USTER® *AFIS PRO 2*

Application Report

Use of AFIS histograms

Mona Qaud / April 2013 / SE 664

USTER®
Think quality

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Contents

1 Introduction

Since the introduction of the AFIS instrument in the late 80's it has been found its place within the process control of the cotton spinning mills. Over 850 units are installed worldwide.

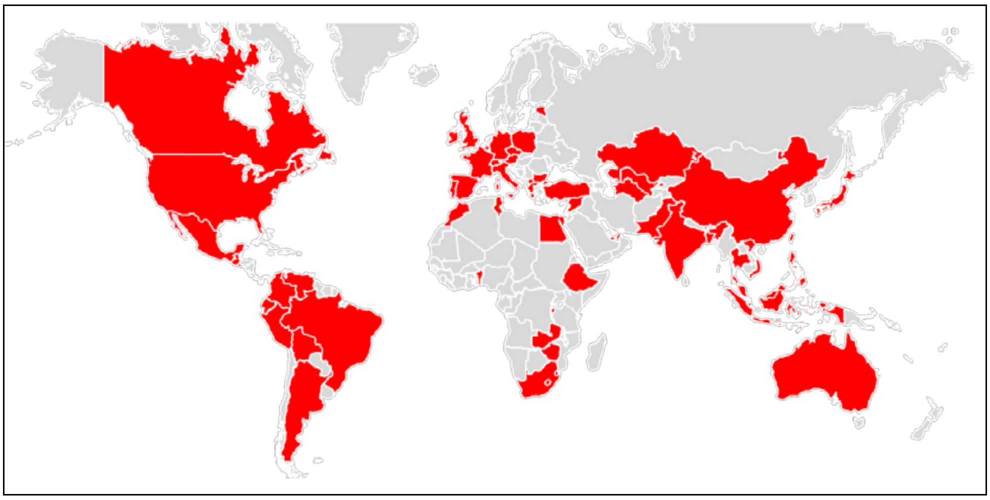

Fig. 1
Worldwide distribution of AFIS instrumentation

All over the world spinning mills use the features of nep testing, individual fiber length measurement as well as trash testing. The advanced fiber information systems has proven its usefulness.

All AFIS installations have the Nep (N) module installed. New on t he USTER® *AFIS PRO 2* is the categorization of fiber neps in addition to the seedcoat neps category that already existed. The occurrence of seedcoat neps is increasing due to changes in seed varieties. A high number of seed coat neps may cause problems in the spinning preparation processes, and if the fiber handling in opening and cleaning is not optimal, even increase in number. If they are not removed, they can cause a higher number of yarn breaks in spinning.

The length parameters including the maturity can be checked with the AFIS-L&M (Length and Maturity) module. There are some processes in the mill, where fiber length and it's distribution is a priority. Not only is it the main parameter for specifiying the cotton quality – it also affects yarn quality, roller settings within the whole mill, and determines the waste level to a great extent. Three processing stages have an impact as well as are affected by fiber length and length distribution – the blowroom, the carding and the combing process.

Also worth mentioning is the importance of monitoring the fiber fineness over the spinning process in order to optimize machinery settings, e.g. at the comber. And fiber fineness impacts to a big deal also the overall quality of a yarn, as it influences the spinning limits: yarn count as well as yarn eveness (CV_m) are highly dependent on the fiber fineness.

The AFIS-T (Trash) module measures the number and well as size of dust and trash particles. With this information, the cleaning efficiencies throughout the cleaning processes of a mill can easily be determined. Monitoring cleaning efficiency is critical to controlling cost and quality.

As the world adopts modern cotton seed, harvesting, and ginning technology, the risk for higher amounts of trash and seedcoat fragments increases compared to hand-picked cottons that do not require as much cleaning and are often roller ginned at lower production rates.

When the spinners try to clean these cottons, they run the risk of increasing short fiber and neps by aggressively removing the trash and seedcoat fragments. Therefore, gentle cleaning of cotton has become a priority.

Rotor spinning was always sensitive to dust and trash. Ring and Compact spinning are more sensitive to short fiber content levels. The quality properties of cotton and the handing of fiber during processing are interlaced. When cleaning fiber to remove trash, dust, and seedcoat fragments, there will be an impact on the nep content and fiber length. How much they are impacted will be determined by the technology utilized and the settings and production rates employed.

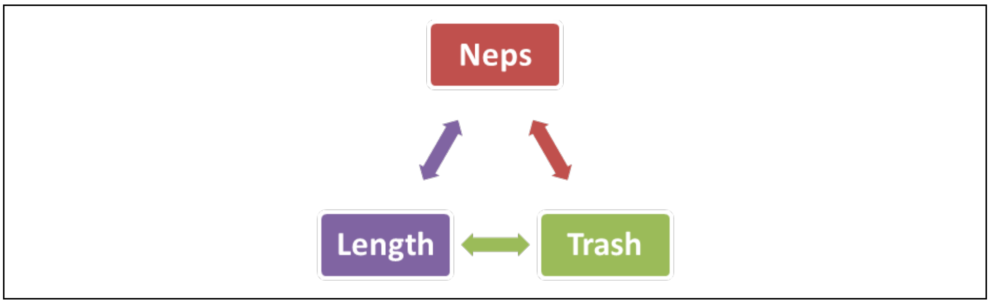

Fig. 2 Interdependency of parameters

One also needs to bear in mind, that the productivity of a mill plays an important role. The delivery speeds of spinning machinery keeps increasing over the years – nevertheless the quality of the yarn in most cases has improved as well. This is only possible if the machine settings are finetuned and the condition of the machinery and technological elements are kept aligned.

The machinery settings, the delivery speeds and the machine conditions interact. Normally they run like well adjusted clockworks. Any “spanner in the works” (in our case: neps, short fibers, dust and trash) will impact not only the performance of the other – but will affect also the quality of the intermediate products, and therefore the yarn as the end product of the spinner.

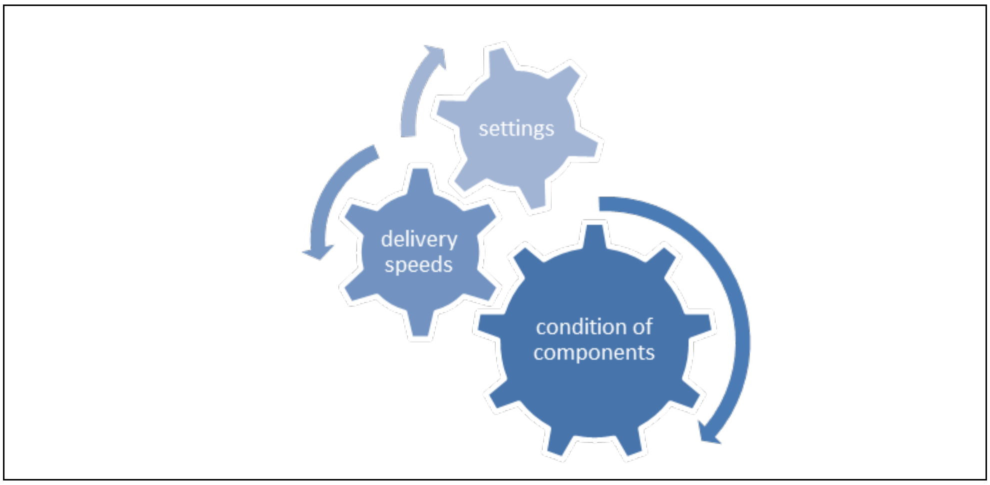

Fig. 3
Machinery influences and impacts

2 AFIS Modules

The USTER® *AFIS PRO 2* with different modules allow the simultaneous testing of fiber samples. When utilizing the Autojet – the samples are fed in automatically into the instrument, and the lab technician can perform other tasks whilst the USTER® *AFIS PRO 2* is testing the samples automatically.

2.1 AFIS – Nep

Fig. 4
Fiber Nep, Seed Coat Fragment

In this module not only are neps and their sizes evaluated – according to their signal form in the sensor, seed coat neps are also detected counted and sized.

2.2 AFIS – Length

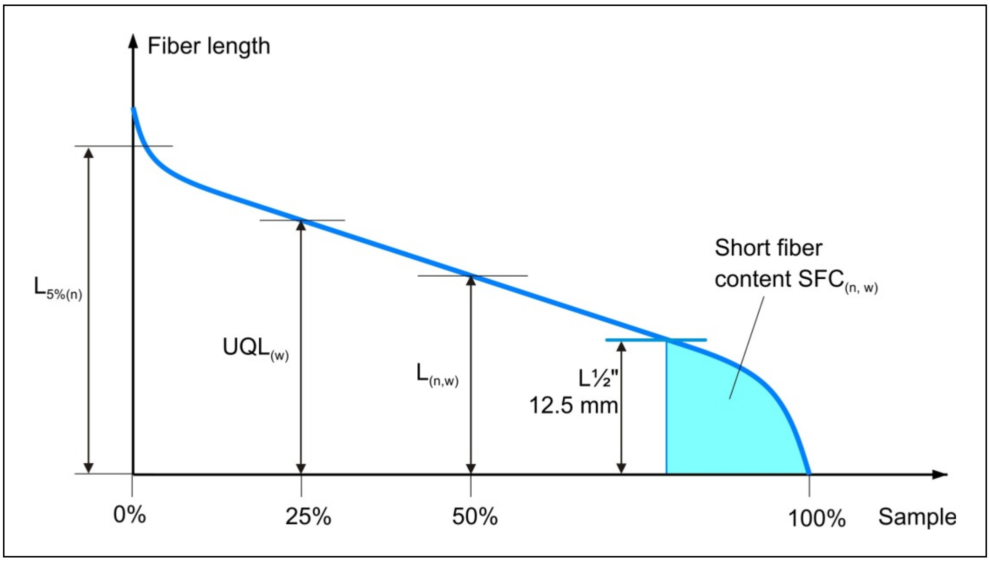

Fig. 5
Staple diagram and fiber length definitions

Fibers in USTER® *AFIS PRO 2* are measured individually for their fiber length – this measurement can be classed as an end oriented testing method. However, the applied level of short fibers differs. In the western hemisphere the short fiber limit of ½" – or 12.7 mm is commonly used – in China and Russia the limit is 0.65" – or 16.5 mm is practiced.

2.3 AFIS – Maturity

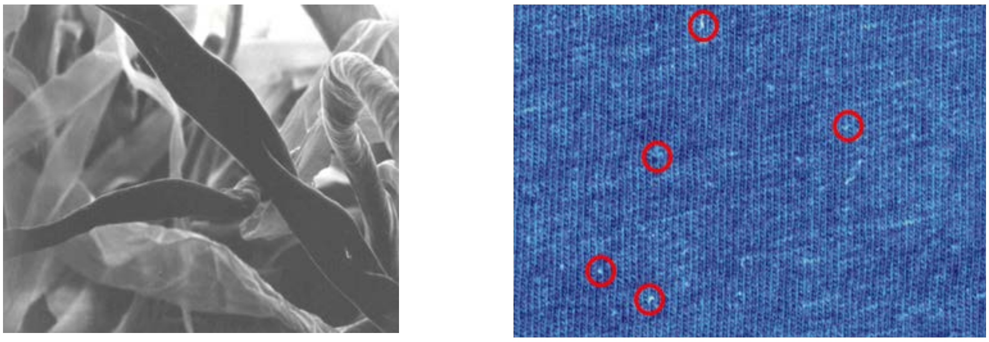

Fig. 6
Immature Cotton and Cotton fabric with white speck

The fibers are tested also for their maturity. Dead or immature fibers have a very thin cell wall, and appear as a thin fiber ribbon. Mature fibers develop thicker cellulosic walls, and tend to convolute.

Depending on the voltage (=height) of the signal, the fiber fineness can be determined. Fiber fineness of cotton fibers can range usually from 120 – 180 mtex.

2.4 AFIS – Trash

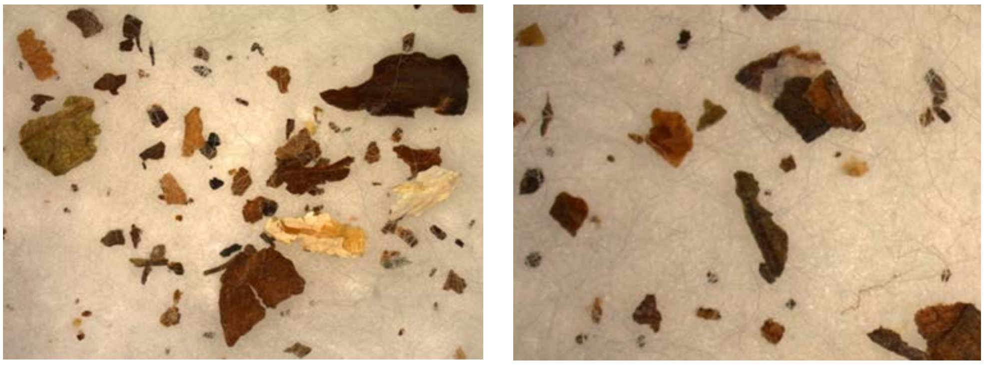

Fig. 7
Dust, Leaf and Trash particles – magnified

Dust and trash particles are heavier and larger than fibers, and therefore are seperated at the opening roller from the fiber flow. The number and size are determined in the optional trash sensor.

3 Types of results

3.1 Numerical results in tables

What kind of information can we obtain out of the classical numerical printouts ?

The standard printout offers us

- **Immediate Results:** Fast, standard printout directly after testing
- **Exceptions:** Outside range can be marked in colors on printout
- **Benchmarking:** Comparisons against Uster Statistic Percentile (USP™) are possible
- **Variation:** Ranges and variation of the samples are visible (CV%)

3.2 Graphical results

What does a user gain in addition when looking at the acompanying USTER® *AFIS PRO 2* histograms ?

The histograms are available for the following parameters

- Neps (including seed coat neps)
- Length by weight (including short fiber)
- Length by number (including short fiber)
- Fineness
- Maturity
- Dust and Trash

The user can select the summary histogram (average of all samples tested) – or if desired see only the histogram of an individual repetition. They can be quickly checked on the screen of the instrument – or as a reference printed out in a electronic pdf-format or as a paper-hardcopy.

We should check for the distribution of parameters due to different aspects:

- With the help of the histograms we can see at a glance if distributions are typical or atypical.

  High variations are seen immediately – also if e.g. a bimodal distribution is present. This can happen, when cottons with different values are blended together (high short fiber, low short fiber).

- We can judge the distributions and assess changes. We not only get more information, we get detailed information.

It requires some experience in judging the histograms in the beginning. However, by checking the starting raw material and the changes through the processes including the blending of the fiber, processes can be optimized using the information in the histograms.

4 AFIS Neps & Seed Coat Neps

4.1 Numerical results

	A	B	C	D	E	F	G
NEP	Rep	Total Nep Cnt	Total Nep Mean Size	Fiber Nep Cnt	FibNep Mean Size	SCNep Count	SCNep Mean Size
		[Cnt / g]	[µm]	[Cnt / g]	[µm]	[Cnt / g]	[µm]
	1	268	688	248	667	20	945
	2	166	671	150	637	16	988
	3	208	630	204	621	4	1,100
	4	226	660	222	654	4	1,000
	5	182	712	180	713	2	625
n	5						
Mean		210	672	201	658	9	932
Std. Dev.		40	31	38	35	8	181
CV%		19.0	4.6	18.8	5.3	89.1	19.4
Q99%		82	64	78	72	16	373
Min		166	630	150	621	2	625
Max		268	712	248	713	20	1100
USP	[2007]	74				39	

Table 1 Print-out of USTER® AFIS PRO 2 with nep result columns

A Number of test repetitions
B Number of total neps per gram (=fiber +seed coat neps)
C Size of total neps in micrometer
D Number of fiber neps per gram
E Size of fiber neps in micrometer
F Number of seed coat neps
G Size of seed coat neps in micrometer

Other abbreviations:

Mean :	Mean result of the test repetitions
Std. Dev. :	Standard deviation of the test repetitions
CV% :	Coefficient of variation of the test repetitions
Q99% :	Range of results within 99% of confidence level
Min :	lowest value of the tested repetitions for that parameter
Max :	highest value of the tested repetitions for that parameter
USP™ :	Uster Statistic Percentile [2007] or [2013] of the parameter (only listed if available)

4.2 Graphical results

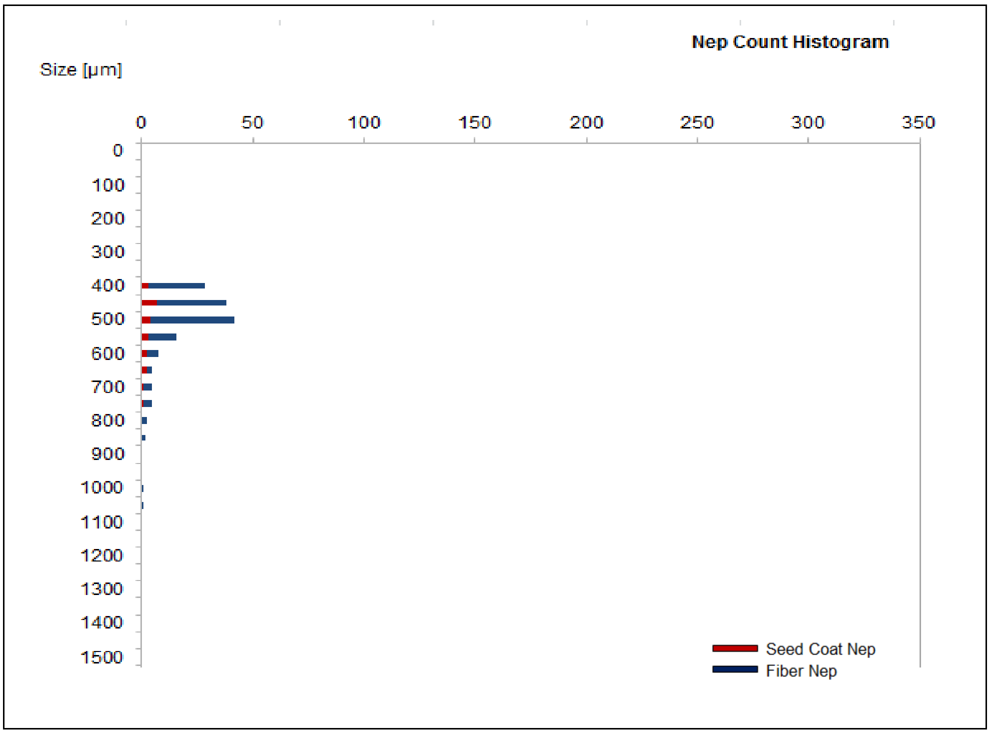

Fig. 8
USTER® AFIS PRO2
Nep Histogram (by count)

The neps and seed coat neps are not only counted but classed according to their size. Due to their different behavior in the sensor, seed coat neps are identified. These are labeled in the histogram in red color.

In the nep histogram we can see clearly the percentage of seed coat neps in the sample. As more red / or shaded particles are within the samples there is a higher probability that they will cause ends down in the spinning.

In the graph above we have a sample of bale material – showing a high amount of seed coat neps.

The graph has two scaling options – one is showing the actual count – the other is relating the counted number to percent ("Percent of total").

The first option is shown in the above displayed graph. It states "Nep Count Histograms" – and the scale range is up to 350.

4.3 Practical example

In this through-the-mill study we can evaluate the effect of the blowroom, the card and the comber on the cotton material by looking at the numerical value histograms side-by-side.

In this real-world example, samples from bale to comber sliver were evaluated. The bale test on HVI showed a Micronaire value of 3.8, a staple length of 37.5 mm and a bundle strength of 43.8 cN/tex.

Characteristics	Bale	Card Mat	Card Sliver	Comber Sliver
Neps [Cnt/g]	210	550	61	17

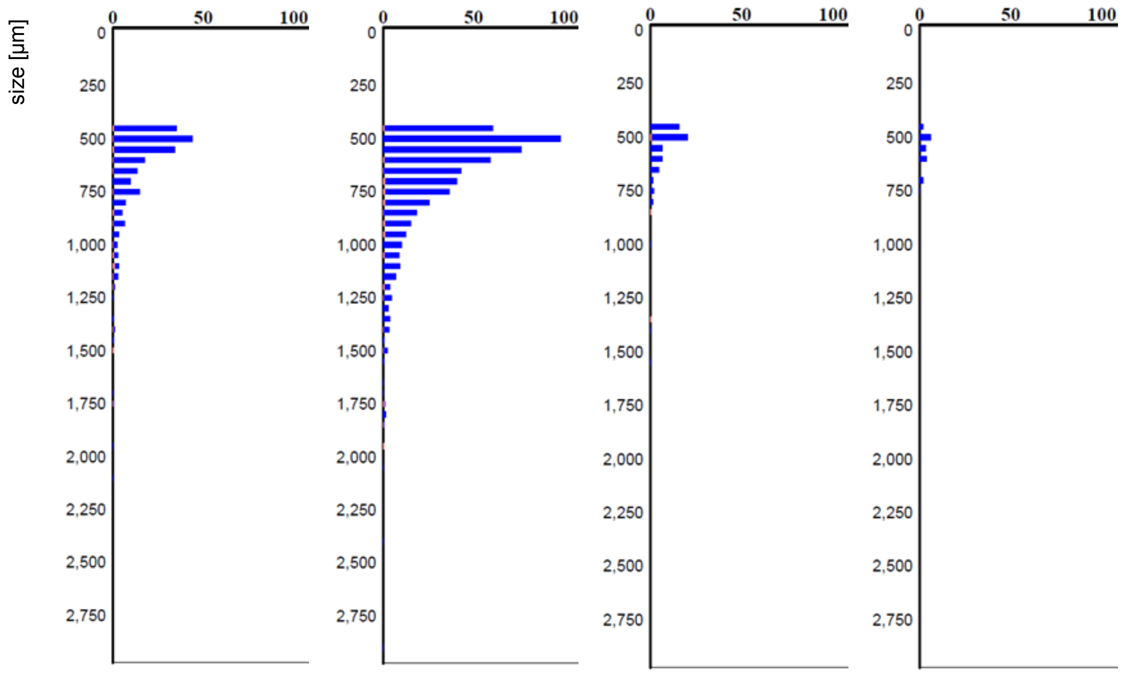

Table 2 Nep size distribution in spinning process

When comparing histograms of the different process steps, it is recommended to use the "by count" histograms. The scaling of the x-axis in this type histogram is up to 350 counts per gram.

In the example histograms we can see the increase in neps from the bale to card mat. It is also apparent that large neps were created in the blowroom. Already in carding all sizes of neps and all but very few seed coat neps were removed. Here, a glance at the histogram helps to determine how well the seed coat neps are eliminated in carding or if many remain in the card sliver.

The effect of the combing process relates also to the noil percentage – as more fibers are combed out, the nep level will diminish accordingly.

In this example, the nep content was increasing in the blowroom, whilethe card and comber were reducing the nep content. This effect can be illustrated by calculating removal efficiency.

To calculate the removal efficiency the following formula is used:

$$\text{Nep Removal Efficiency} = \frac{(\text{Nep Input}) - (\text{Nep Output})}{\text{Nep Input}} * 100$$

A negative nep count removal efficiency therefore states an increase of the values. So in the blowroom we increase dramatically the number of neps – from 210 to 550 neps per gram, i.e. by 162 %. As a rule of thumb, an increase of neps in the blowroom should, depending on the fiber fineness and the starting point of neps in the bale, not be more than increase by 100% (lower than double).

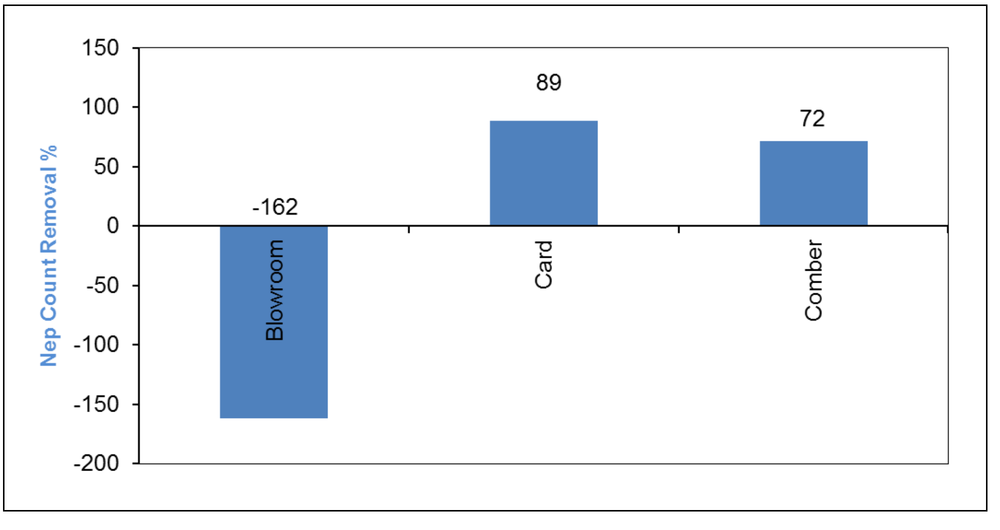

Fig. 9
Nep efficiencies in spinning process

For the carding process a cleaning efficiency of 89% is good, and quite respectable – this however is not only due to the high level of neps, but also to machine state, condition, speeds as well as settings.

Also the efficiencies can be displayed and calculated by the experienced operator in the laboratory directly on the USTER® *AFIS PRO2* instrument.

But before fully acknowledging the nep level reduction in our case – the other quality parameters need to be checked and considered as well, which we do in the following chapters.

5 AFIS Length

5.1 Numerical results

		H	J	K	L	M	N	O	P	Q	R	S
LEN	Rep	L(w)	L(w) CV%	SFC(w)	UQL(w)	L(n)	L(n) CV%	SFC(n)	5% L(n)	ineness	Maturity Ratio	IFC
		[mm]	[%CV]	%<12.7 mm	[mm]	[mm]	[%CV]	%<12.7 mm	[mm]	[mtex]		[%]
	1	31.9	30.9	3.8	38.9	25.8	48.3	17.4	43.7	148	0.97	4.2
	2	31.3	32.7	4.7	38.0	25.0	50.1	19.5	42.9	149	0.96	4.9
	3	33.1	30.6	3.8	40.0	26.7	48.8	17.9	45.1	144	0.94	5.6
	4	31.4	31.9	4.4	38.3	25.0	50.6	19.9	43.0	146	0.95	4.6
	5	32.4	30.6	3.6	38.9	26.4	47.8	17.1	44.0	153	0.98	5.0
n	5											
Mean		**32.0**	**31.3**	**4.1**	**38.8**	**25.8**	**49.1**	**18.4**	**43.7**	**148**	**0.96**	**4.8**
Std. Dev.		0.7	0.9	0.5	0.8	0.8	1.2	1.3	0.9	3	0.01	0.5
CV%		**2.3**	**2.9**	**11.7**	**2.0**	**3.0**	**2.4**	**6.9**	**2.0**	**2.3**	**1.4**	**10.8**
Q99%		1.5	1.9	1.0	1.6	1.6	2.4	2.6	1.8	6	0.03	1.1
Min		31.3	30.6	3.6	38.0	25.0	47.8	17.1	42.9	144	0.94	4.2
Max		33.1	32.7	4.7	40.0	26.7	50.6	19.9	45.1	153	0.98	5.6
USP	[2007]			38				56		44	5	19

Table 3 Print-out of USTER® AFIS PRO 2 with length result columns H to P

H	Mean length by weight in mm / or inch
J	Coefficient of variation of mean length by weight in percent
K	Short fiber content by weight in percent
L	Upper Quartile Length by weight in mm / or inch
M	Mean length by number in mm / or inch
N	Coefficient of variation of mean length by number in percent
O	Short fiber content by number in percent
P	Length of the 5% longest fibers in mm / or inch

K+O	The selected level of short fiber content (1/2 " or 0.65") is given on the printout

5.2 Graphical results

For the fiber length measurement we test 3000 fibers per repetition. Results of this end oriented methods are commonly shown in two different frequency distributions – the by weigth distribution or the by number distribution.

The abbreviations are

(w) – for the by weigth distribution and values

(n) – for the by number distribution and values

Differences between those two types of evaluation are the frequency in the individual length classes are by either gravimetrical weight or mass – or by the counted number of fibers. So the same fibers are evaluated by the number of events in the class – or by the weight those fibers would have on a balance. As short fibers weigh less than longer ones, those frequencies of short lengths are lower in the by weight distributions.

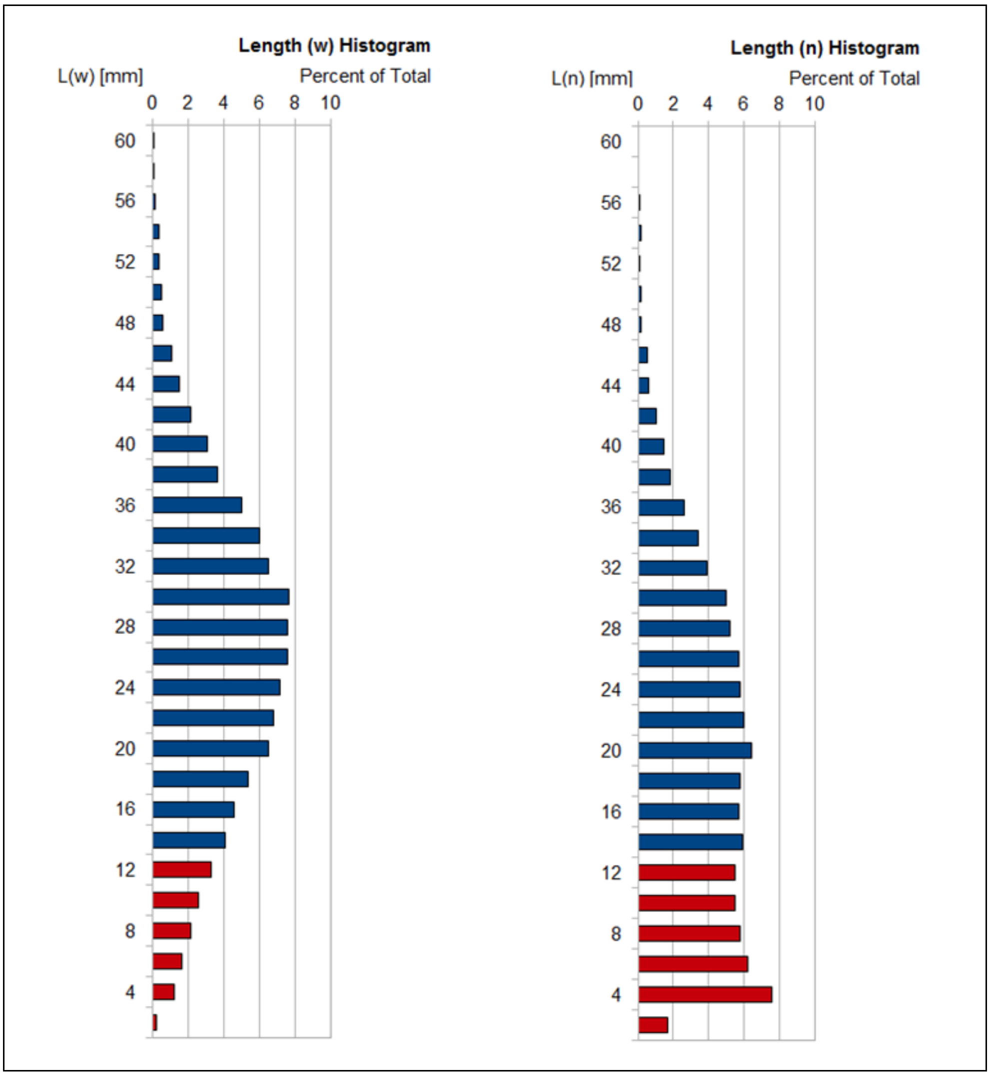

Fig. 10
Left side:
Histogram length by weight
Right side:
Histogram length by number

The level of short fibers most commonly referenced worldwide is 12.7 mm. In China a level of 16.5 mm is often selected. The customer can chose his own level, and will get numerical results as well as the histograms with his selected level. In the histogram the fibers shorter than this selected limit are highlighted in red bars.

Changes in the fiber length distribution (breaking of fibers, removing short fibers) are so clearly visible, and will be seen first in the more senstitive by number distribution.

5.3 Practical example

The same samples that were evaluated for neps were also tested for their length values. The extra long staple cotton was intended to spin fine yarn counts for mens shirting, and therefore was used in combed ring spinning.

Characteristics	Bale	Card Mat	Card Sliver	Comber Sliver
Length UQL (w) [mm]	38.8	33.9	32.6	34.8
Length L (w) [mm]	32.0	27.0	25.6	28.3
Short Fiber SFC (w) [%]	4.1	8.0	10.1	3.6

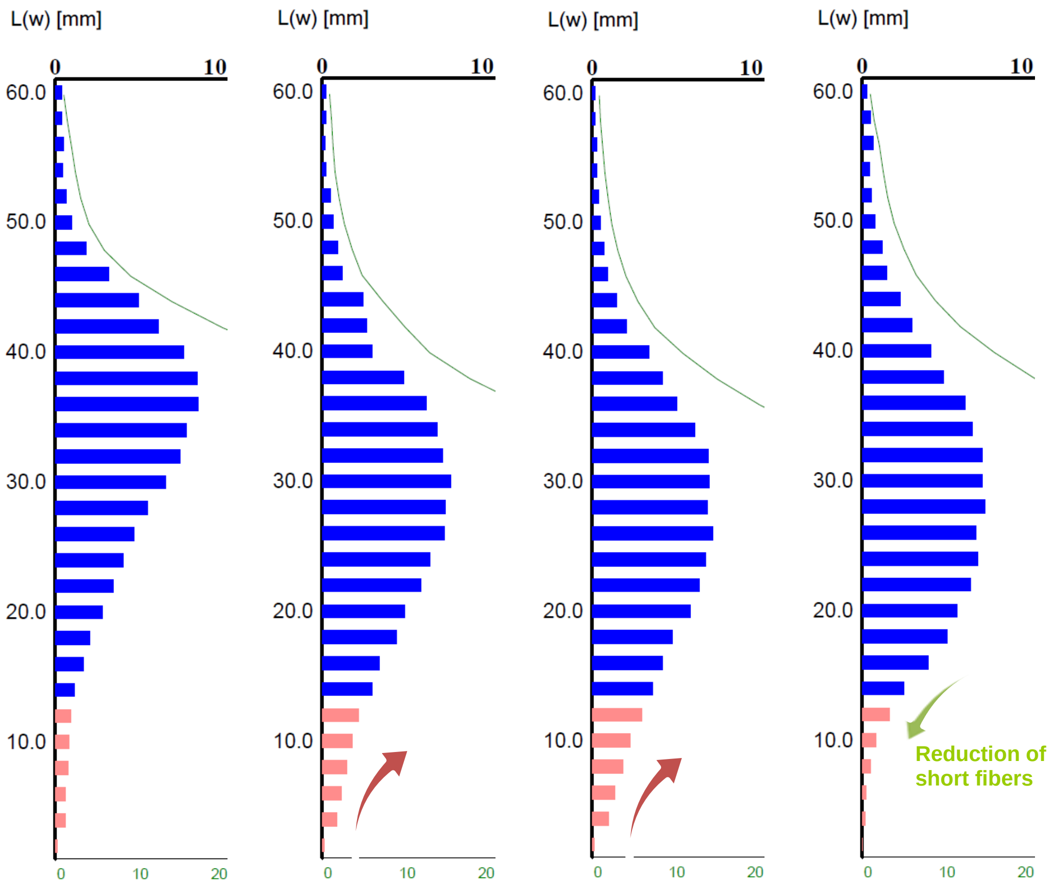

Table 4 Length by weight distributions in spinning process

The length values in the table show that the extra long staple cotton, is being damaged in the blowroom, and then again at the card. The increase in short fiber content by weight was almost 4% from bale to card mat, and another 2% from card mat to card sliver.

At the combing process the short fibers were removed, bringing short fiber level back to the level of the original bale. The changes are visible in the histograms of the by weight distributions, but the shape of the distribution maintain a similar shape.
However the breakage in the blowroom is considerable – loosing 5 mm in average length, leads to the conclusion that settings were extremely close, to operating speeds too high or any other parameters that are out of tune. Due to this reduction in average length, the short fiber of course increased considerably.
Normally we expect in a standard and well adjusted process a short fiber to decrease at each process stage.

Characteristics	Bale	Card Mat	Card Sliver	Comber Sliver
Neps [Cnt /g]	210	550	61	17
Length L (n) [mm]	25.8	20.6	19.3	24.0
Short Fiber SFC (n) [%]	18.4	26.4	30.2	10.9

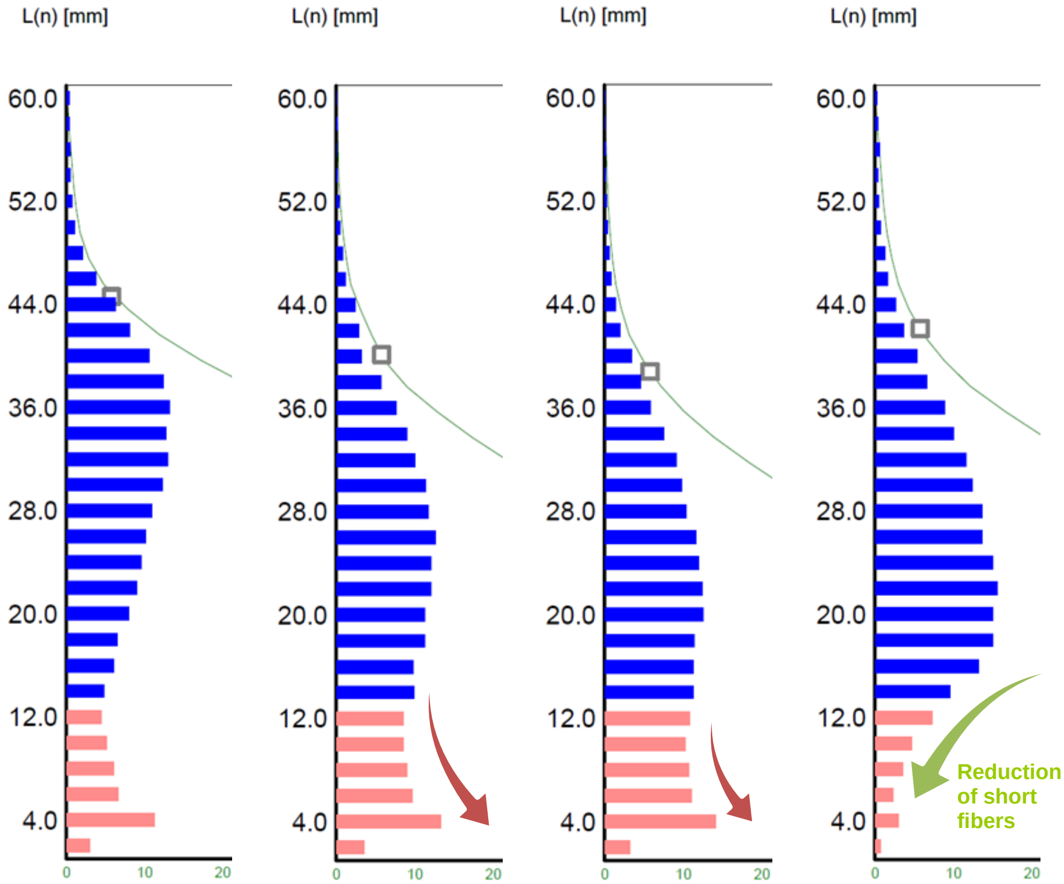

Table 5 Length by number distributions in spinning process

The short fiber content by number reacts considerably to the breakage in the blowroom and c ard. Also the effect of the combing process can be clearly seen in the length by number distributions. The bars of the histograms increase through carding and decrease considerably at combing.

Even subtle change in fiber length will be seen first in the by number distributions before they will be visible in the by weight distributions. For a quick check to determine if fibers are damaged in processing a glance at the length by number distribution is recommended. This is even more critical when processing a new material or applying new settings to a process.

In this example the mill has used a rather aggressive opening and cleaning process for such a delicate fiber. The neps and the short fiber content increased considerably. In carding, trying to achieve a high nep removal efficiency, the settings had led into breaking fibers. The mill should consider testing different settings at the card flats.

6 AFIS Maturity

6.1 Numerical results

		H	J	K	L	M	N	O	P	Q	R	S
LEN	Rep	L(w)	L(w) CV%	SFC(w)	UQL(w)	L(n)	L(n) CV%	SFC(n)	5% L(n)	ineness	Maturity Ratio	IFC
		[mm]	[%CV]	%<12.7 mm	[mm]	[mm]	[%CV]	%<12.7 mm	[mm]	[mtex]		[%]
	1	31.9	30.9	3.8	38.9	25.8	48.3	17.4	43.7	148	0.97	4.2
	2	31.3	32.7	4.7	38.0	25.0	50.1	19.5	42.9	149	0.96	4.9
	3	33.1	30.6	3.8	40.0	26.7	48.8	17.9	45.1	144	0.94	5.6
	4	31.4	31.9	4.4	38.3	25.0	50.6	19.9	43.0	146	0.95	4.6
	5	32.4	30.6	3.6	38.9	26.4	47.8	17.1	44.0	153	0.98	5.0
n	5											
Mean		**32.0**	**31.3**	**4.1**	**38.8**	**25.8**	**49.1**	**18.4**	**43.7**	**148**	**0.96**	**4.8**
Std. Dev.		0.7	0.9	0.5	0.8	0.8	1.2	1.3	0.9	3	0.01	0.5
CV%		**2.3**	**2.9**	**11.7**	**2.0**	**3.0**	**2.4**	**6.9**	**2.0**	**2.3**	**1.4**	**10.8**
Q99%		1.5	1.9	1.0	1.6	1.6	2.4	2.6	1.8	6	0.03	1.1
Min		31.3	30.6	3.6	38.0	25.0	47.8	17.1	42.9	144	0.94	4.2
Max		33.1	32.7	4.7	40.0	26.7	50.6	19.9	45.1	153	0.98	5.6
USP	[2007]			38				56		44	5	19

Table 6 Print-out of USTER® AFIS PRO 2 with length result columns Q to S

Q Fiber fineness in mtex

R Maturity ratio

S Immature fiber content in percent

6.2 Graphical results

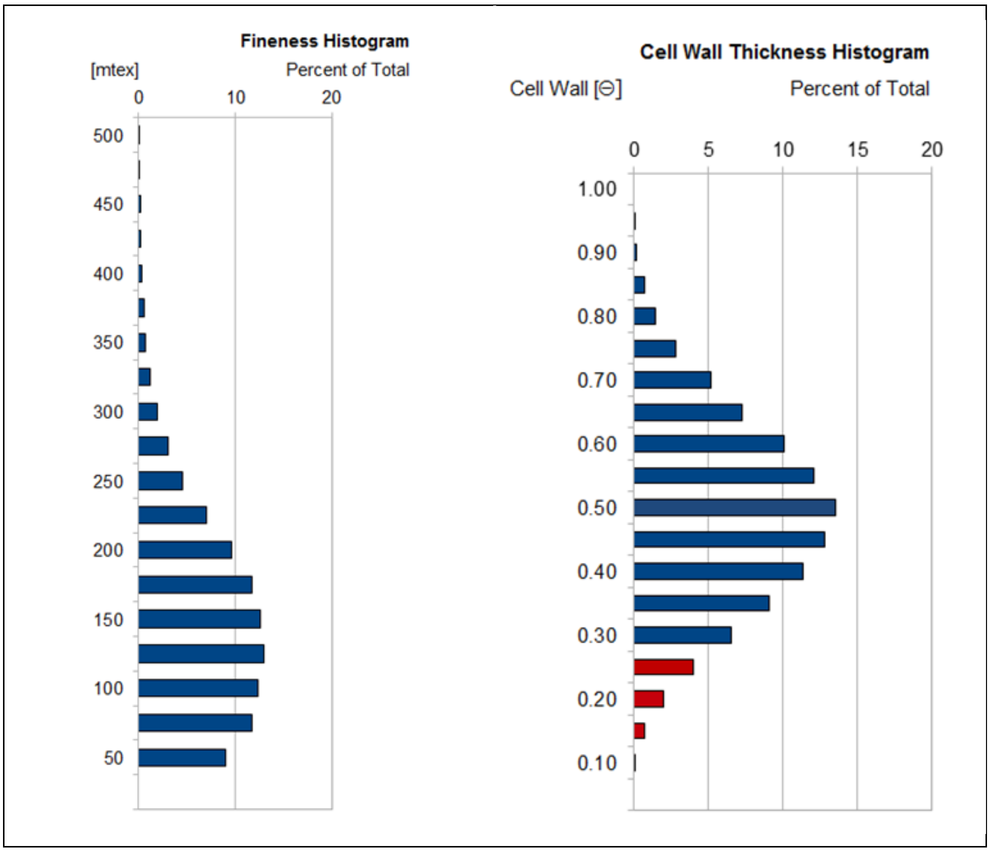

Fig. 11
Left side:
Histogram Fiber Fineness
Right side:
Histogram Cell Wall Thickness

Fineness: In the fineness histogram the individual fibers - normally 3000 per sample - are classed according to their fineness.

Ranges from 50 – 350 mtex are common – averaging to 130-200 mtex. This would correspond to Micronaire values from 3.3 - 5.0.

Cell Wall: The fibers which have a cell wall less than 0.25 are considered as immature - and are highlighted by the red bars in the histogram. These fibers reflect also the immature fiber content (IFC).

Fibers that have developed a cell wall of 0.25 to 0.5 are considered as thin walled fibers.

Maturity is calculated out of these parameters shown in the histogram

$$\text{Maturity} = \frac{(\text{Mature fibers} > 0.5\%) - (\text{Immature fibers} < 0.25\%)}{200} + 0.7$$

6.3 Practical example

The higher the immature fiber content the more problems will occur in dyeing. Immature fibers cause “white specks” in dyed fabrics, as they will not absorb the dye stuff. These immature cotton fibers have no cellulose in the wall, and therefore the dye stuff can not be taken up. Therefore, a mill should monitor fiber maturity level and its variability through processing to prevent problems later in the fabric.

Characteristics	Bale	Card Mat	Card Sliver	Comber Sliver
Maturity ratio [ ]	0.96	0.89	0.87	0.97
IFC [%]	4.8	6.0	7.2	3.7

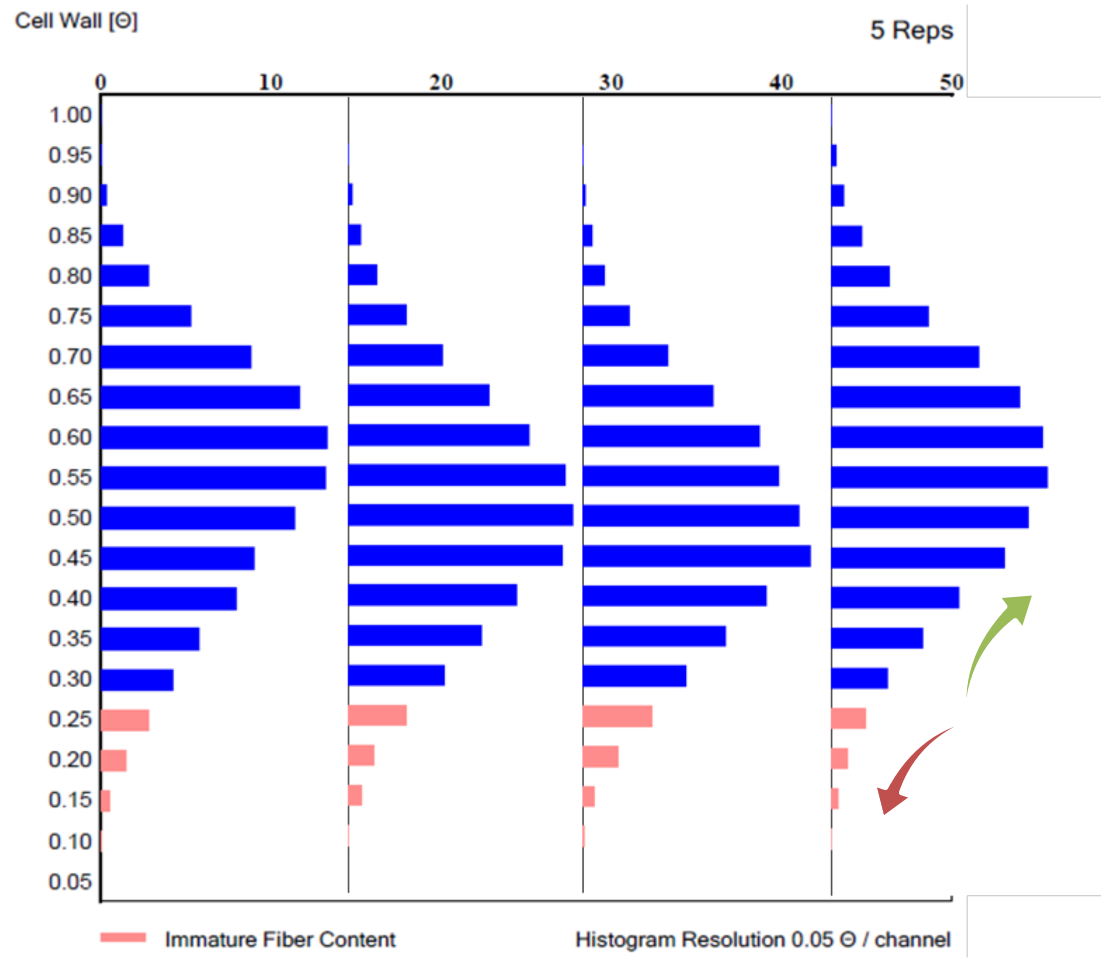

Table 7 Cell wall distributions in spinning process

With the histograms above, one can easily see what happened in the spinning process in our example study. Within the openening and carding process fibers were damaged, and therefore the IFC content increased slightly.

Immature fibers are also weak and t herefore break easily during processing. These broken fibers then get distributed throughout a bl ended sample causing more problems for dyeing.

The effect on the maturity ratio is also clearly visible. It drops in the two stages card mat and card sliver.

However in the combing process - where the short fibers are combed out – also the immature fibers were reduced as they were likely part of the short fibers removed. This allows us to draw the conclusion, that often the short fibers are also the immature ones.

If the comber noil would be tested on the instrument – one would see – besides the high amount of neps and the high short fiber content that the maturity within the noil would also be low, indicating a high amount of immature fibers..

Additionally the dust and trash content can be considerably high in comber noils.

7 AFIS Dust & Trash

7.1 Numerical results

		T	U	V	W	X	Y	Z
TRASH	Rep	Total Trash Count	Total Trash Size	Dust Count	Dust Mean Size	Trash Count	Trash Mean Size	VFM
		[Cnt / g]	[µm]	[Cnt / g]	[µm]	[Cnt / g]	[µm]	[%]
	1	246	239	228	206	18	664	0.33
	2	696	191	666	170	30	651	0.61
	3	394	218	380	197	14	789	0.46
	4	312	225	304	199	8	1,225	0.59
	5	434	213	414	185	20	790	0.50
n	5							
Mean		416	217	398	191	18	824	0.50
Std. Dev.		172	18	166	14	8	234	0.11
CV%		41.4	8.1	41.7	7.4	45.1	28.4	22.4
Q99%		354	37	342	29	16	482	0.23
Min		246	191	228	170	8	651	0.33
Max		696	239	666	206	30	1,225	0.61
USP	[2007]			33		<5		6

Table 8 Print-out of USTER® AFIS PRO 2 with trash result columns

- T Number of total dust & trash particles per gram
- U Mean size of all the particles in micrometer
- V Dust particles per gram
- W Mean size of dust particles in micrometer
- X Trash particles per gram
- Y Mean size of all trash in micrometer
- Z Visible foreign matter in percent

7.2 Graphical results

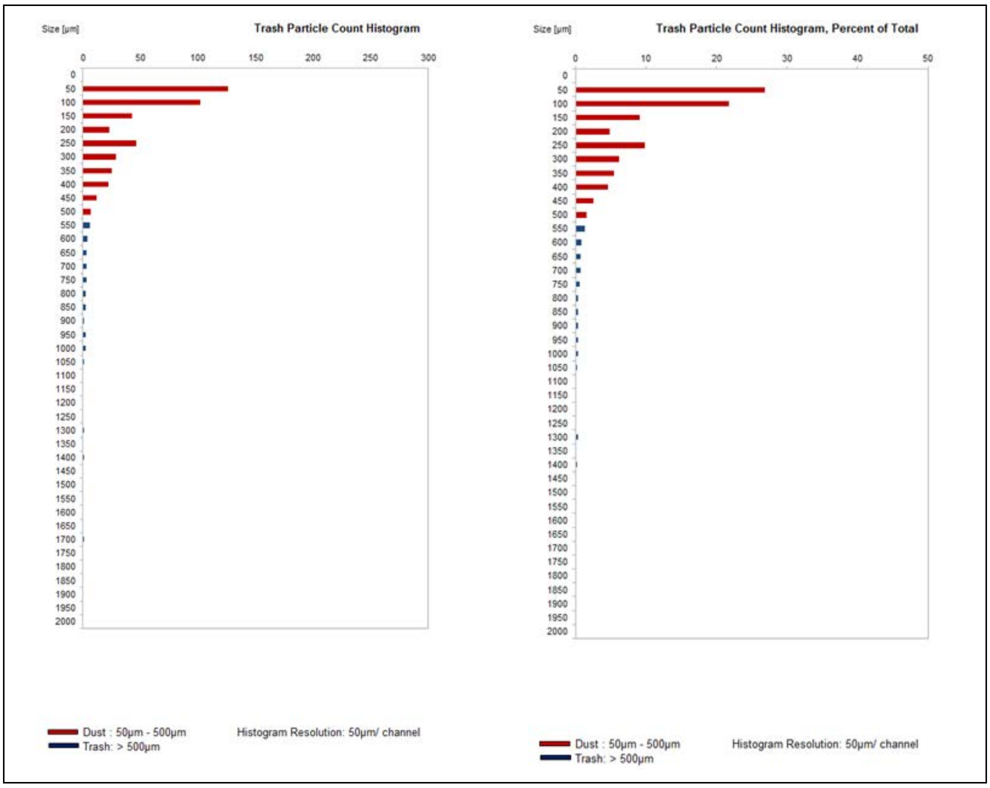

Fig. 12
Left side:
Histogram Trash Particle by Count

Right side:
Histogram Trash Particle by percent of total

All particles smaller than 500 µm are classed as dust particles – the ones above this limit are classed as trash particles.
The visible foreign matter, the VFM is given as a percentile value. It is based on an algorithm, which considers the number of events, their sizes and the density.

For judging the removal of neps or trash particles and their sizes, it is recommended to use the <u>histograms by count.</u> So the effect of the processes e.g. of the card or of the comber can be seen easily.

Please note, that when comparing graphs within a spinning process one should compare always the same type of graph, as they are two options selectable, and the histograms look similar, but are not the same.

7.3 Practical example

Characteristics	Bale	Card Mat	Card Sliver	Comber Sliver
Dust [Cnt /g]	657	354	21	2
Trash [Cnt /g]	47	36	1	0
VFM [%]	1.08	0.86	0.02	0.00

Table 9 Dust and trash results in spinning process

Besides the judgement of the histograms (removal of trash particles according to their sizes) – the trash removal efficiencies can also be calculated. The input and output data pair are always used for the calculation.

$$\text{Trash Efficiency} = \frac{(\text{Trash Input}) - (\text{Trash Output})}{\text{Trash Input}} * 100$$

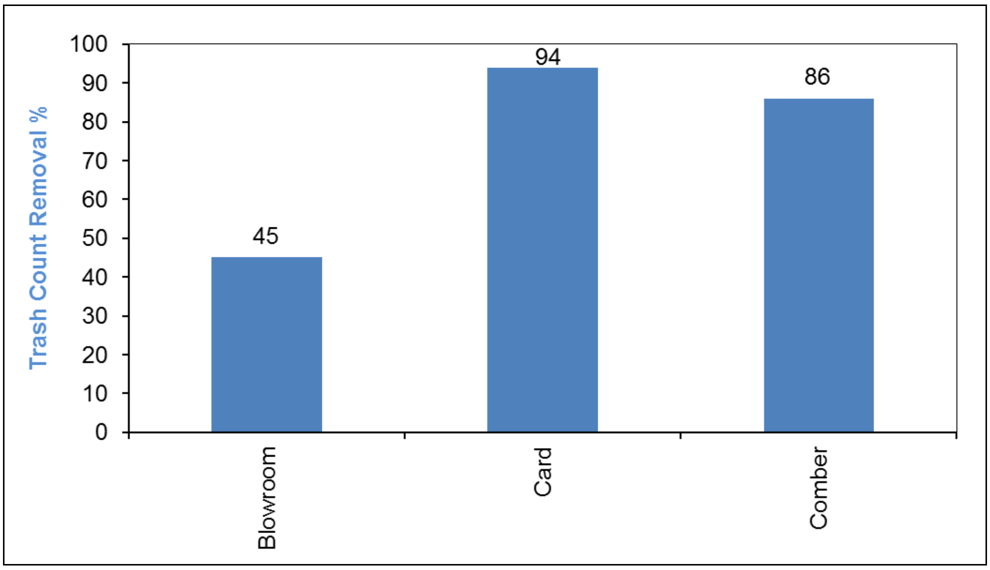

Fig. 13 Trash efficiencies in spinning process

In a mill, between bale to card mat we usually experience trash removal efficiencies of 40-70 %. At the card trash removal efficiencies of 80-90 % can be expected.

The trash removal efficiency is useful in judging the complete blowroom depending on incoming trash level, machine speeds and settings.

In general, the performance assessment of blowroom, carding and combing is based on the results of neps, fiber length and trash. Not one by one, but all together.

8 Application reports & control charts

Within the application reports you will find three types of graphs – the critical nep size, the roller spacing and the efficiency reports.

8.1 Critical nep size

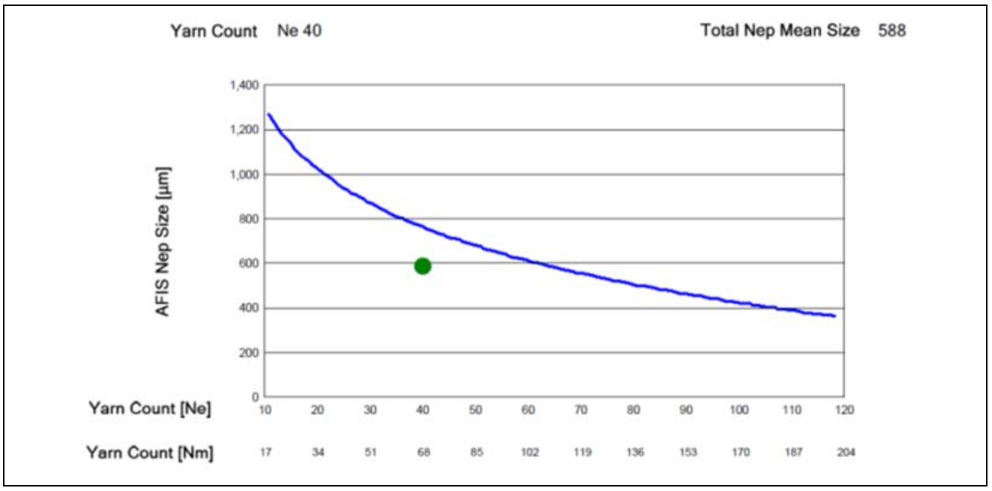

Fig. 14
Application report: Critical nep size

For 100% cotton yarns in ring and rotor spinning the report of the critical nep size shows if the average nep size will cause imperfections in the yarn. If the dot is above the blue line, it will be plotted in red, meaning the critical nep size is exceeded for the selected yarn count. If the dot is plotted in red, it means the average nep size is not critical for that particular yarn count.

8.2 Roller spacing

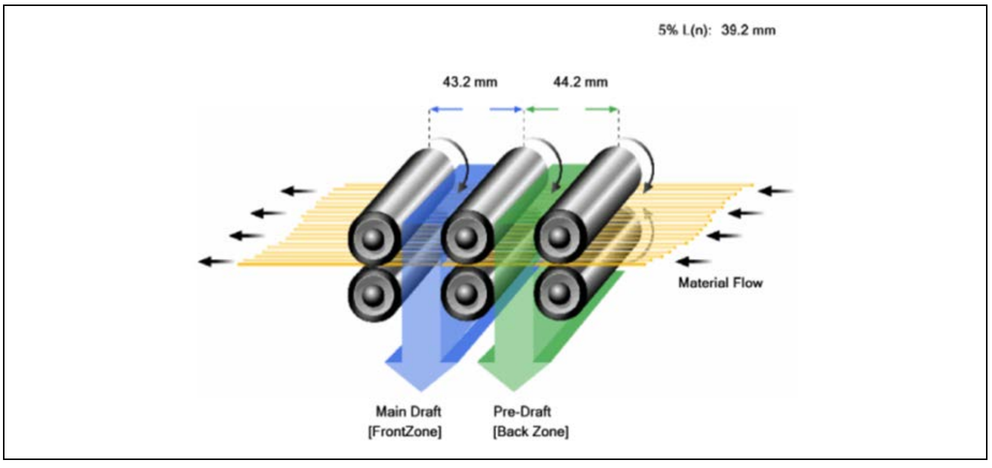

Fig. 15
Application report: Roller space setting

The roller space setting report gives a recommended roller space setting as a starting point for draw frame roller distances (3 over 3 rollers) in a spinning mill. These values are based on the 5% length by number. A suggestion is made for distance of the pre-draft zone, and the main-draft zone.

8.3 Efficiency reports

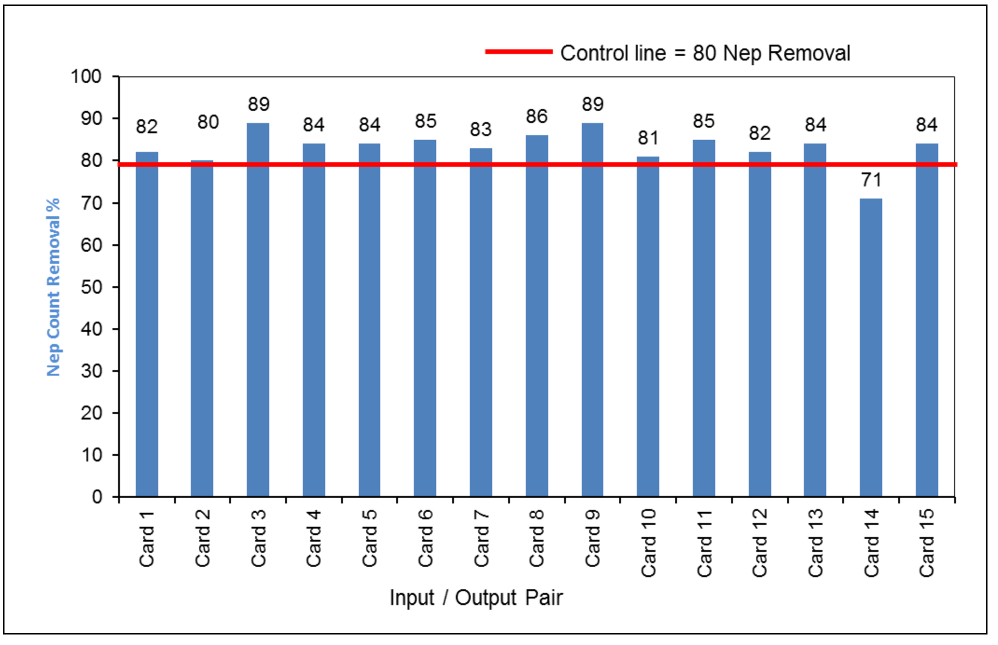

Fig. 16
Application report:
Efficiency report of different cards

These reports are available in the report section of the instrument and the parameter can be selected individually by the user.

The pairs (input vs.output) need to be specified, e.g. card mat can be paired up with the corresponding card slivers.

It is useful to determine individual cards within a spinning mill, that do not perform as good as expected – or judge the cleaning behavior of a certain material. Best way in getting this, is by calculating the efficiencies.

Efficency reports can be calculated for short fiber content, neps and trash values.

The level of removal efficiencies however also depends highly on the starting level trash, neps or short fiber in the raw cotton. With a higher trash, neps or short fiber content normally higher removal efficiencies can be achieved.

Besides the histograms, the numeric data should not be forgotten. For rotor yarn, a level of V.F.M. below 0.1 % needs to be achieved, as high dust counts or trash particles will affect the running performance on OE-machines.

Also trash and seed coat fragments are responsible for yarn breaks, especially in warping, since they are weak places, and thus replace fibers in the yarn cross-section.

8.4 Control charts

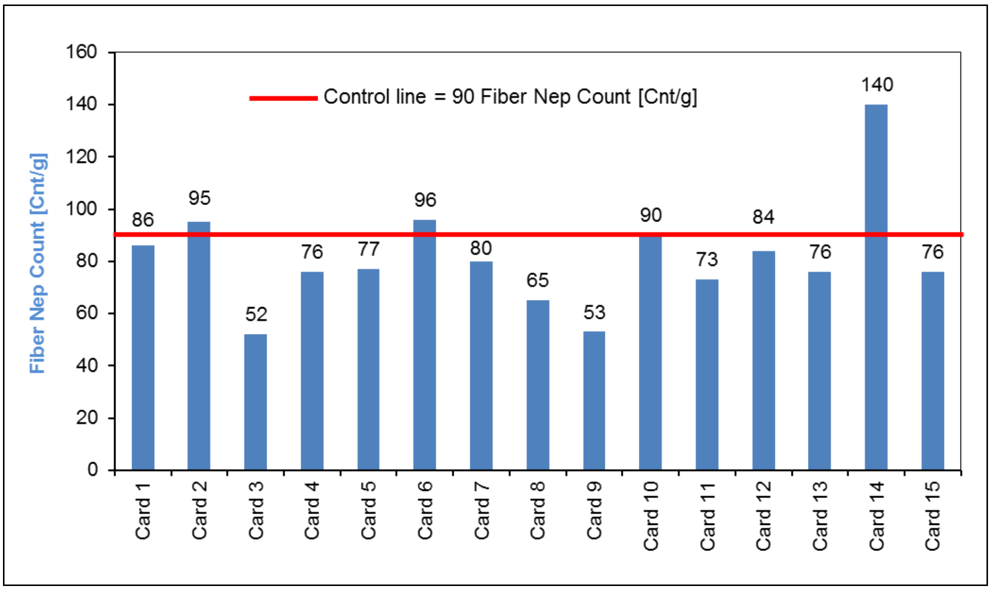

Fig. 17
Control Chart Neps of different cards

Another report that can be used to monitor the processes performance is the control chart. In this report, one can set a limit value and then plot all the machines in the process against the limit value to identify which machines are not performing to standard for a particular measured parameter like neps, short fiber, and VFM%.

Here we do not have a calculation like in the efficiency graph, just the graphical display of the originally tested values. The customer can select manually the positions he wants to have displayed in the same graph.

With this type of graph also a view of a specific machine over time (long-term-report) can be generated. To make this report effective, it is recommended that useful and reproducible naming and filing of the tested samples be utilized.
When we always use at each test the same name, such as CARD No. 1, we can obtain a control chart with the date on the scale of the x-axis. Needs for card grinding or rewiring can then be determined.

Both types, the actual status of all cards – or an individual card over time- allows to identify individual cards out of the complete line, which do not perform up to the required level. Settings or the grinding or rewiring schedule can be adjusted accordingly.

Exceptions can be recognized fast and easy with these reports. The long-term quality therefore can be maintained in the desired tolerances.

9 Benefits when using histograms

Besides the numerical data in USTER® *AFIS PRO 2,* we have the possibility of obtaining the accompanying histograms of the individual parameters on the measured fiber. This allows us, to identify problem areas in the spinning process by making a more detailed analysis.

Even though we might be satisfied with the nep level, and nep removal efficienies – the short fiber content or the trash might be not behave like expected. A look and comparison of the different histograms of the individual process step helps us in identifying those areas.

So knowing if a setting improves our quality or just increases our combing noil can help a spinner in saving raw material.

The spinner in our example used previously was damaging his fiber in the blowroom and later had to remove the created short fiber at combing just to regain his orginal fiber length. His loss in fiber length is dramatic, and can be expressed in monetary loss, assuming he could use a shorter staple to begin with, and handle this with care.

With better settings / speeds in the area of blowroom and card the mill would be able to maintain their fiber quality. Therefore, yarn quality would get better as well, or he could spin finer and higher quality yarns out of the extra long staple quality.

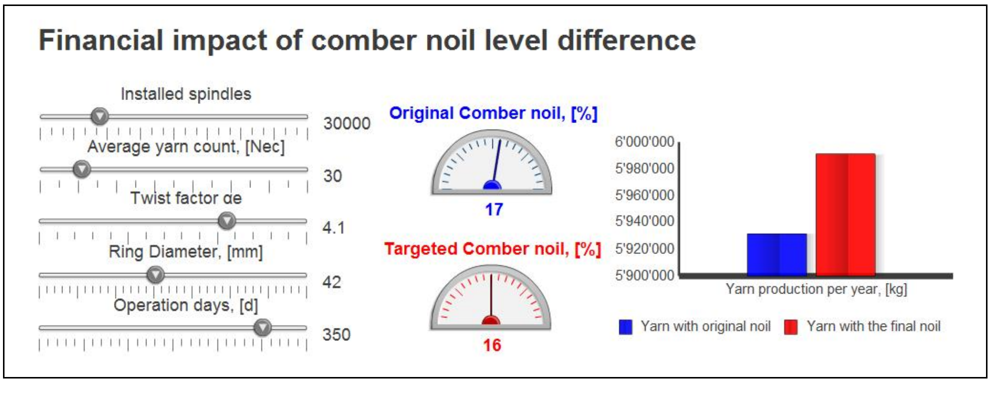

Fig. 18
Impact of noil level on financial gains

10 Conclusion

With the help of the single fiber testing USTER® *AFIS PRO 2* in the spinning mill, the processes can be optimized – not only the blowroom, carding, and combing, but also in the drawing and roving level.

Evaluating the numeric data gives us one indication for improvement – equally important is to check the histograms to see what is happening within the distribution of the measured properties.

There first indications of fiber damage can be seen in the length by number distributions. Also, well-intended approaches, such as increase of noil percentage can be evaluated before even getting to the yarn stage.
The subtle balance between fiber quality parameters and machine settings can be adjusted and fine tuned to the customer needs and requirements.

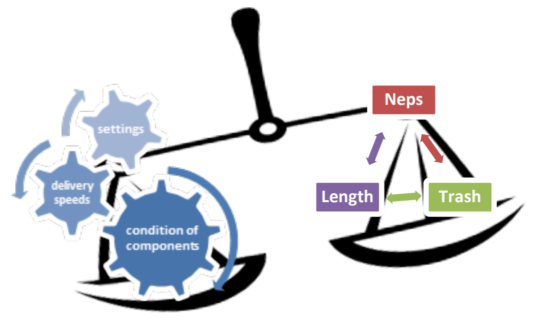

Fig. 19
Subtle balance of fiber quality and machinery impacts.

The USTER® *AFIS PRO2* offers a means to check the fiber quality for all relevant parameters in the spinning process. The impact on fiber quality due to the machinery state can be easily assessed and measured to optimize quality and productivity.

Fiber testing in the spinning process helps the customer to optimize quality, retain it and therefore maintain margins.

11 Literature / References

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- Different lab trials / field studies
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- Application Report SE610, Richard Furter, Application of single fiber testing systems for process control in spinning mills, November 2007
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