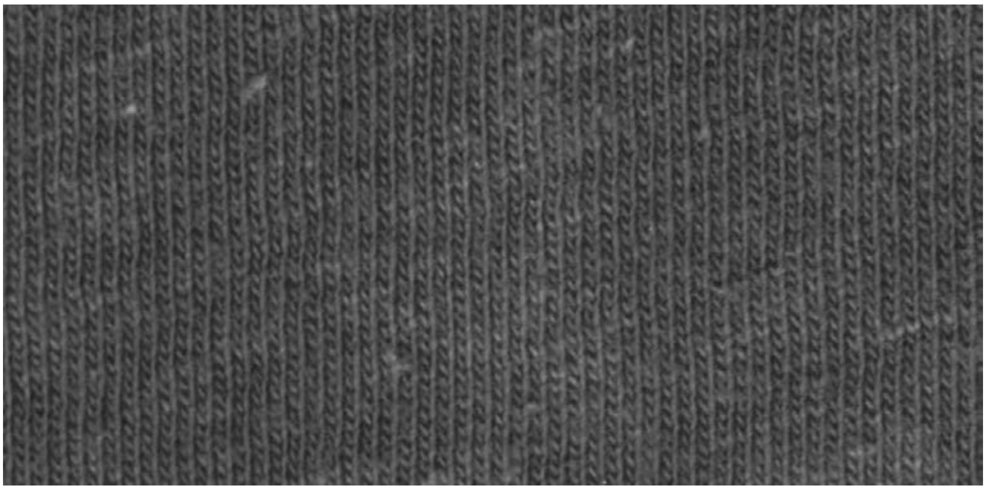


Fig. 35
High nep card

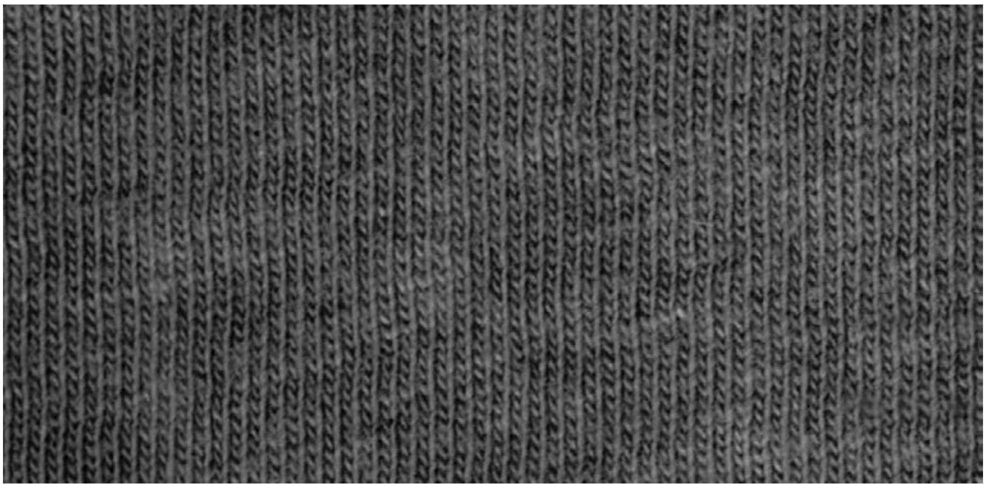


Fig. 36
Low nep card

6.2 Card wire maintenance

Card wire analysis can also be accomplished using the AFIS instrument. Two cards are rewired using different wire types. The cards are tested regularly over a period of 35 days. Analysis is done on nep removal efficiency and the short fiber content of the card sliver. The comparison of the results shows clearly that after one month the card nep removal efficiency of Fig. 37dropped and stabilized at around 80%. The card wire maintained a higher nep removal efficiency (Fig. 38) at the end of one month that was approximately 10% higher. Short fiber content was higher on the card with the high nep removal but after one month it stabilized at about 14% as compared to 13.3% on the card with the lower nep removal (Fig. 37).

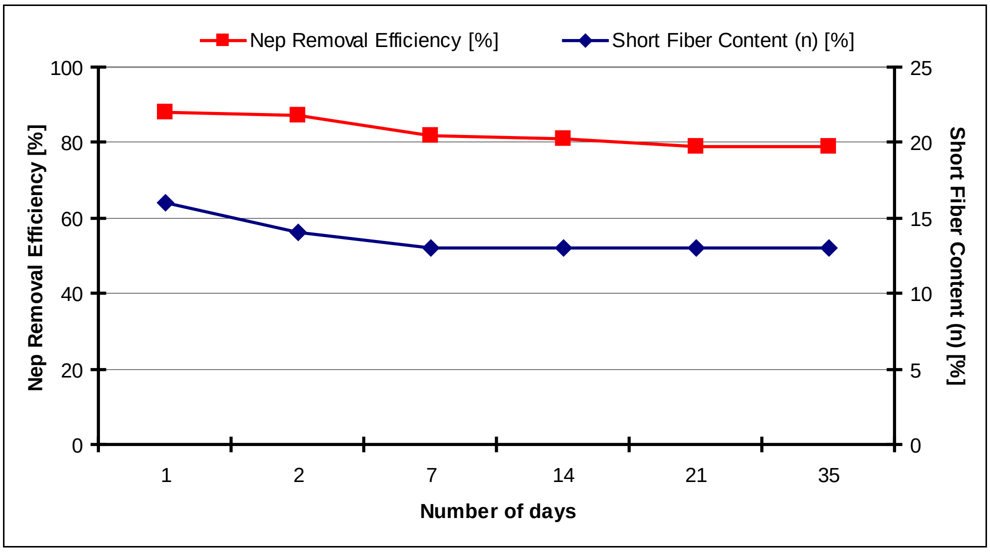


Fig. 37
Card wire analysis: Current wire design

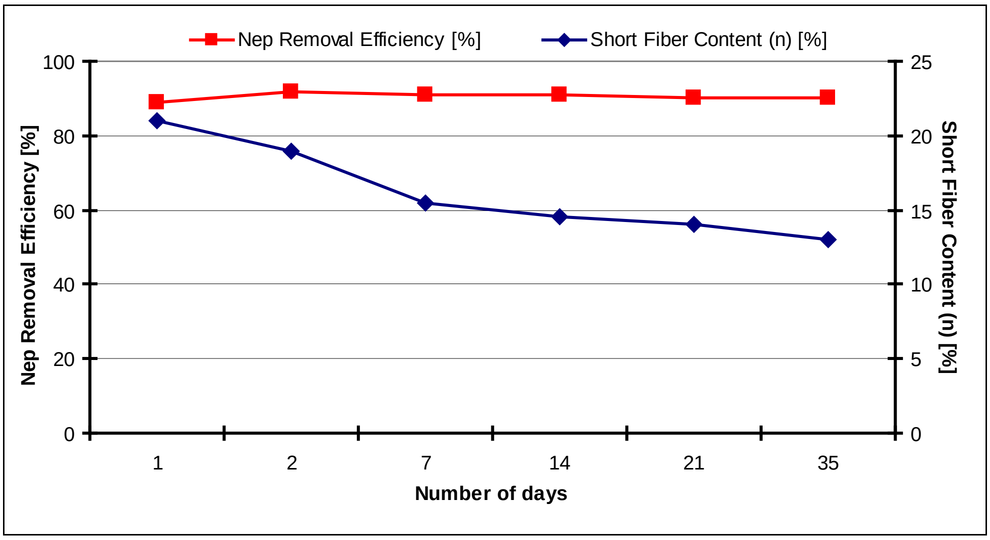


Fig. 38
Card wire analysis: New wire design

Traditional methods of rebuilding and grinding cards can be replaced by using the information from the AFIS Nep instrument. Simple control charts can be used plotting nep levels over time. These charts can establish and predict when a card should be rebuilt and wire ground or replaced. Control charts should be established for each individual card. Upper limits should be established depending on end product and spinning system.

Fig. 39 shows the nep level of a card sliver after grinding.
Test duration: 22 weeks

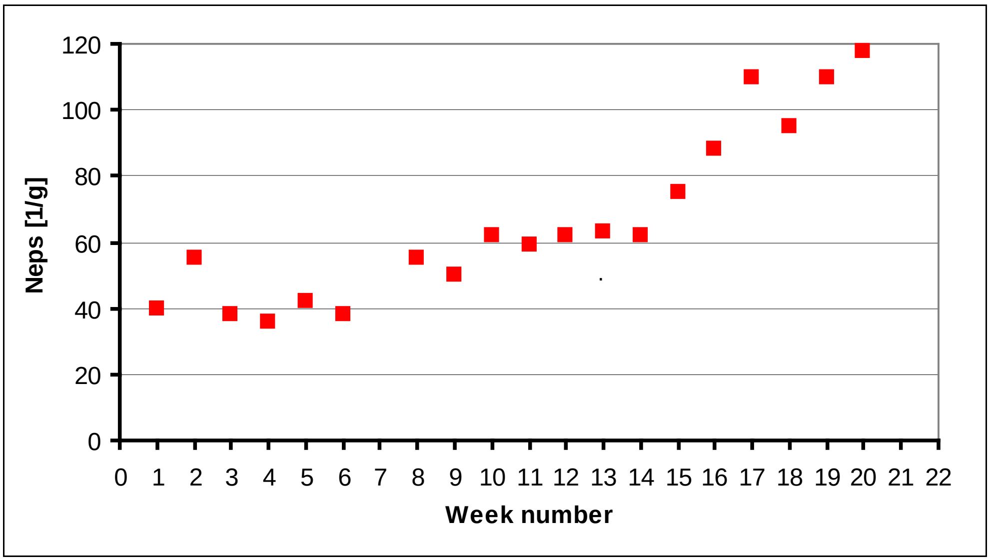


Fig. 39
Increase of neps in card sliver after grinding, 22 weeks in operation

6.3 Length application

The control and reduction of short fiber content has a direct impact on thick places in yarn. Reducing the number of thick places can be done by reducing the amount of short fiber in the spinning process. This can clearly be shown by comparing comber sliver with different levels of noil removal and the yarn produced by this material. There is a direct correlation between the amount of short fibers and the number of thick places in the yarn. This is generally caused by the short fibers in the drawing process. Drawframe draft and roller settings are based on the length of the longest fibers being processed. The short fibers of less than 0.5 inches are not controlled consistently in the draft zones. The short fibers tend to float in between the drafting rollers and then pass through in small bundles or groups of fiber. These small bundles or groups are the major cause of thick places when the sliver is again drafted in the actual spinning process.

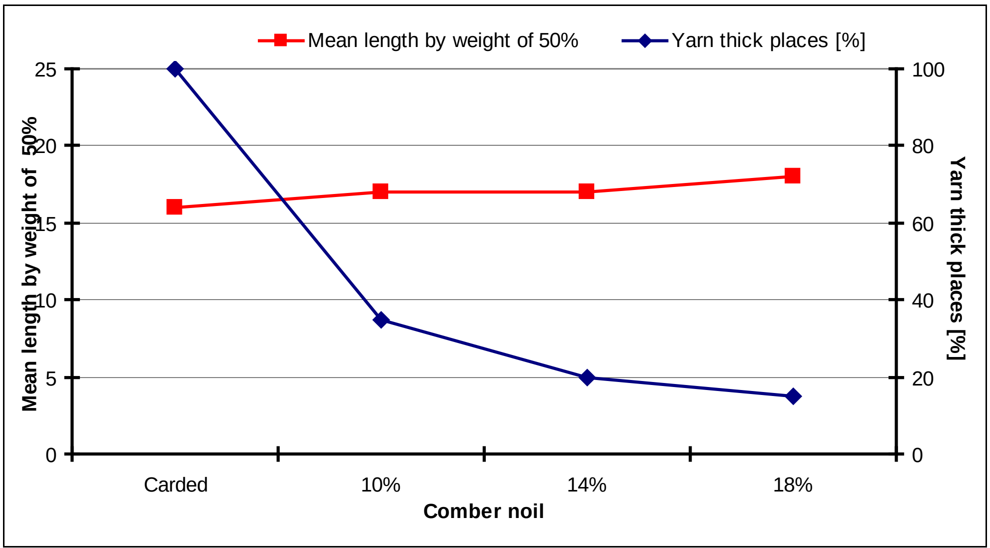


Fig. 40
Increase of mean fiber length and decrease of yarn thick places by increasing the comber noil

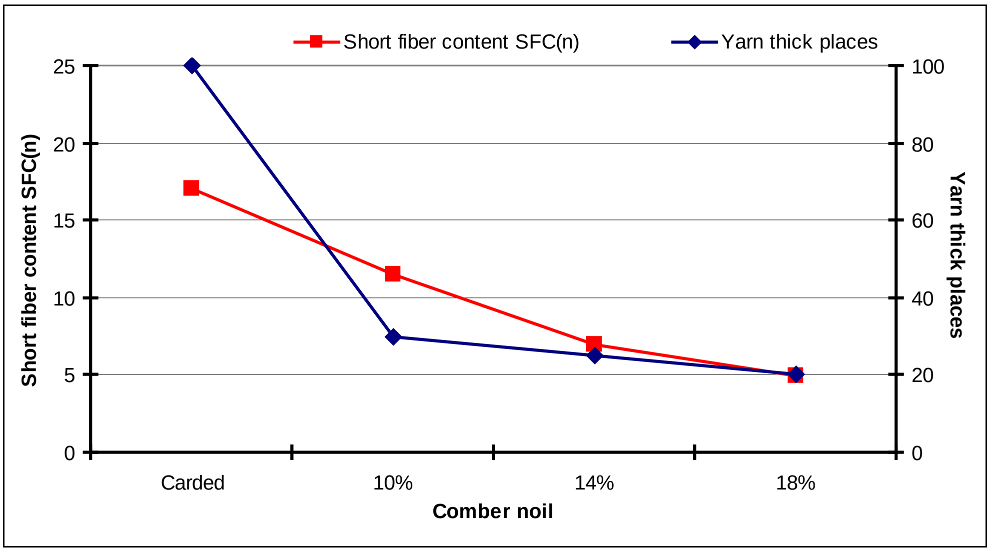


Fig. 41
Short fiber content by number SFC(n) versus comber noil and yarn thick places

6.4 Trash application

Many times a better grade of cotton is purchased to compensate for poor cleaning and carding equipment. A trial was done to compare a low and high efficiency card. Two laydowns were picked using HVI trash and grade information. The high and low trash mixes were processed through the cards. The results show that a card with a high cleaning efficiency produces sliver with a lower trash level even with a high trash content in the mat. The poor efficiency card with lower trash levels in the mat produces a lower quality sliver with increased trash amounts (Fig. 42).

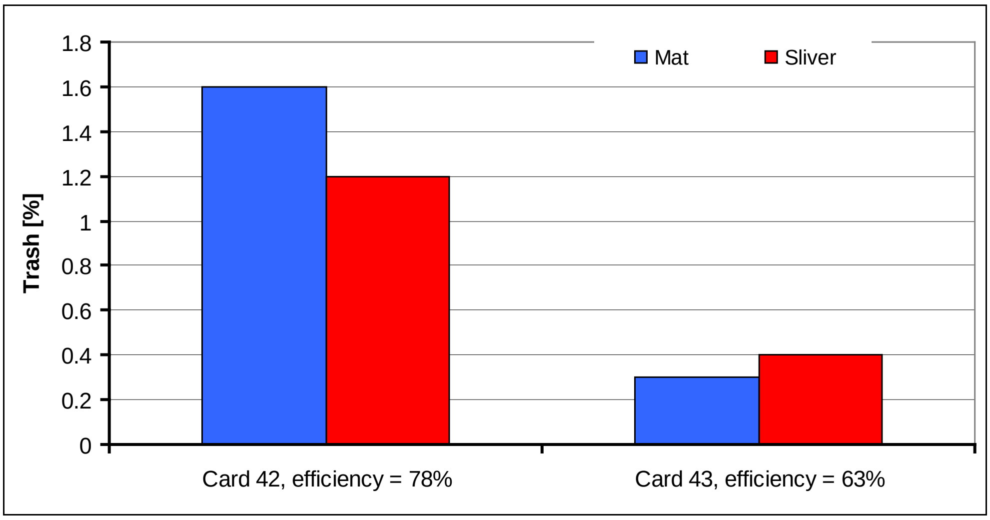
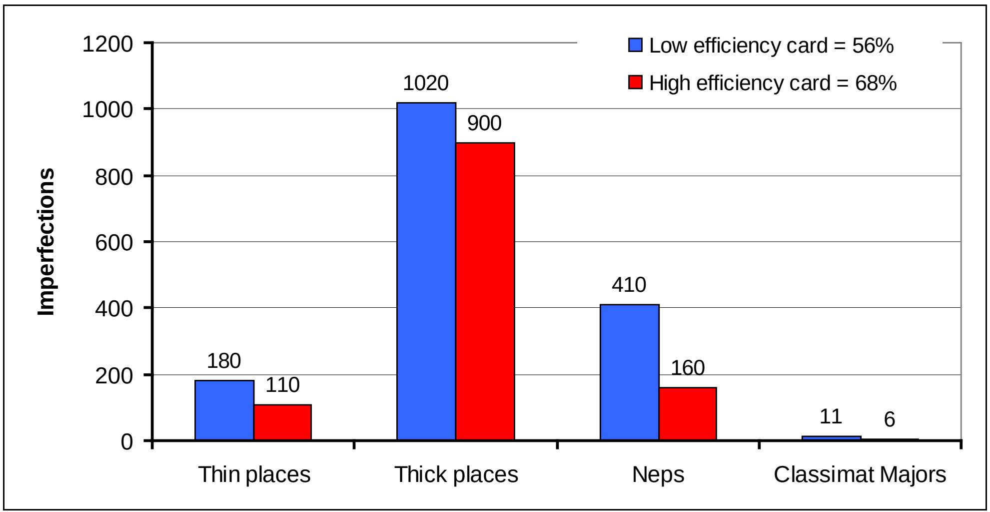


Fig. 42
Trash reduction, high and low efficiency cards

Yarn spun on ring spinning equipment from sliver processed on low and high efficiency cards produce very different quality levels. Cards with low efficiency produce yarn that has high Uster imperfections for thin places, thick places, and neps.

This yarn also has a higher number of Classimat faults than yarn produced on a high efficiency card (Fig. 43).



Classimat Majors: A3+B3+C2+D2, cumulative

Fig. 43
Trash removal efficiency of card versus yarn imperfections

Cleaning lines in spinning mills should be compared to make sure that each piece of equipment is operating efficiently. It is possible that two cleaning lines coming from the same laydown have very different cleaning efficiency. Certain pieces of equipment may not be adjusted correctly so that the cleaning can often be optimized (Fig. 44).

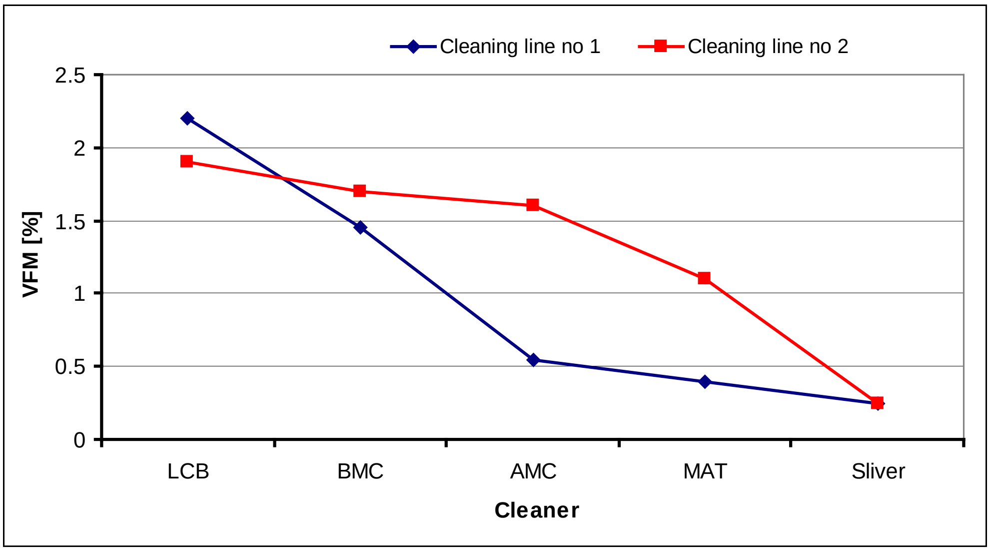


Fig. 44
Cleaning equipment analysis
VFM% comparison line 1 & 2

The trash content in sliver coming from the card room has a significant impact on the spinning efficiency and yarn quality. There is also an affect on the weaving efficiency of looms when the trash content of sliver becomes too high. A trial was done in a vertical spinning operation to determine the impact on reducing the trash content in card sliver on spinning and weaving. Trash levels in card sliver were found to be at a very high level and a aggressive maintenance and rebuilding schedule was then put into practice.

Over a six month time period the trash levels in card sliver were reduced from 0,48% to 0,13%. During this same period of time the spinning and weaving efficiencies were monitored (Fig. 45).

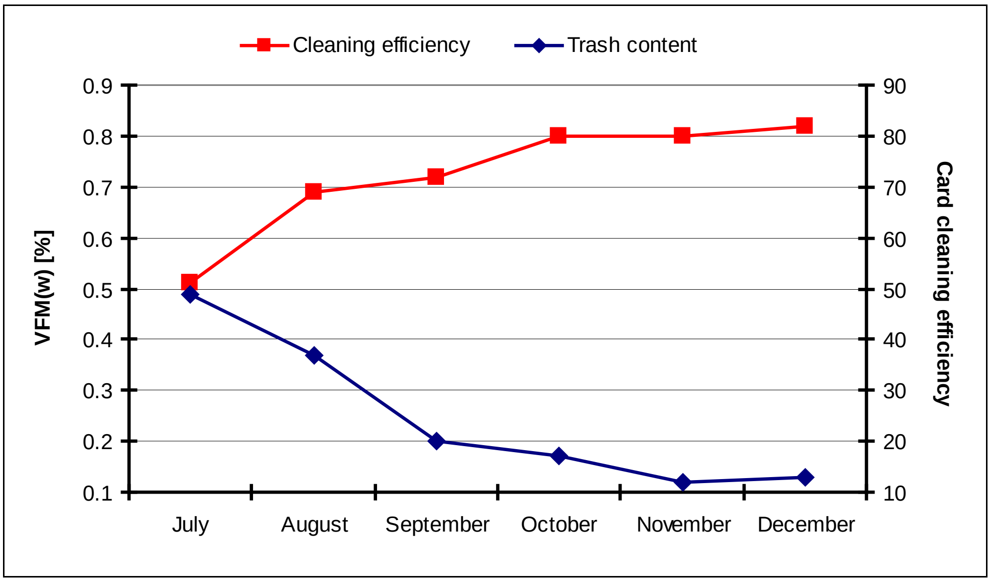


Fig. 45
Trash cleaning efficiency of the card versus sliver trash content

The ends down in spinning improved dramatically from a high at the beginning of the trial of over 50 per 1000 spindle hours to an acceptable level of 18 ends down after six months (Fig. 46). Weaving efficiency was monitored during the same period of time. Weaving efficiency improved greatly due to less breaks in warp and filling yarns. This improvement in yarn quality resulted in an increase of weaving efficiency from 88% to 93% (Fig. 47).

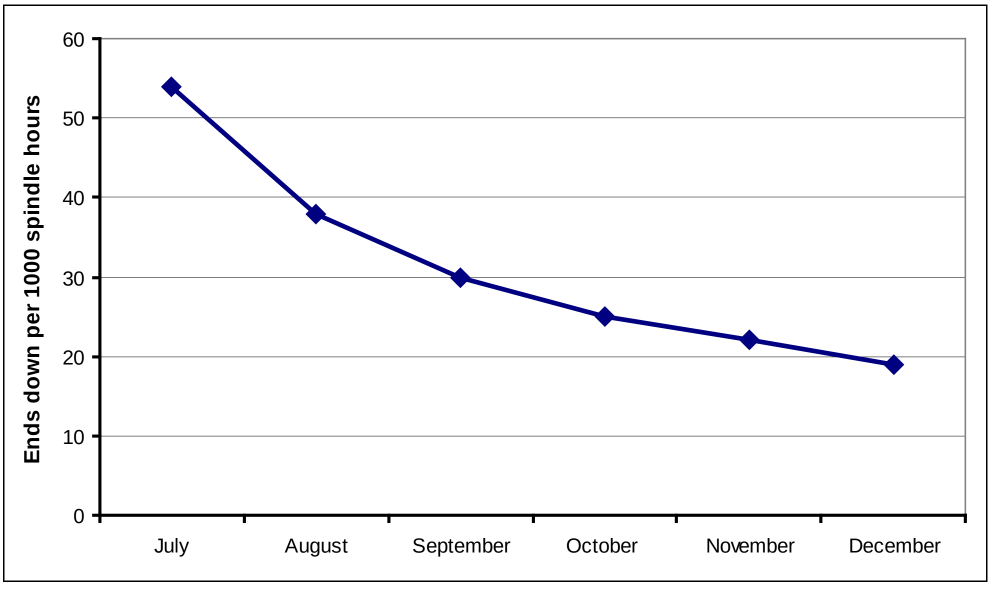


Fig. 46
Reduction of ends down per 1000 spindle hours

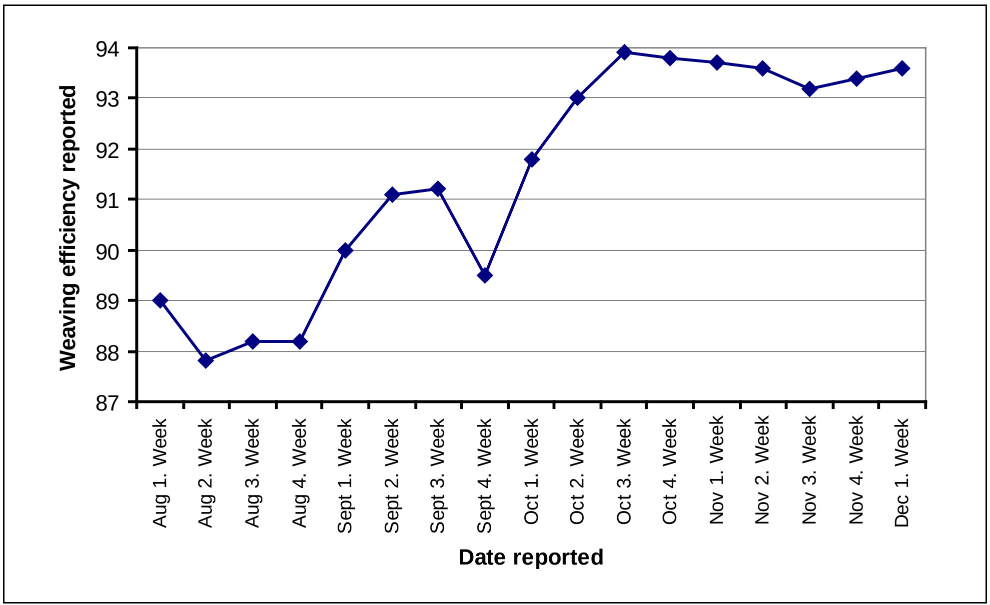


Fig. 47
Improvement of the weaving efficiency, 4 months

Increased rotor speeds and improved yarn quality can be achieved with a reduction of trash levels in card sliver. A mill trial was done to reduce the trash in sliver and monitor the improvement in spinning efficiency. Four different lots were tested using sliver produced from cleaning and carding at reduced speeds and throughput.

Mill trial descriptions

New rotor spinning, older opening and carding

60,000 rpm rotor speed increase from 48,000 rpm

Yarn count: Ne 16 100% cotton

Filling yarn in weaving for denim cloth

Equipment settings for mill trial			
Sample number	**Cleaning [kg/h]**	**Carding [kg/h]**	**Lickerin [1/min]**
1	730	41	850
2	730	41	1133
3	560	32	1133
4	418	23	1133

Trash levels in card mat and sliver showed drastic improvements compared to the sample 2 lot which was the plant standard. Trash levels in the card mat were reduced from 1.41% to 1.24% and levels in card sliver were reduced from 0.42% to 0.27%. Card cleaning efficiency increased from 69% to 78% (Fig. 48).

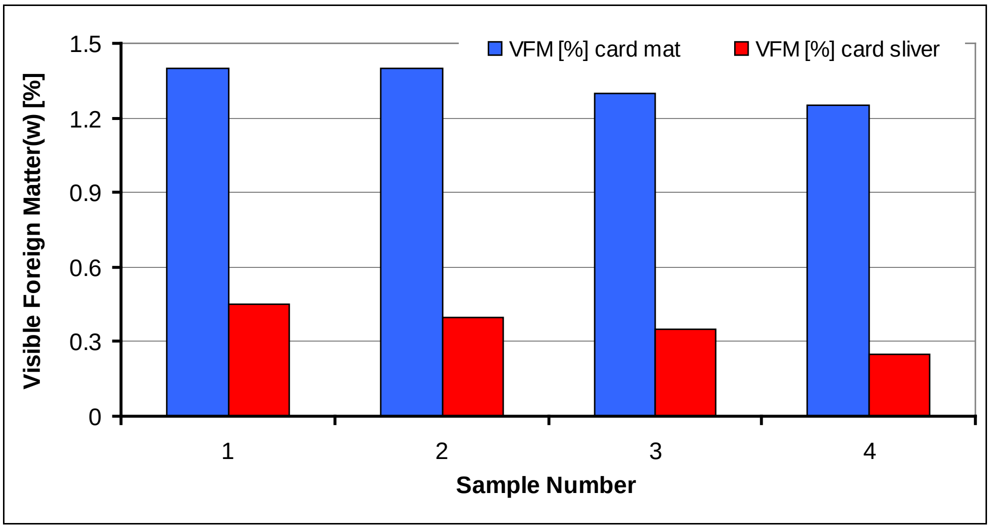


Fig. 48
Trash analysis in rotor spinning. Mill trial

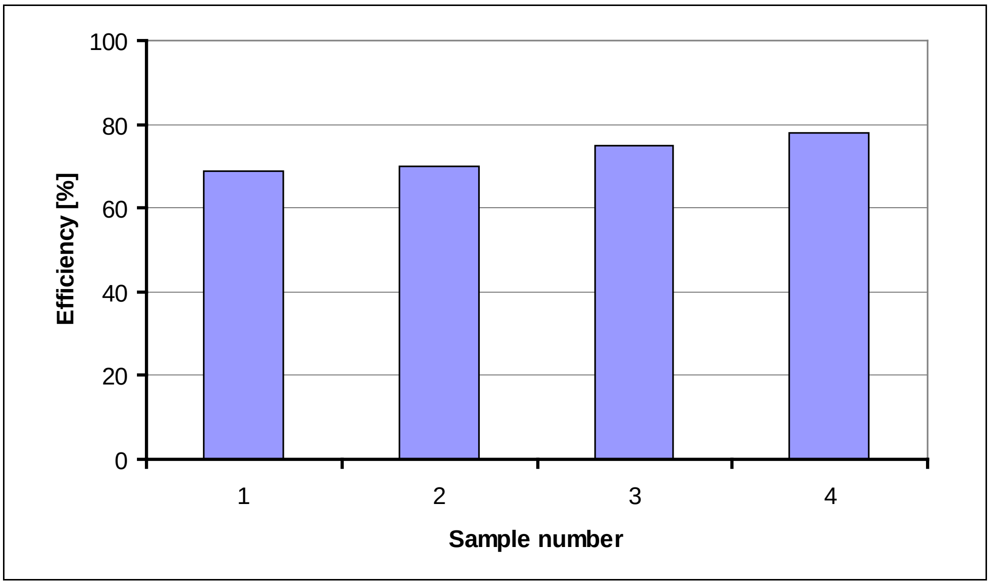


Fig. 49
Trash analysis in rotor spinning
Card cleaning efficiency, breaker sliver

The card sliver from the four sample lots were spun on open end spinning frames at 120'000 rpm. The yarn with the low trash levels was processed at this speed with improved yarn imperfections and improved spinning efficiency. Please note that the Uster CVm did not show an improvement in all four sample lots. Classimat values for H1 and H2 long thin places showed an improvement.

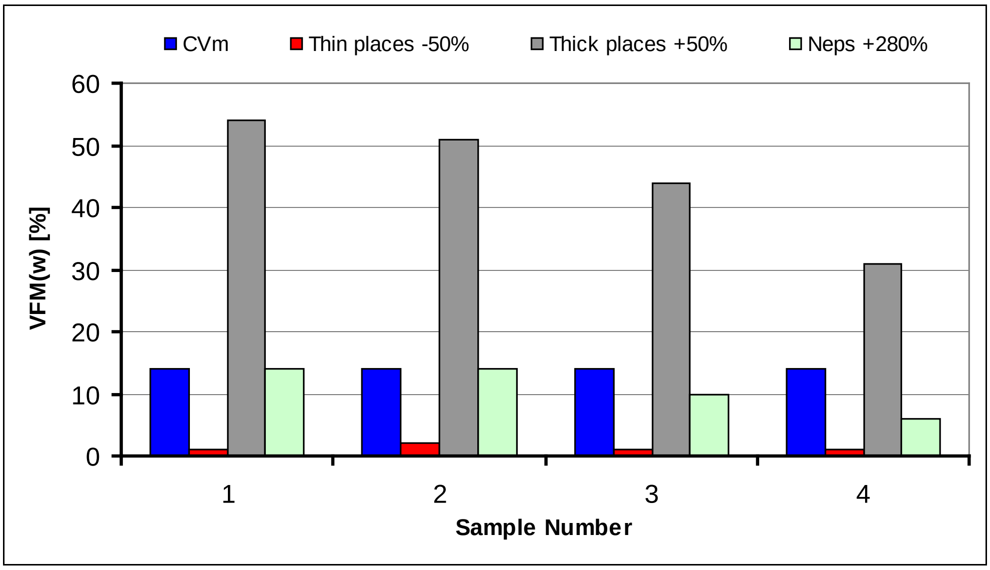


Fig. 50
Trash analysis in rotor spinning
Yarn quality Ne 6, 100% cotton

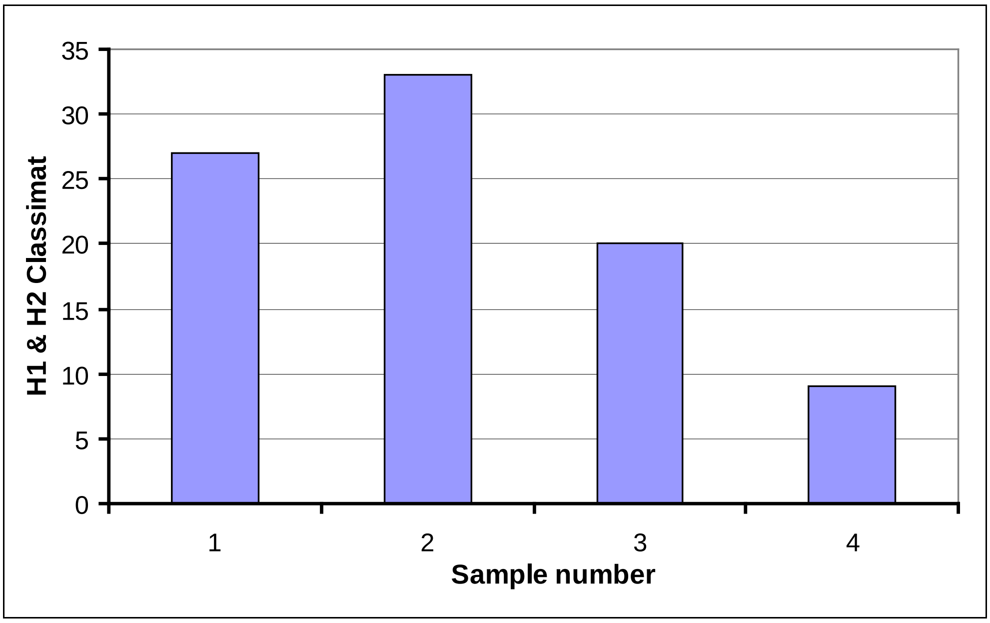


Fig. 51
Trash analysis in rotor spinning
Yarn quality Ne 6, 100% cotton

Conclusions are that reduced levels of trash in sliver can improve spinning efficiency and reduce yarn imperfections.

Conclusions: Trash analysis in rotor spinning

Lower cleaning and carding throughput produced the following results

Reduced trash in sliver allows increased rotor speeds

Major improvement in spinning efficiency

Improved yarn quality imperfections

Reduced classimat faults

Trash level and moiré effects can be analyzed using Uster yarn clearer on open end spinning equipment. This mill trial was done to determine the results from lowering the trash levels on sliver and the number of Polyguard moiré yarn cuts. High and low trash sliver was channeled to the same set of rotors and monitored using Uster yarn clearer for 1000 rotor hours.

Trash analysis on yarn moiré

Determine trash influence on yarn moiré in rotor spinning

Obtain yarn quality and spinning performance using Uster yarn clearer

Yarn used for weaving in verticle denim mill

Trash analysis mill trial description

Channel high and low trash card sliver to open end spinning

Control sample was plant average for trash & Uster yarn clearer cuts

Yarn quality checked with Uster yarn clearer on 24 rotors for 1000 hours

The low card sliver average trash level was 0.386% and the high trash level was 0.420%. The overall plant standard of trash levels in card sliver was 0.404%.

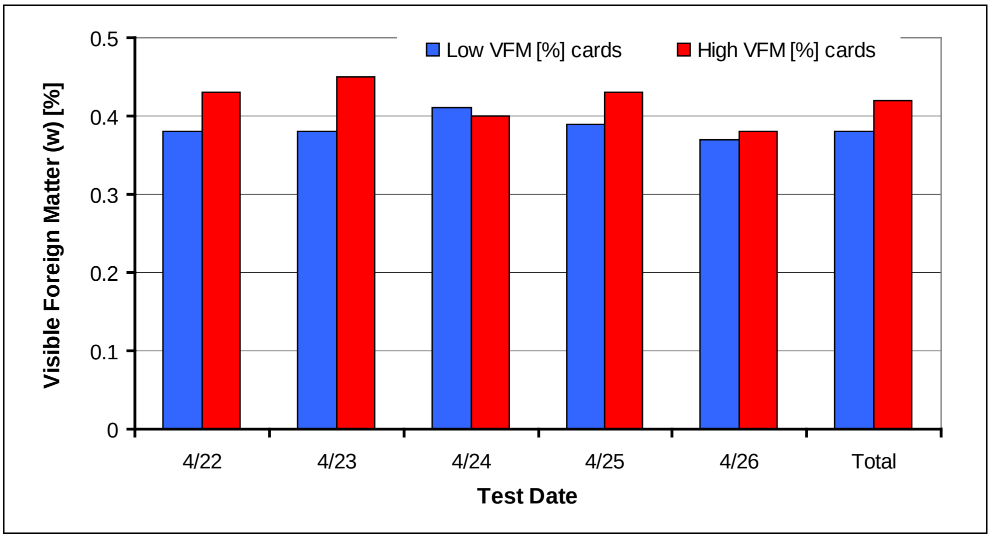


Fig. 52
Trash analysis on yarn moiré
Average trash in cards

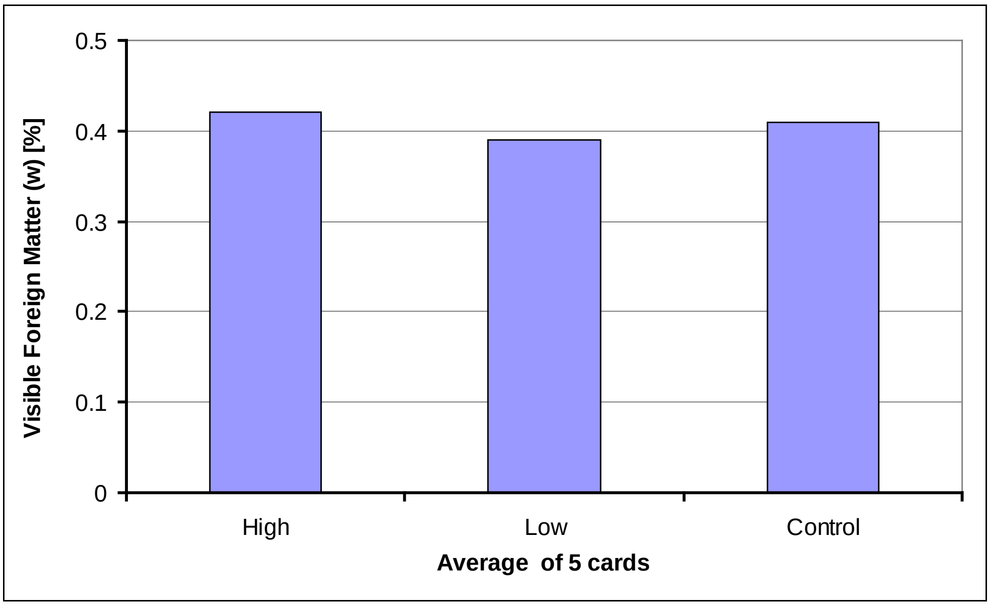


Fig. 53
Trash analysis
Average VFM% in card sliver

Yarn was spun from the high and low trash slivers. Uster evenness data shows no difference in CVm but a significant reduction of short thick places in the low trash yarn. Moiré cuts in the yarn also showed major improvements as compared to the high trash sliver and the overall plant standard.

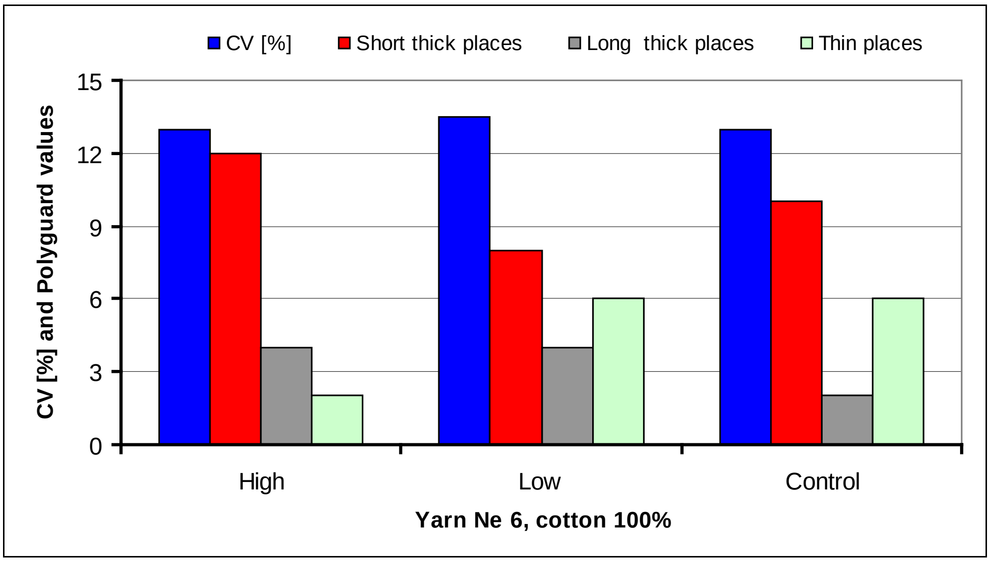


Fig. 54
Trash analysis on yarn moiré
Yarn quality and Uster clearer cuts

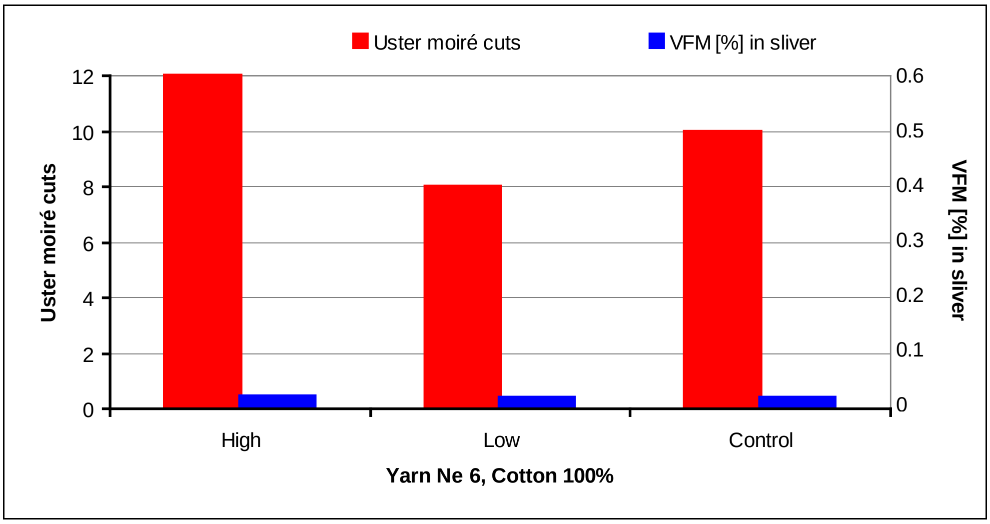


Fig. 55
Trash analysis on yarn moiré
Uster clearer cuts per 100 rotor/hours

Conclusions: Trash analysis on yarn moiré

Trash particles in sliver have a direct effect on yarn moiré

Reduced trash in sliver produces less yarn faults and Uster clearer cuts

Trash particles that stick in rotor grooves cause yarn moiré

7 USTER® *AFIS* analysis of comber and draw frame

7.1 Abstract

Comber slivers are rarely tested for short fiber content and neps as part of routine quality checks in the mill. Unevenness of comber sliver CVm, weight variation, and percent noils are checked on a regular basis believing that the comber is producing a consistent sliver. The percentage of noil removal is set by each plant, based on the raw cotton used and the yarn quality requirements. Many of these decisions are based on experience, along with trial and error, using yarn CVm as an indicator. The purpose of this trial was to determine how much, if any, variability there is between and within combers on Short Fiber Content by number SFC(n). A trial was then designed to adjust combers to reduce comber noil removal and compare yarn and fabric quality.

The setting of the distance between drafting rollers in a drawbox is important in producing an even sliver for spinning. Traditional methods have used the Fibrograph or Comb Sorter method to determine the length of the longest fibers. This process can be very time consuming and the results difficult to quantify. Major equipment manufacturers are not clear what fiber measurement should be used in determining the “effective fiber length”.

A trial was designed to compare the results from setting up a drawbox using AFIS length information compared to the more traditional Fibrograph and array methods.

7.2 Comber analysis

The comber analysis was done with a sales yarn mill producing ring spun Ne 30 count yarn. Summary of the equipment and material is as follows:

Platt Saco Lowell CA Combers
220 nips/min 35# per hour
American Upland Cotton $1^{5}/_{32}$ in (29,5 mm)
13% noil removal plant standard

Seventeen combers were sampled and slivers from the left and right side were tested. Fig. 56, Fig. 57 and Fig. 58 show the results of the SFC(n) for the comber slivers. During the analysis, we also wanted to determine if there was any correlation between the amount of SFC(n) and neps in the comber slivers tested. These results are also included in Fig. 56, Fig. 57 and Fig. 58.

Reviewing the data we then randomly chose a comber with above average SFC(n) values. These were right side deliveries of comber number 16. The six individual deliveries of the comber were sampled and tested and the results of the SFC(n) are given in Fig. 59. These results were analyzed and specific deliveries were targeted for closer review and possible readjustment. In comber 16, delivery 1 had a very low SFC(n) and delivery 2 had a high SFC(n). These deliveries were found to be out of adjustment as per the plant standards for top comb settings. Fig. 60 shows the before and after results of changing the top comb settings.

7.3 Comber trial

We then had information on the amount of comber variability and the ability to optimize each comber delivery to get the most consistent fiber properties possible. A trial was designed to determine if the mill could reduce the percentage of comber noils removed by optimizing the settings of each delivery. All deliveries could be set and adjusted, then tested to make sure all combed slivers were consistent.

Standard settings for the comber were as follows:

- Top comb 0.030" (0,76 m)
- Cushion plate 0.280" (0,71 mm)
- Comber noils 13%

For the trial, we set comber number 10 to the following specifications:

- Top comb 0.050"
- Cushion plate 0.250"
- Comber noils 11.5%

The sliver from comber 10 was then processed into ring spun Ne 30 yarn. Fiber properties from the comber lap, and sliver are given in Fig. 61 and Fig. 62. The yarn was tested on the Uster Evenness Tester. Results from the yarn are shown in Fig. 63 showing the overall 1 and 3 yarn CVm. The imperfections were also recorded at the normal level and at a more sensitive setting. This is done simultaneously in the Uster Evenness Tester. These results are given in Fig. 64 and Fig. 65.

7.4 Comber conclusions

1. Short Fiber Content removal varies between combers
2. There is no correlation between short fiber removal and nep removal
3. Individual deliveries vary, much as they do with cards
4. Comber sliver requires regular testing for SFC and neps
5. Reduced variability in comber sliver can lead to reduction of noils and waste
6. A reduction in comber noil levels can be obtained with no negative impact on yarn CVm, imperfections and fabric appearance.

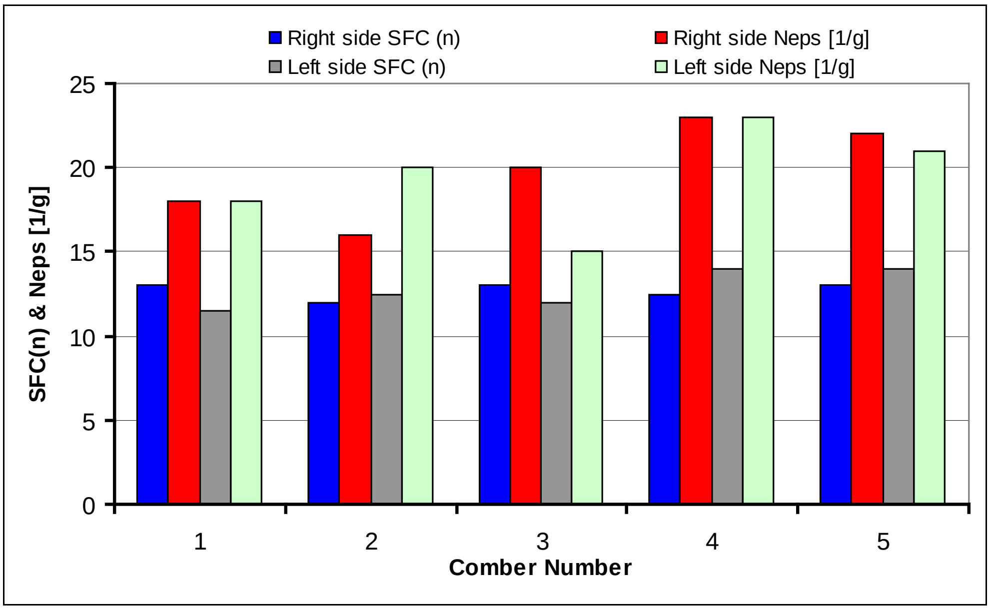


Fig. 56
Comber results: SFC(n) and neps

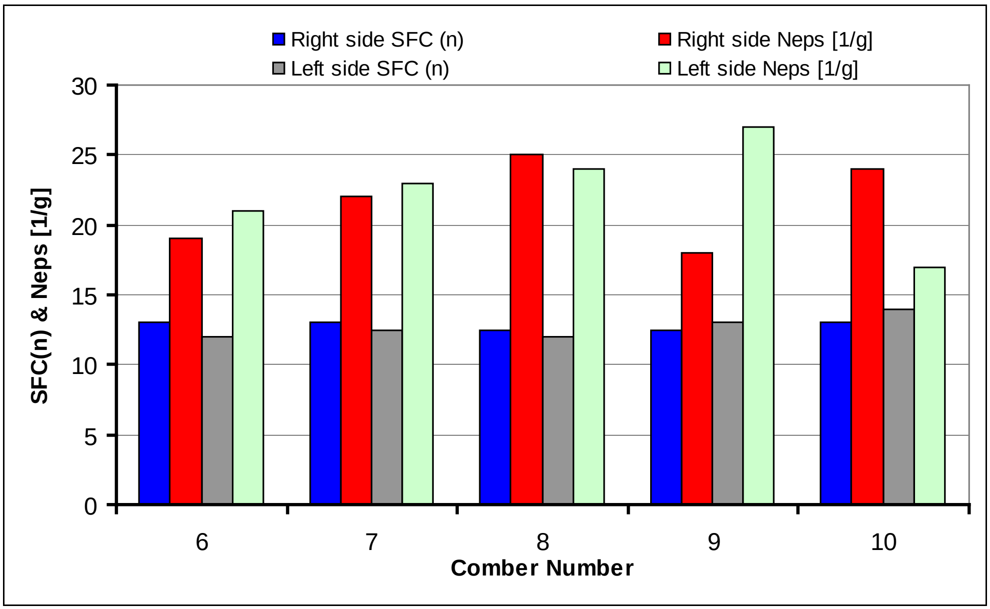


Fig. 57
Comber results: SFC(n) and neps

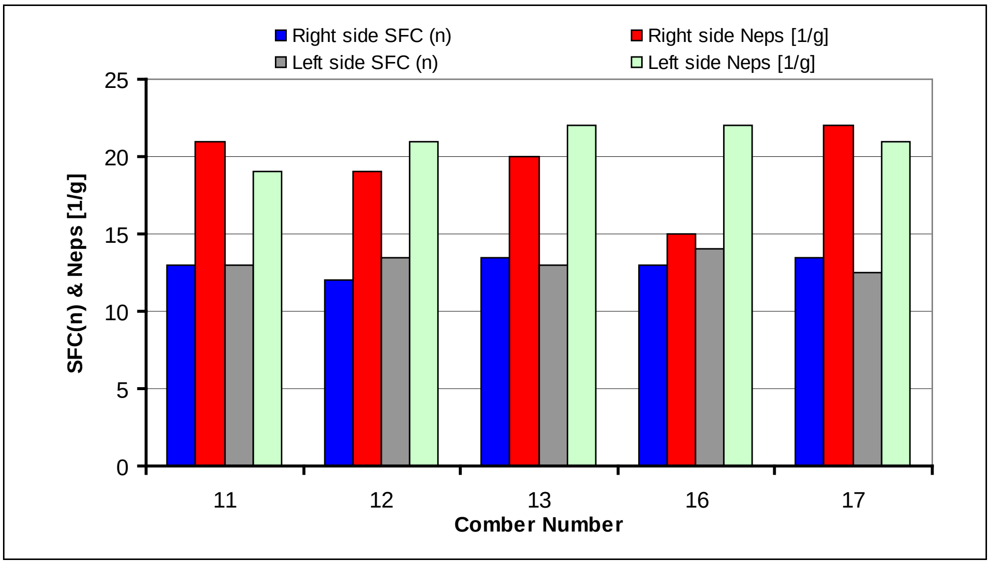


Fig. 58
Comber results: SFC(n) and neps

Fig. 59
Comber 16 results, right side SFC(n)

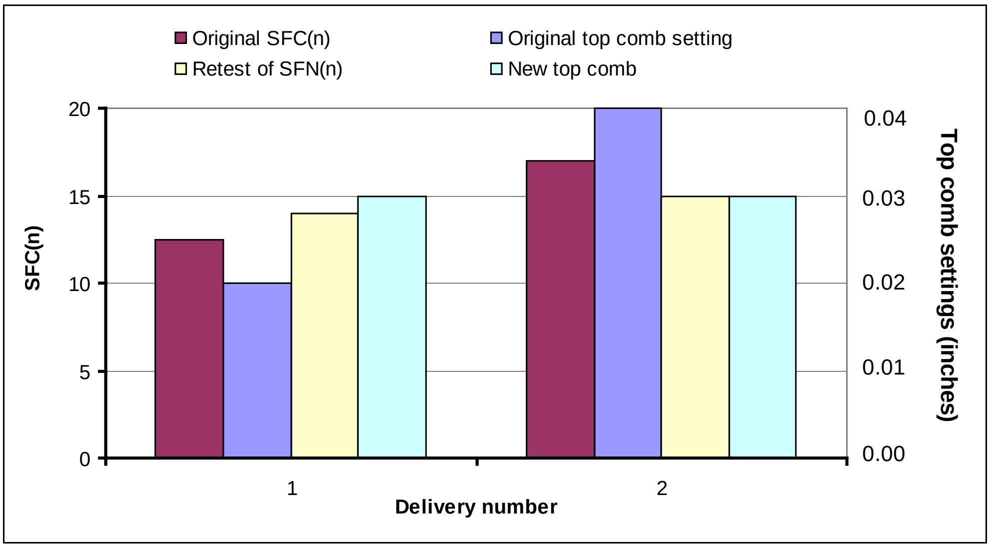


Fig. 60
Comber 16 – before and after

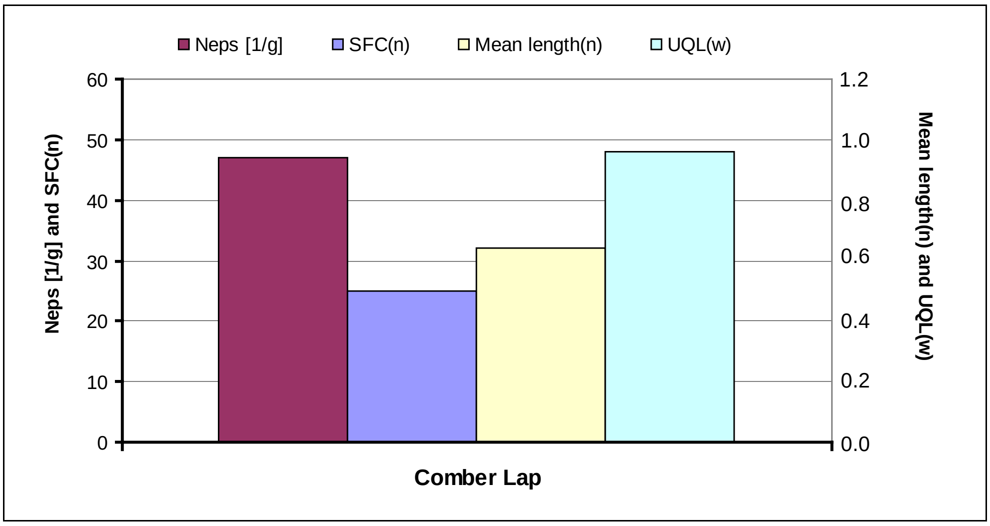


Fig. 61
Comber lap results

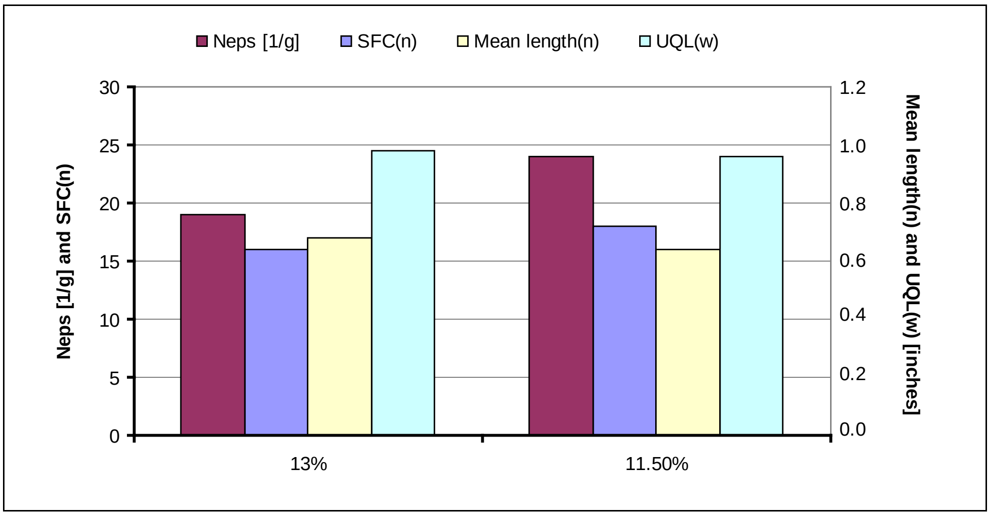


Fig. 62
Comber sliver results

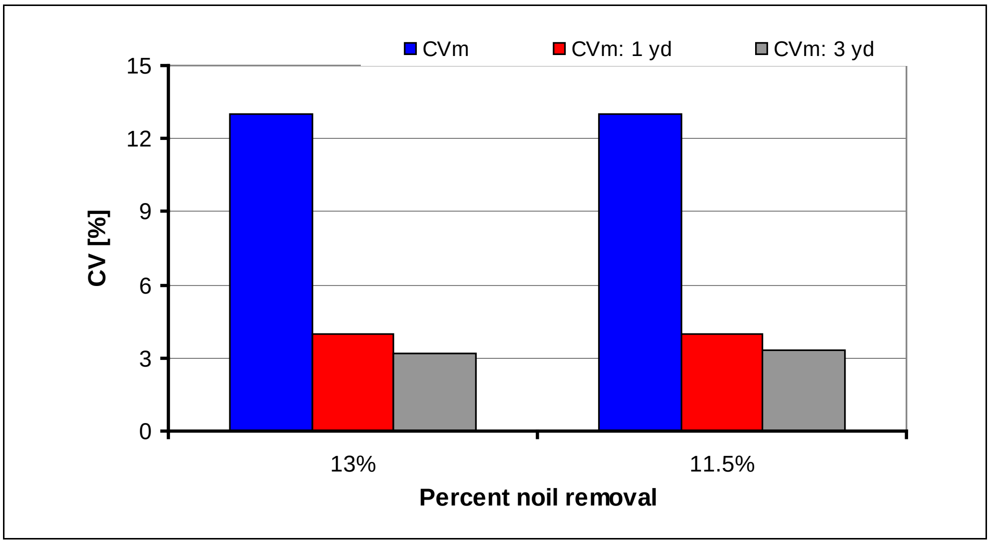


Fig. 63
Uster yarn evenness CV versus comber noil percentage
1 yd = 0,91 m

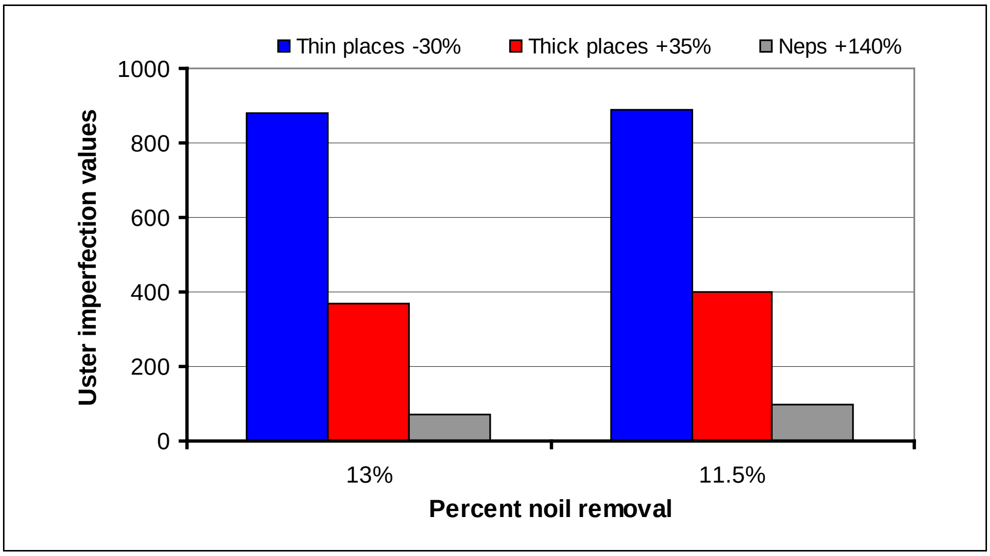


Fig. 64
Uster yarn imperfections versus comber noil percentage

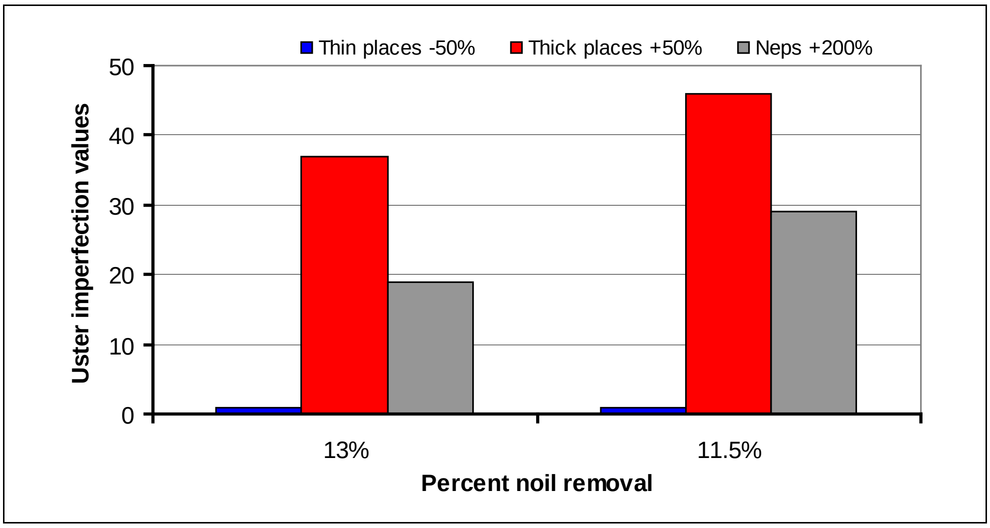


Fig. 65
Uster yarn imperfections versus comber noil percentage

7.5 Drawframe trial

We conducted a trial at a sales yarn spinning mill producing 100% cotton Ne 18. The yarn was processed on ring spinning equipment. The yarn knitted from this plant had occasional problems with long, thin places in the fabric. This plant traditionally used the fibrograph fiber growth test to determine the optimum roller settings. The process of setting the back and front draft zones typically required 5 to 6 tests on the Fibrograph. This method can prove to be a time consuming exercise. We choose a finisher drawframe that had recently been set up using the Fibrograph method, the quality of its roving and yarn is shown in Table 1. The breaker sliver was then tested on the AFIS Length module. The 5% length by number of results were used to reset the roller spacing in the front and rear draft zones. Table 2 shows the improvement in the roving and yarn quality. This improvement at cut lengths of 1 m, 3 m, 10 m and 50 m showed a visible reduction of long thin places in the knitted fabric. Setting up the draw frame using the AFIS Length module did not require multiple tests and overall set up time was reduced drastically.

7.5.1 Draw frame conclusions

1. Roller settings on finisher draw frames can improve roving and yarn quality
2. AFIS single fiber length data can be used to improve settings in the front and back draft zones
3. AFIS Length module can be used to reduce the time needed for setting up draw frames

7.6 Evenness quality parameter

Unevenness of rovings and yarns	Roving	Yarn
CVm	5.64	12.45%
CVm 1m	3.17	4.3%
CVm 3m	2.94	3.39%
CVm 10m	2.71	2.79%
CVm 50m	2.41	2.33%

Table 1
Evenness before using Fibrograph

Unevenness of rovings and yarns	Roving		Yarn	
	Original	AFIS-L *	Original	AFIS-L *
CVm	5.64	5.08	12.45%	12.14%
CVm 1m	3.17	1.96	4.3%	4.15%
CVm 3m	2.94	1.59	3.39%	2.9%
CVm 10m	2.71	1.28	2.79%	1.93%
CVm 50m	2.41	1.04	2.33%	1.11%

Table 2
Evenness after using AFIS Length

* Unevenness after better settings, of the front and rear draft zones of the breaker drawframe.

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