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USTER® *NEWS BULLETIN*

USTER® *STATISTICS 2018* – The industry's quality language enters a new dimension

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Editorial

In 2017 we celebrated the 60th anniversary of USTER® *STATISTICS*. What began in 1957 as three simple tables had grown to an immense volume of data. Over these decades, USTER® *STATISTICS* was continuously increasing in importance as an essential aid to textile producers. Today, fiber purchasing, yarn development and trading would be virtually unthinkable without these unique global benchmarks. This year, we enter a new dimension, with USTER® *STATISTICS 2018* published as a mobile application – simply called the STATISTICS app.

Ten years ago, nobody would have imagined a world dominated by mobile apps. Now it's here – an extremely dynamic environment for both personal and business communication. A big plus is that we are now able to react promptly to customer needs. It brings us closer to the market, making it faster and easier to innovate and to share experience – in our case textile experience. That's why we were keen to exploit this technological opportunity.

A key global trend today is the growth of 'smart' systems. In the digital world of apps, this is usually understood to mean 'smart' interaction with the user. Artificial intelligence (AI) and clever algorithms can bring novel future functionalities, so that interactions between humans and machines will become even smarter, more intuitive. Through machine learning and AI, digital products will be able to solve problems by themselves in the near future. This future journey USTER® *STATISTICS* is now embarking on.

The basic steps are in place, providing the established benchmarking data in the mobile app format. USTER® *STATISTICS 2018* is cloud-based, allowing access to all data at any time. This provides the foundation for bringing new data and features to USTER® *STATISTICS* faster than ever before. So, the five-year publication intervals will be a thing of the past.

As well as data and IT specialists, there is a host of people behind each new USTER® *STATISTICS* publication. I would like to convey my special thanks to the USTER laboratory teams in China and Switzerland, where thousands of fibers and yarns have been tested tirelessly and the data processed. My thanks also go to the customers who provided the materials and to the Service and Textile Technology teams who collected the materials from the industry. I also congratulate the project team which created and implemented the STATISTICS app. This new dimension for the USTER® *STATISTICS* is the beginning of further beneficial developments in the future.

Iris Biermann
Head of Textile Technology
Uster Technologies AG

Contents

1 Introduction

For the first time, USTER® *STATISTICS* is offered in a new format that meets the industry's increasingly mobile requirements: a knowledge base within an app that is portable and quickly accessible any time, even if no internet connection is available.

The USTER® *STATISTICS 2018* app is ready to download now. The QR code leads to a website (www.uster.com/statistics2018) with all the details.

The easy-to-use concept of the STATISTICS app offers useful search mechanisms with customizable features. The chapter structure of the previous versions of USTER® *STATISTICS* is thus replaced. Favorites – individual filters – are simple and quick to store in order to recall frequently used benchmarks. Charts and tables can be sent or printed at the touch of a button, enabling direct communication between business partners via the STATISTICS app.

Fig. 1 Possible range for blend ratio selection in 1 % steps. The indications and options change relative to the blending agents

With the new mobile app, we are proud to present a virtually seamless blended yarn range. Users can enter their chosen blend ratio in 1 % steps **Fig. 1**. After entering the ratio, the graph relating to the input value is selected in the background. This fulfills requests by many users for more blended yarn options in USTER® *STATISTICS*, making the STATISTICS app much easier to use.

Fig. 2 shows the possible blend ratio areas now available with USTER® *STATISTICS 2018*.

USTER® *STATISTICS 2018*

Raw material	Blend ratio range (%) Entry of 1 % steps possible	Yarn type	Carded	Combed	Any process	Cop	Package
PES/CO	30 – 80 / 70 – 20	ring yarn	•	•		•	•
	15 – 29 / 85 – 71	ring yarn	•	•		•	•
	50 – 65 / 50 – 35	air-jet yarn			•		•
	30 – 90 / 70 – 10	rotor yarn	•				•
PES/CV	80 – 50 / 20 – 50	ring yarn	•			•	•
	65 – 70 / 35 – 30	air-jet yarn	•				•
PES/WO	30 – 70 / 70 – 30	worsted yarn		•		•	•
CO/CMD	48 – 60 / 52 – 40	ring yarn			•	•	•
	50 – 50 / 50 – 50	compact yarn		•		•	•
CO/CV	50 – 70 / 50 – 30	ring yarn			•	•	•
CO/EL	90 – 97 / 10 – 3	core yarn	•	•		•	•

Fig. 2 Blend ratio areas available with USTER® *STATISTICS 2018*

The USTER® *NEWS BULLETIN* is organized in two main parts. Chapter 2 describes what has changed since the previous edition of USTER® *STATISTICS* – along with possible reasons for the changes and trend analyses. Chapter 3 introduces the new characteristics of USTER® *STATISTICS 2018* and explains their use, with practical guidance which readers will find beneficial.

2 Trends

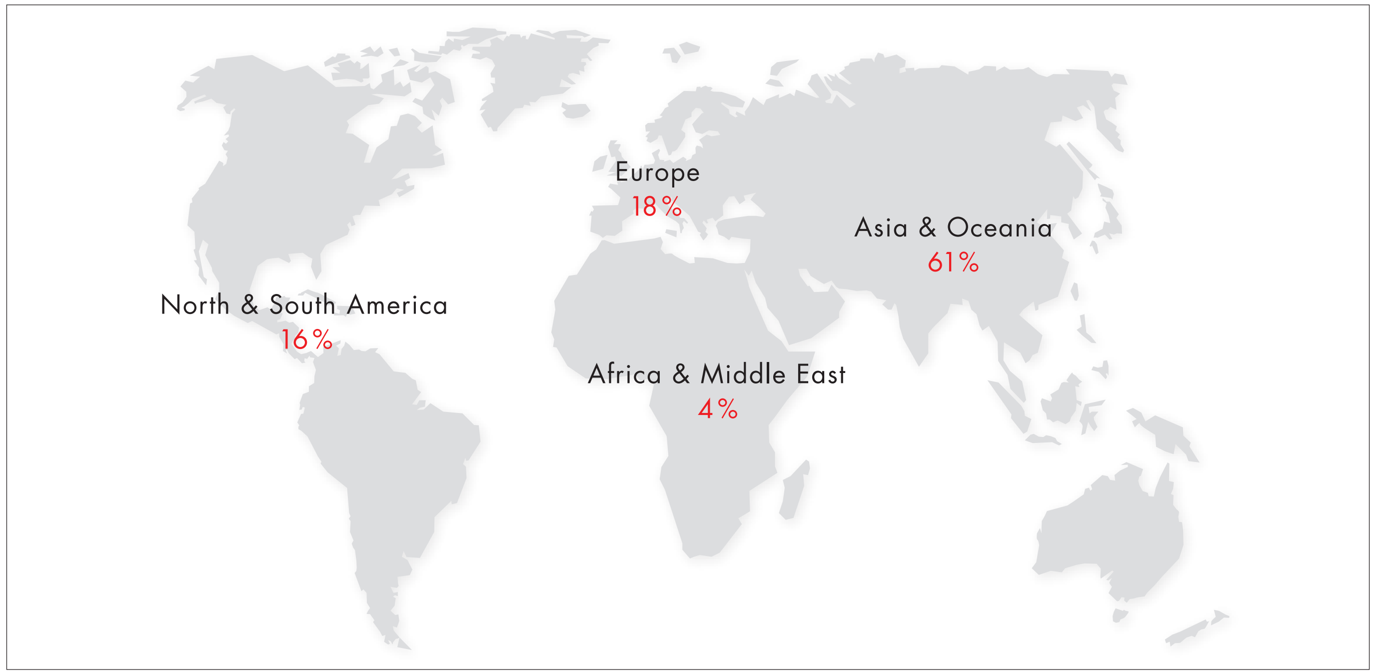


Fig. 3 Geographic distribution of fiber and yarn samples provided by customers and business partners during the testing period

Uster Technologies enters a new dimension of superlatives with USTER® *STATISTICS 2018*. The sheer number of diagrams illustrates the variety and diversity of yarns on the market today. The publication comprises nearly 4 000 graphs, with quality data about numerous fibers, yarns and processes. The geographic distribution **Fig. 3** shows the representative nature of the global sample collection from Uster Technologies. The dominance of Asia and Oceania has decreased from 71 % to 61 % compared to USTER® *STATISTICS 2013*. North and South America have increased from 8 % to 16 %, while Europe (15 % to 18 %) and Africa (6 % to 4 %) show marginal changes. Overall, the distribution of the samples correlates with the world map of textile economic importance.

Analysis of these samples – the data on which the new USTER® *STATISTICS* is based – provides interesting insights into the current quality benchmarks. Comparison of USTER® *STATISTICS 2013* and USTER® *STATISTICS 2018* identifies a number of trends, which are presented in Chapter 2.

2.1 Fiber outcomes

Comparing the USTER® *STATISTICS 2013* and *2018* data, short fiber content of raw cottons has decreased. This applies especially to longer fibers. At the same time, fiber tenacity has increased. **Fig. 4** clearly shows, for example, that a 31 mm long cotton fiber today (USTER® *STATISTICS 2018*) has, on average, a short fiber content of 6.99 % at USP™ 50 %. Previously, in USTER® *STATISTICS 2013*, it had 7.96 % of short fibers.

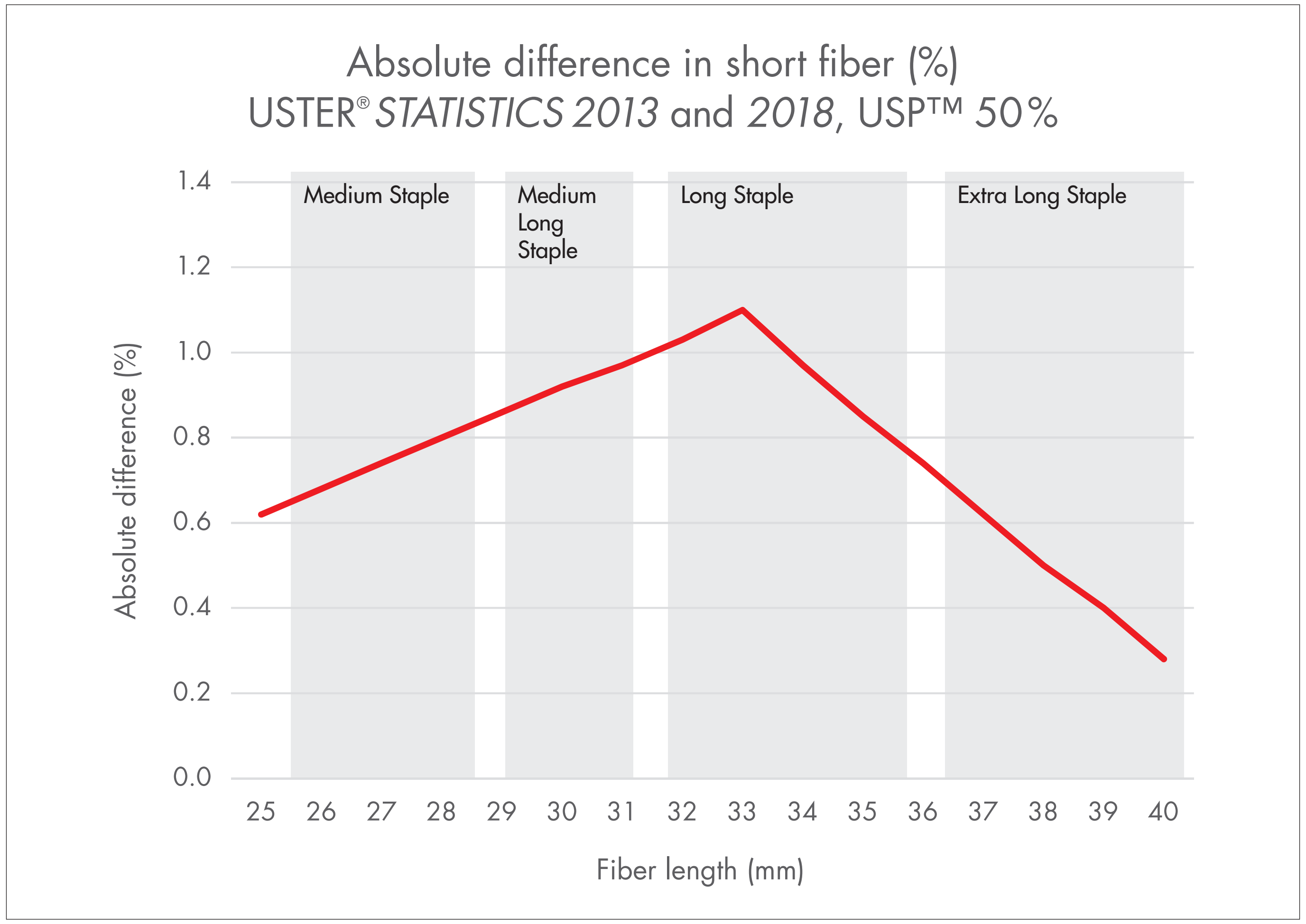


Fig. 5 Absolute differences in short fiber content between USTER® *STATISTICS 2013* and *2018*

USTER® *STATISTICS 2018*

USTER® Products: HVI | Characteristic: SF

Bale, Loose

SF - Short fiber [%]

mm	5%	25%	50%	75%	95%
25	7.36	9.29	11.19	13.20	15.40
26	6.99	8.75	10.49	12.31	14.34
27	6.61	8.21	9.79	11.43	13.28
28	6.24	7.66	9.09	10.54	12.22
29	5.87	7.12	8.39	9.66	11.16
30	5.49	6.57	7.69	8.77	10.10
31	5.12	6.03	6.99	7.89	9.03
32	4.74	5.48	6.29	7.00	7.97
33	4.37	4.94	5.58	6.12	6.91
34	3.30	4.02	4.78	5.58	6.30
35	3.19	3.90	4.62	5.39	6.13
36	3.07	3.77	4.45	5.20	5.97
37	2.95	3.65	4.29	5.01	5.80
38	2.83	3.52	4.13	4.82	5.64
39	2.71	3.39	3.96	4.63	5.48
40	2.59	3.27	3.80	4.44	5.31

USTER® *STATISTICS 2013*

UHML mm	UHML inch	5%	25%	50%	75%	95%
25.0	0.98	8.65	10.20	11.81	13.57	15.45
26.0	1.02	8.22	9.67	11.17	12.78	14.54
27.0	1.06	7.79	9.14	10.53	12.00	13.64
28.0	1.10	7.36	8.61	9.89	11.21	12.74
29.0	1.14	6.94	8.08	9.25	10.42	11.84
30.0	1.18	6.51	7.54	8.61	9.63	10.94
31.0	1.22	6.08	7.01	7.96	8.84	10.04
32.0	1.26	5.65	6.48	7.32	8.05	9.13
33.0	1.30	5.22	5.95	6.68	7.27	8.23
34.0	1.34	4.14	4.93	5.75	6.72	7.65
35.0	1.38	3.88	4.66	5.47	6.43	7.36
36.0	1.42	3.62	4.39	5.19	6.14	7.07
37.0	1.46	3.37	4.11	4.91	5.86	6.77
38.0	1.50	3.11	3.84	4.63	5.57	6.48
39.0	1.54	2.85	3.57	4.36	5.29	6.19
40.0	1.57	2.60	3.30	4.08	5.00	5.89

Fig. 4 Short fiber content in USTER® *STATISTICS 2013* and *2018*

Comparisons identify that the long staple fibers at 33 to 34 mm show the greater difference between the two editions **Fig. 5**. A clear trend is that the short fiber content is always to be smaller, regardless of fiber length.

Higher fiber tenacity helps counteract fiber damage due to the ginning process. The genetic modification of cotton during the past few years apparently made a positive impact.

Cotton breeders had been focused on fiber tenacity, especially regarding long staple qualities, to enable fine yarn counts, which typically have a low number of fibers in the cross-section.

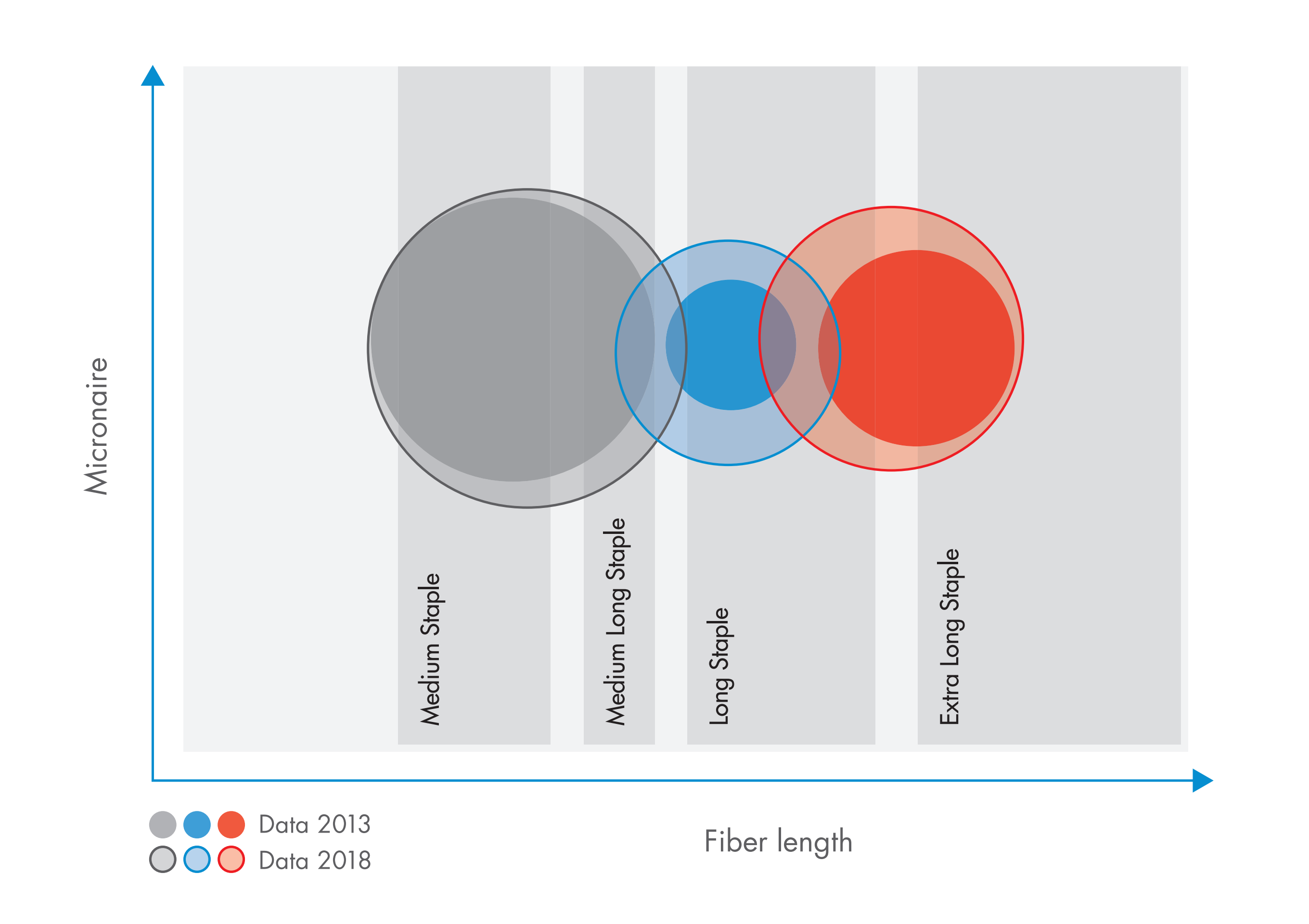


Fig. 6 Distribution of micronaire versus fiber length with measurements published in the 2013 and 2018 editions

Fig. 6 shows the micronaire distribution across the fiber length range for USTER® *STATISTICS 2013* (colored circles) and *2018* (semi-transparent circles). The focus is not on the micronaire distribution on the y axis; rather it is on the length distribution on the x axis. Even allowing for the fact that we have tested many more samples for 2018, the semi-transparent circles show that the medium long staple (29–31 mm) have a tendency to merge with long staple (31–36 mm), as do the long staple with the extra-long staple (>36 mm).

The reason for this trend can also be seen in some of the main cotton-growing areas. Many of the fiber qualities cultivated in Texas, Australia and Brazil today fall between medium long and long staple fibers. These areas account for a huge ratio of world cotton production.

2.2 Fiber processing

We received significantly more in-process samples, compared to previous publications. This is why we were able to dispense with the 'provisional' status of the processing statistics. The following processing statistics are included **Fig. 7**:

- For ring yarns and compact yarns
  - 1 Bales, 2 card mat, 3 card sliver, 6 finisher sliver, 7 roving
  - 1 Bales, 2 card mat, 3 card sliver, 4 comber lap, 5 comber sliver, 6 finisher sliver, 7 roving
- For rotor yarns
  - 1 Bales, 2 card mat, 3 card sliver

The basic changes in raw cotton are reflected in the processing statistics. The start points – the values at bale – have changed, and therefore, the following differences have been noted:

Changes in ring spinning mills

The level of seed coat neps in bales and card mat material has risen, as shown in fiber processing data for ring spinning mills. The same applies to dust and trash.

Higher production quantities in the blowroom and high carding speeds have increased the levels on a global scale.

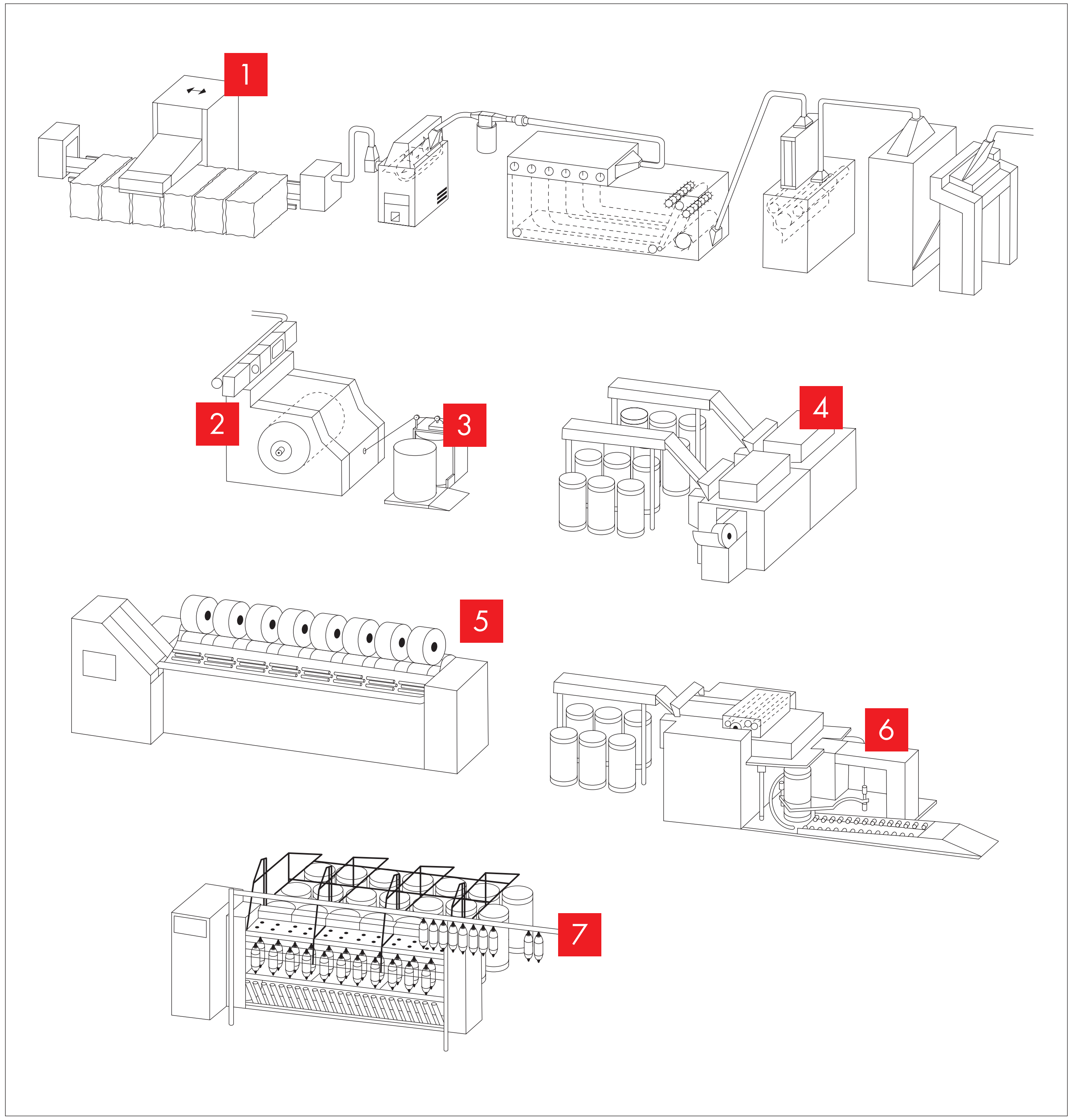


Fig. 7 Sampling points for fiber process statistics

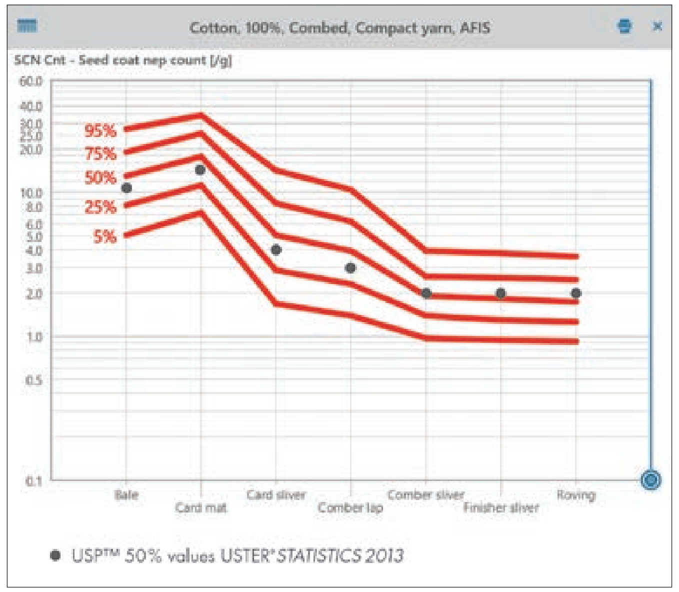


Fig. 8 Changes in seed coat nep count levels in combed compact yarn production. Grey dots represent the USP™ 50 % values in USTER® *STATISTICS 2013*

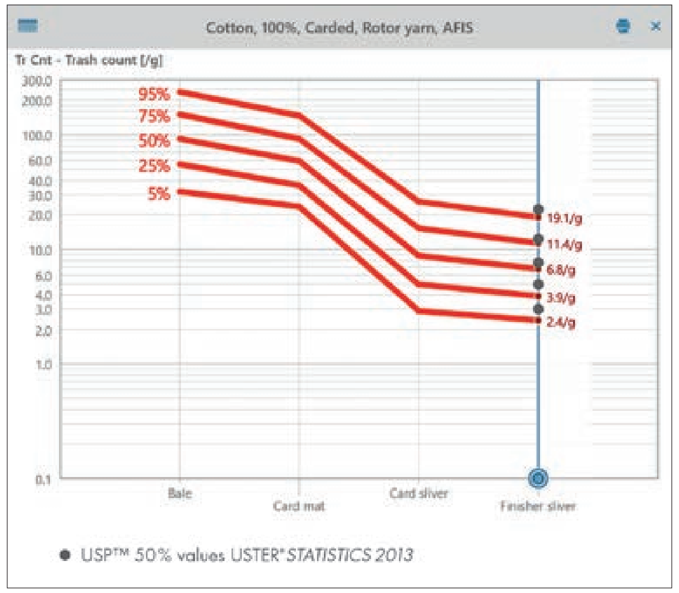


Fig. 9 Changes in trash count levels in rotor yarn production. Grey dots represents the USP™ 50 % values in USTER® *STATISTICS 2013*

Changes in compact spinning mills

Obviously, increasingly more cost-effective raw cottons are being used for compact yarn spinning. For this yarn type, the seed coat nep count has clearly risen, which can be traced back all the way to the card mat material **Fig. 8**: The visible foreign matter content in comber slivers has also risen, according to the fiber processing data for compact spinning mills.

There are a number of possible reasons for this. An important factor could be the trend for increased productivity at the expense of quality. The production of different levels of comber noil, as well as the tendency for more cotton varieties to have a higher content of seed coat neps, could also play a role.

Changes in rotor spinning mills

Evaluation of the fiber processing data for rotor spinning shows that the content of short fibers, visible foreign matter and dust in finisher slivers is almost the same. The trash content has decreased **Fig. 9**.

Although secondary fibers are widely used for rotor spinning, the trash content has decreased. We can assume that hardly any cotton rotor yarn is spun without the addition of some level of secondary fibers from the spinning preparation processes, which has been the case for several decades. The reduction in trash could result from more efficient cleaning and carding processes, as well as the use of larger volumes of comber noil, which is a 'clean' secondary fiber with a low trash content.

2.3 Yarn outcomes

The following section shows yarn quality trends for major characteristics.

2.3.1 Yarn evenness

Yarn evenness values have remained stable for almost all yarn qualities. Looking back over the 60-year history of USTER® *STATISTICS* **Fig. 10** shows that yarn evenness for ring cotton yarns has remained stable since 1997 and that no further significant improvements have been made in this sector.

Feedback from weavers suggests that ring yarn should have more 'liveliness'. What they actually mean is that the yarn should not be 'too even' – as yarns that are too smooth can cause weaving processing problems. This confirms that not all markets require more even ring yarns. Uster Technologies will continue to monitor the situation, but it does seem likely that there will be no further improvement in the future.

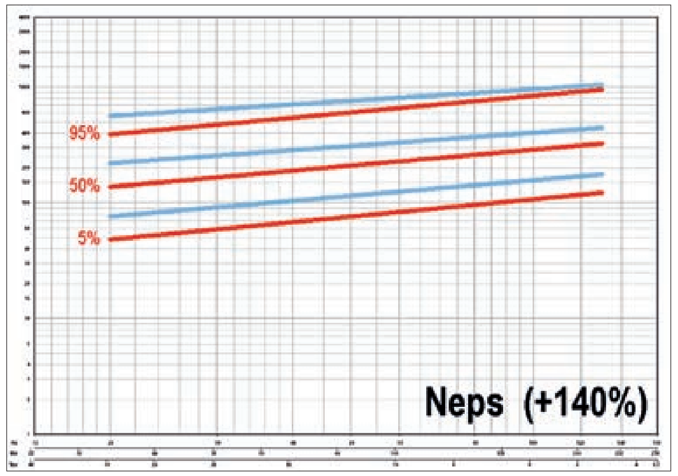


Fig. 11 Example of 100 % combed cotton compact yarn on weaving packages (blue lines show data from 2013 and red lines data from 2018)

2.3.2 Yarn imperfections

Generally, it can be said that imperfections have improved in almost all yarn qualities. This applies particularly to sensitive levels -40 % thin places and +140 % neps.

Fig. 11 shows the evident situation in many yarn qualities. The blue lines are the calculation of the 2013 data, while the red lines relate to 2018. The +140 % neps levels has decreased.

A possible explanation for the improvement in the occurrence of sensitive neps is that modern spinning preparation equipment helps to prevent nep formation, even at higher productivity. The reduction in sensitive thin places can more likely be attributed to the use of better drawframes and spinning machines.

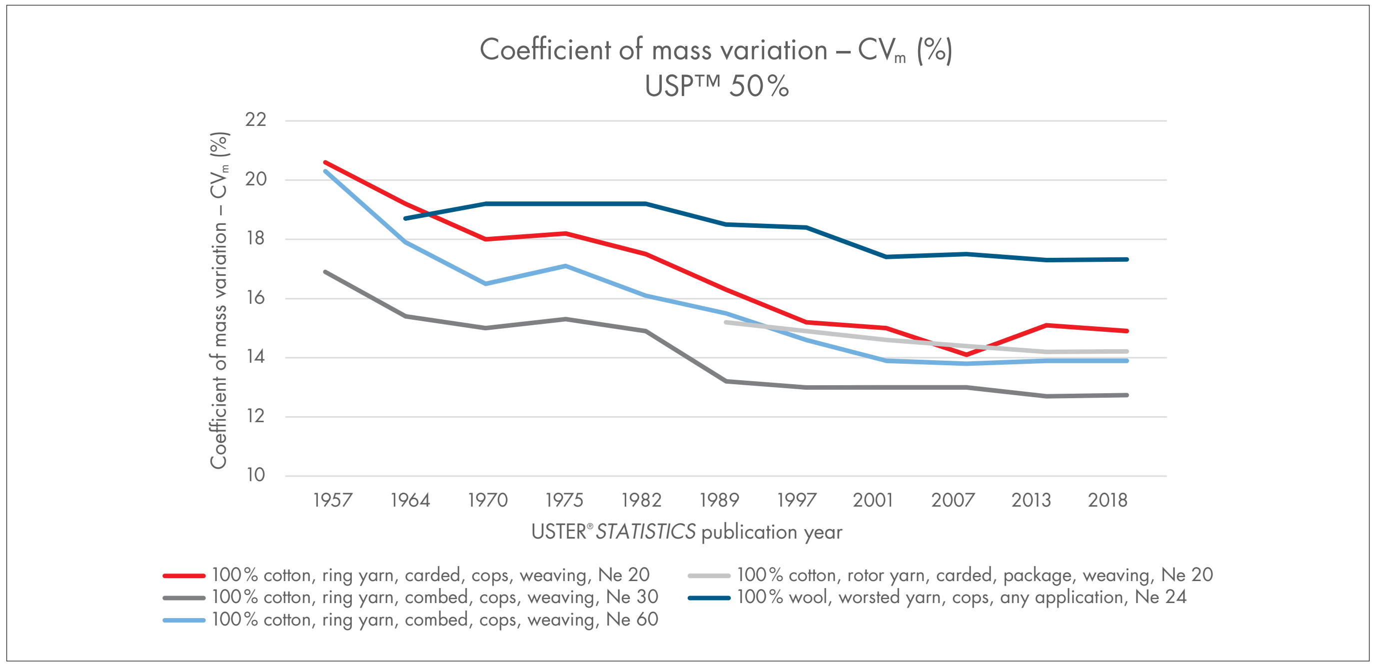


Fig. 10 Changes in yarn evenness since the first USTER® *STATISTICS*

Unfortunately, the figures for +140 % neps have been published only since 2007. For this reason, a historical view of this characteristic is less useful. The historical view of standard imperfections, as shown in **Fig. 12**, has been stable since 2001.

This leads to the conclusion that there is a notable impact in the sensitive classes, but not in the classic classes normally used in yarn profiles for trading purposes.

The level of +50 % thick places **Fig. 13** has decreased over the years. The latest phase, between 2013 and 2018, is the first period in which the decrease was small. The biggest decrease over time is visible in carded ring yarns. The level of thin places has been stable since 2001.

There could be two reasons for this development. Either, spinning mills have learned to optimize their raw materials and spinning processes at a constant level, to meet customer requirements, while the markets are not requesting lower levels. Or, it could indicate that machine manufacturers are not focusing on the reduction of absolute thin place levels. Their priority is to achieve constant imperfection levels between spinning positions, leading to lower variations between yarn packages – rather than an absolute reduction.

2.3.3 Yarn density

Interesting trends here include the incidence of low yarn density, especially in the coarse count ranges. This is consistent with the trend for fewer yarn twists, again particularly for coarser yarns.

There are a number of possible reasons for this. Firstly, producers may be trying to achieve a softer fabric handle, by using lower twist levels in the yarn. Alternatively, there might be financial concerns, with less twist producing higher output from the spinning machine. This is supported by the use of longer and stronger fiber.

Naturally, this works only up to a certain point, since the production gains could change at any point due to unstable spinning behavior, turning a potential profit ultimately into a loss.

There are some general observations that can often be applied here. Firstly, the finer the count, the higher the density. It is also seen that the cops and the packages have almost the same yarn density, with the package density being only marginally greater. Finally, the more polyester in a blended yarn, the higher the density will be.

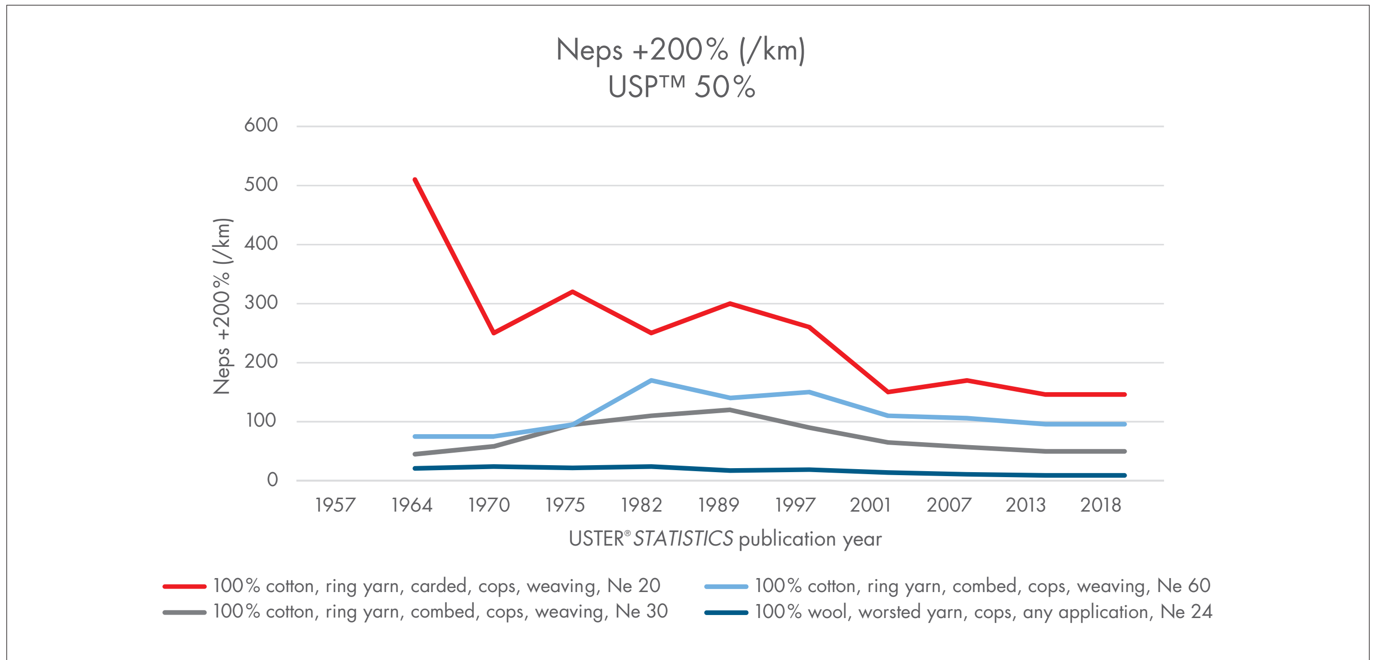


Fig. 12 Changes in +200 % neps since publication of the first USTER® *STATISTICS*

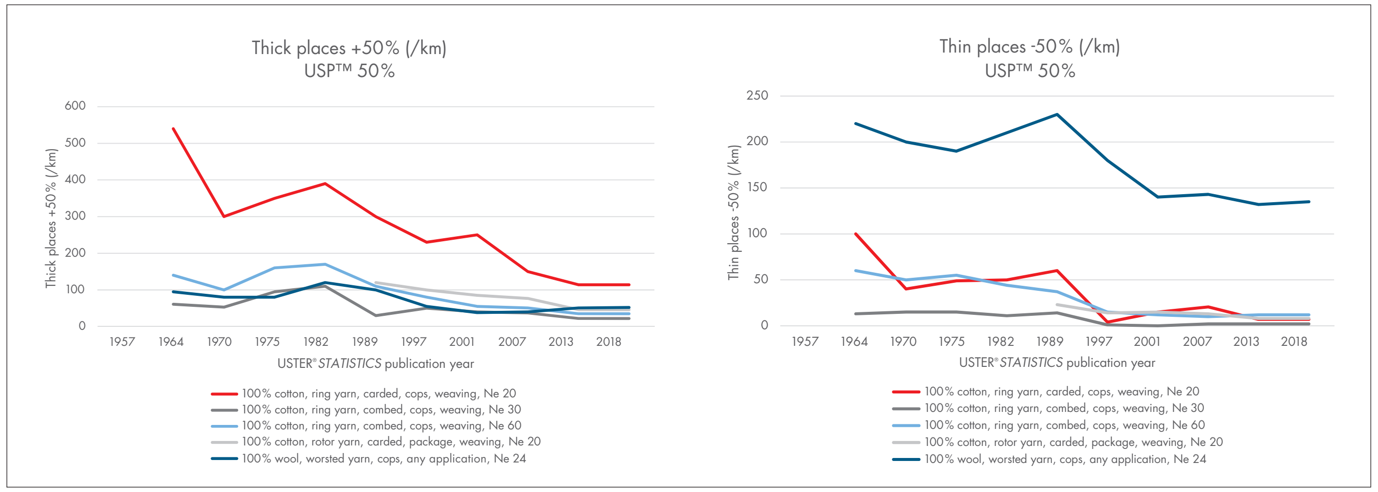


Fig. 13 Changes in +50 % thick and -50 % thin places since publication of the first USTER® *STATISTICS*

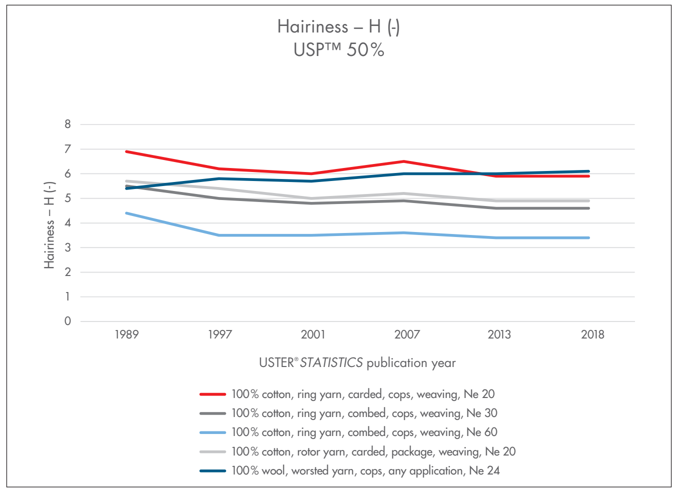


Fig. 14 Changes in hairiness since publication of the first USTER® *STATISTICS*

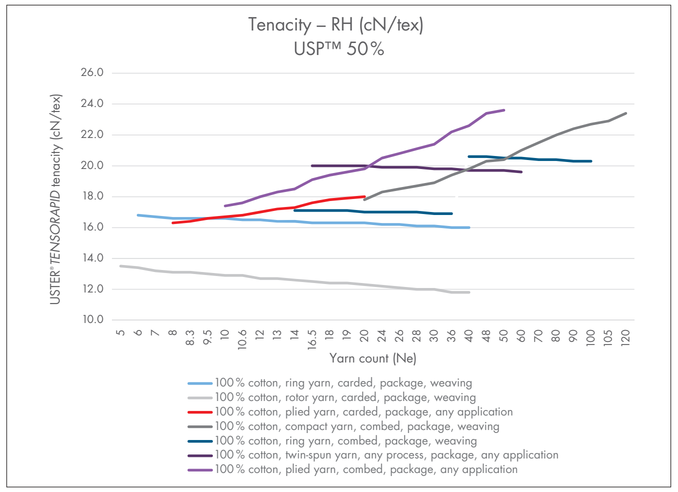


Fig. 15 Yarn tenacity trends of cotton yarns for weaving applications

2.3.4 Yarn hairiness

Yarn hairiness has remained relatively stable, with no new trend discernible. This has been the case since the beginning of the hairiness index measurements **Fig. 14**.

2.3.5 Yarn strength and elongation

The most important trend shifts in yarn strength and elongation between USTER® *STATISTICS 2013* and *2018* are as follows:

- For blended yarn, 50/50 % lyocell/cotton, the finer the yarn count, the lower the fineness-related tenacity. This applies to ring yarns and compact, air-jet or rotor yarns.
- For twin-spun yarns this trend is less distinct. However, the finer the yarn count, the lower the fineness-related tenacity still also applies here.
- The trend is reversed for 100 % combed cotton ring, compact and air-jet yarns. Here, the finer the yarn count, the higher the fineness-related tenacity. This is a reason why the use of stronger cottons in fine yarn counts has increased more than in medium staple cottons, which are more likely to be used in the medium yarn count segment.
- In terms of elongation the following applies: the finer the yarn count for blended yarns, the lower the elongation. This specifically applies to ring yarns and compact yarns. For rotor and air-jet yarns, these trends apply to a lesser extent.

What do these trends mean if we compare different yarn types? Among cotton yarns, a combed plied yarn has the highest tenacity, as measured with USTER® *TENSORAPID* **Fig. 15**, especially in the fine count area. Only a combed compact yarn up to Ne 100 can reach a higher tenacity. Carded plied qualities are at the same level, which could be caused by the use of a higher plied twist. It is interesting to note the overlap area in the medium count range Ne 16 – 28. Here, tenacity-wise, there is no reason to use a plied instead of a twin-spun yarn. If tenacity is not the main requirement, then a twin-spun yarn could be used up to Ne 60. The carded and combed ring yarns are added to this chart to compare the tenacity trend of a normal yarn. Rotor yarn has the lowest tenacity. However, it is clear that tenacity is not the only important characteristic to consider here.

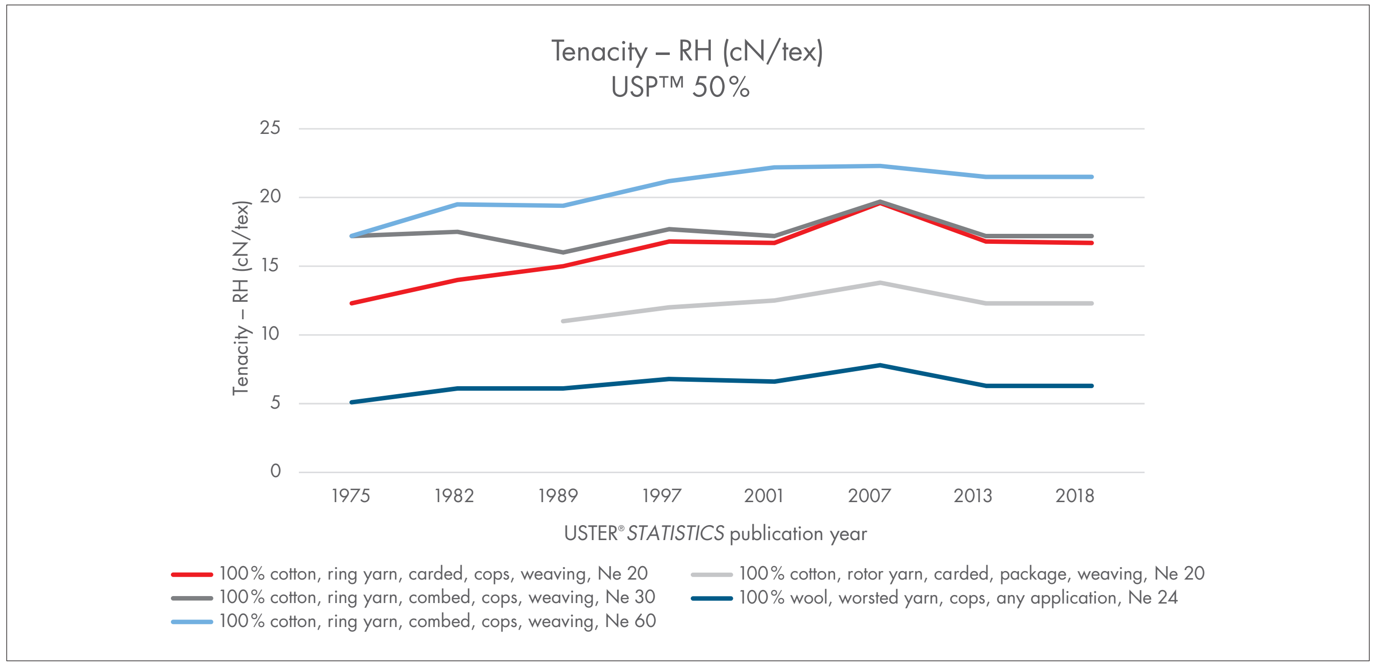


Fig. 16 Changes in tenacity since publication of the first USTER® *STATISTICS*

Again, a look back into history shows that the machine manufacturers have done a great job in recent years with their engineering **Fig. 16**, with the result that strength and elongation values have continuously increased.

Better parallelization of the fibers, in the entire production chain of a spinning mill, helps to optimize the advantage of higher fiber strength. However, the cotton breeders have also contributed to this trend, by developing higher strength varieties.

2.3.6 USTER® *CLASSIMAT 5* top classes

Analysis of trends in USTER® *CLASSIMAT 5* data focuses on the top classes. The USTER® *CLASSIMAT 5* top 9, 12 and 16 classes are a summary of the following single classes:

- Top 9 =
  sum of A4, B3, B4, C3, C4, D2, D3, D4, E
- Top 12 =
  sum of A3, A4, B3, B4, C3, C4, D2, D3, D4, E, F, G
- Top 16 =
  sum of A3, A4, B2, B3, B4, C1, C2, C3, C4, D1, D2, D3, D4, E, F, G

For a more detailed explanation, please see section 3.3.2.

Selected yarn applications are analyzed here. The following charts display ring and compact yarn results for weaving and knitting applications. Yarns are made from carded and combed cotton, differentiated by coarse, medium and fine counts.

- Coarse count < Ne 20
- Medium count Ne 20 – 40
- Fine count > Ne 40

The trends for differences in the number of events per top classes are shown in **Figs. 17 to 19**. The arrows indicate a trend (increasing quality, decreasing quality or stable quality) without giving the degree of change.

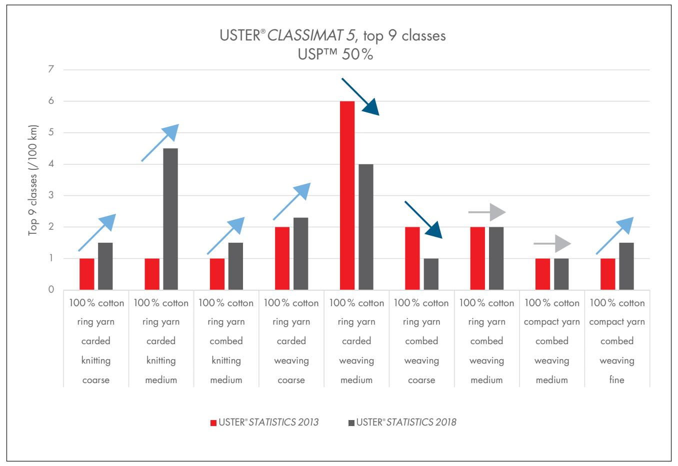


Fig. 17 Top 9 classes, showing changes since 2013

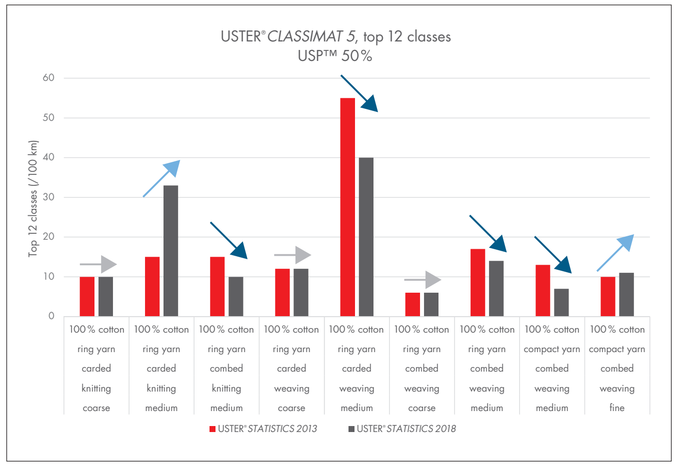


Fig. 18 Top 12 classes, showing more downward trend than upward, which means less events in traded yarns

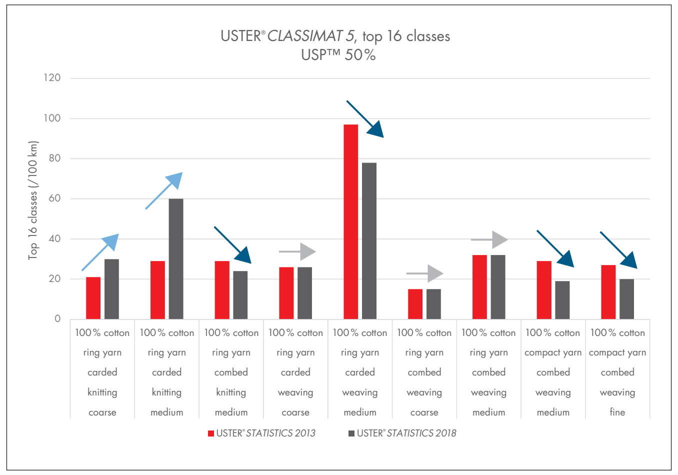


Fig. 19 Top 16 classes; no clear picture whether the yarns are better or worse compared to 2013

The selected cotton qualities show that most of the top 9 classes have more events (5), two have similar numbers of events and only two have fewer events, compared to the USTER® *STATISTICS 2013* data. Knitting applications show a negative trend, while weaving applications have more of a downward or neutral trend.

For top 12 classes, two have more events, three have the same number of events and four have fewer events, compared to the previous STATISTICS. Almost the same is true for the top 16 classes.

This suggests the following conclusion: the more classes that are included, the more sensitive events are counted. The more sensitive classes that are added – as with the Top 12 and 16 rather than Top 9 – the bigger the difference compared to USTER® *STATISTICS 2013*. Knitting yarns show a greater increase (2013 to 2018) in the top classes compared to weaving yarns.

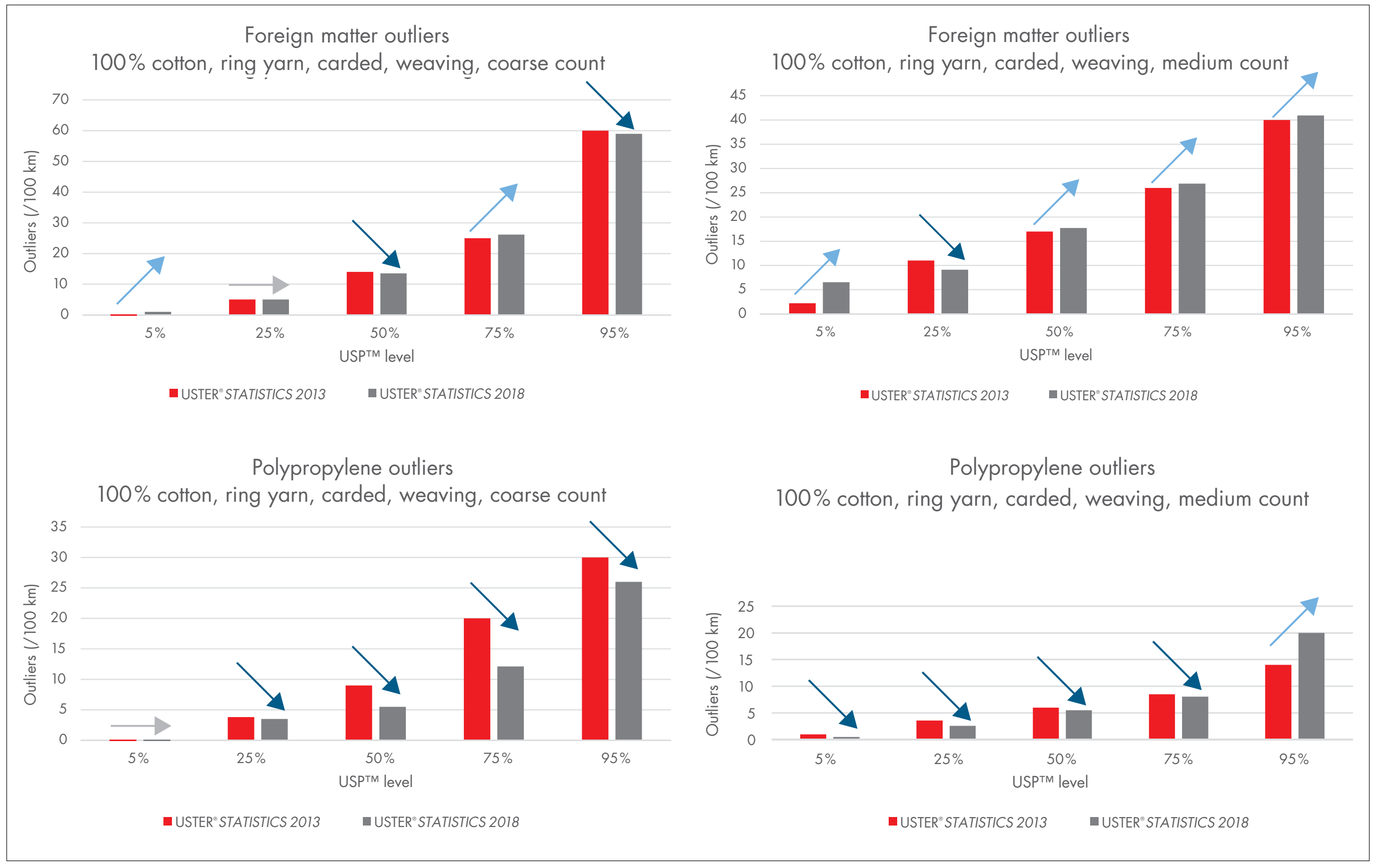


Fig. 20 USTER® *CLASSIMAT 5* outlier comparisons of carded cotton ring yarn for weaving applications

2.3.7 USTER® *CLASSIMAT 5* outliers

Measurement of outliers such as NSLT, foreign matter, polypropylene or vegetable are important, especially for yarn trading. Each outlier means an exception in a quality characteristic, which most often leads to a defect in fabric or a problem in the processing of the yarn.

Textile technologists are often asked what is an acceptable level. To evaluate that, it is first necessary to calculate what minimum level is actually possible, with existing manufacturing processes. **Fig. 20** highlights two examples: the foreign matter and polypropylene outliers of two carded cotton ring yarns for weaving applications. One is in a medium count and the other a coarse count range. Here again, the benefit of using USTER® *STATISTICS* is demonstrated. The arrows indicate a trend (increasing quality, decreasing quality or stable quality) without giving the degree of change.

The USP™ 25 % level of a coarse count yarn is at 6 foreign matter outliers, while the medium count yarn has around 9 outliers per 100 km. It is logical that a finer count has a higher amount, because there is less chance that foreign matter is completely covered inside the yarn. There are no major differences between USTER® *STATISTICS 2013* and *2018* data, but there is a tendency for an increase in foreign matter outliers.

Even though the number of fiber cleaning systems in the blowroom has increased over the past ten years, this has had only a small impact, as shown in the above example. There has also been a massive rise in the number of yarn clearers with foreign matter detection – but still the impact is not evident in the comparison. This shows that the contamination problem, which typically derives from the cleanliness of the raw cotton, is increasing at a rate faster than spinning mills can deal with it.

For polypropylene outliers, however, the trend is positive, which means there is a decrease in the number. Coarse count yarns show a greater decrease then medium counts.

> We can conclude that the polypropylene issue has been reduced in the industry, thanks to the increased use of fiber contamination detection equipment such as the USTER® *JOSSI VISION SHIELD* and USTER® *JOSSI MAGIC EYE*, as well as polypropylene detection at the yarn clearer.

2.4 Yarn processing

The yarn processing statistics help the industry to evaluate if the winding process is effective, without changing the yarn character too much. The setting of winding speed and winding tension is very important. Both parameters are related to the productivity of the winding machines but at the same time are responsible for a deterioration in yarn quality during the winding process, together with the influence of the yarn path. Today, spinning mills have several options to optimize those settings, thanks to the efforts of winding machine manufacturers.

This section of USTER® *STATISTICS* enables a spinning mill to compare the quality changes in its winding process with global results, and to decide if there is an opportunity for improvement or not. Practically, these graphs offer the possibility to compare against best practices worldwide.

For example, the increase in yarn hairiness from cop to package not only reveals insights into the structural characteristics of the yarn (twist, friction, etc.) but also highlights the contribution of the winding process to the quality level. The friction applied during the winding process at touch points on the yarn can initiate fiber movement – leading to higher imperfection values (thin and thick places, neps). The hairiness change is mainly caused by friction of protruding fibers, which is influenced by winding speed. Comparisons between USTER® *STATISTICS 2013* and *2018* allow conclusions as to how good the mills are at defining winding machine settings, and how gentle the modern winding machines are at building the yarn packages.

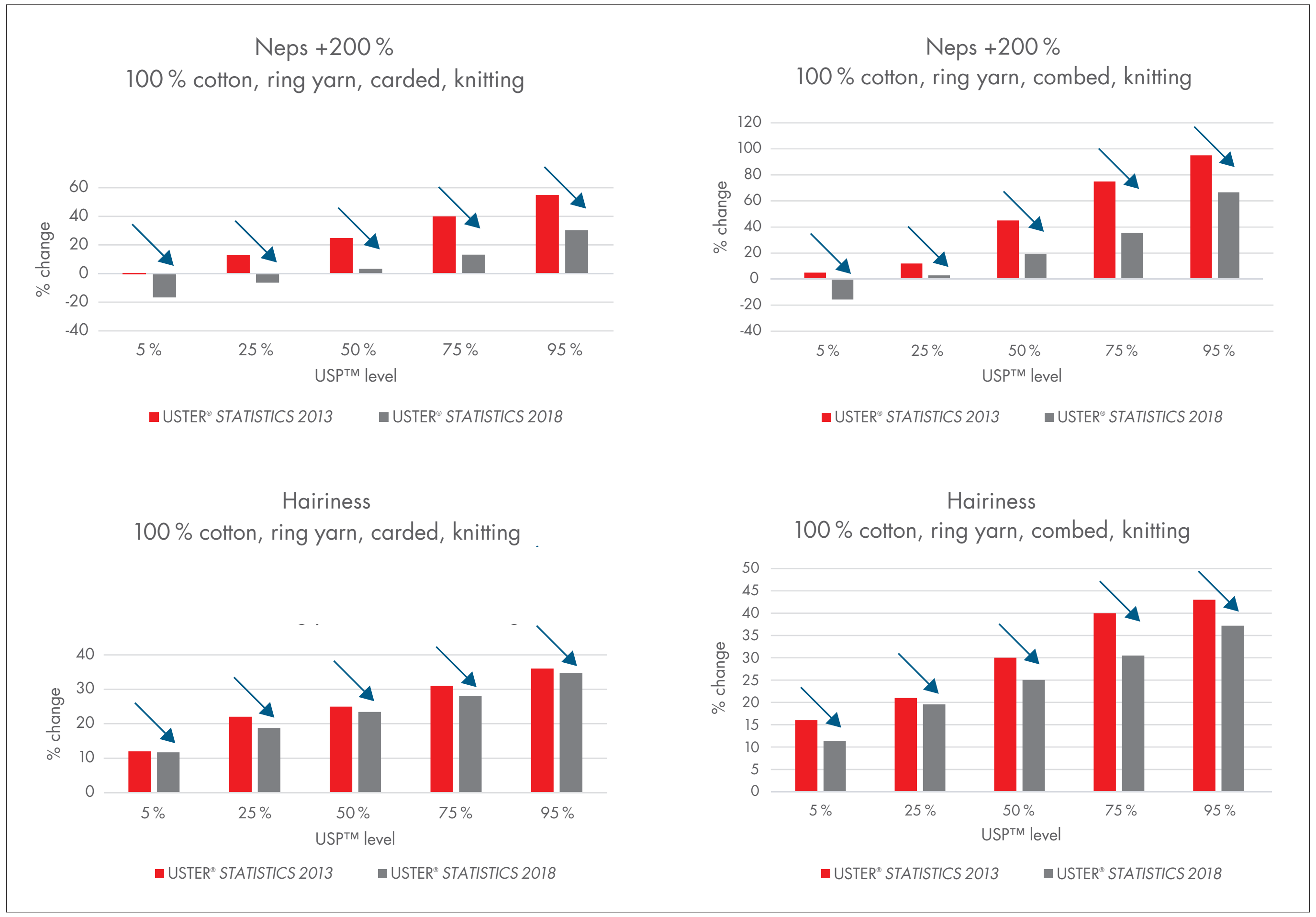


Fig. 21 Changes in winding, showing comparison of data from USTER® *STATISTICS 2013* to *2018* for a combed and carded knitting yarn

It is useful to explain how yarn processing statistics are created. Spinning mills all over the world sent cops and packages to the laboratories of Uster Technologies. It was possible to match the values within each lot, although not to exactly the same yarn. A lot with a high variation in quality would obviously have an impact on the accuracy of the STATISTICS. For this reason, it appeared in a few cases that imperfections decreased, rather than increased, between cop and package. In order to maximize accuracy, Uster Technologies collected even more samples than before. It is important to note that the charts are not separated by count ranges. This is significant, because a fine count yarn normally has a higher tendency to change the characteristics than a coarse count yarn.

Fig. 21 compares data from USTER® *STATISTICS 2013* with *2018*, for a combed and carded knitting yarn.

It is gratifying to see the clear trend in the winding process for a reduced impact on yarn quality. Here, the industry can congratulate the machine producers for developing gentler winding processes. Of course, there is still some impact on quality characteristics, but it is much smaller compared to USTER® *STATISTICS 2013*.

3 What's new in USTER® *STATISTICS 2018*

Assistant Q is the virtual textile technology expert in quality from fiber to fabric. He examines test data and takes in all results, providing reliable analysis and interpretation. This chapter offers insights and recommendations based on his knowledge and 65 years of USTER experience.

A wide variety of new content is included in USTER® *STATISTICS 2018*. This is due to the fact that the number of samples tested in USTER laboratories has reached an all-time high for this edition.

3.1 New characteristics for fiber testing

USTER® *STATISTICS 2018* introduces several new characteristics, with the aim of providing a comprehensive service to the market. The new characteristics are largely in the area of yarn testing and are mainly included on the basis of customer inputs or because the latest USTER® testing equipment offers the relevant measurements.

3.1.1 Fiber elongation

The new graphs for fiber elongation show relatively even curves **Fig. 22**, since the elongation of cotton fiber depends on the type of cotton and not so much on the fiber length.

Apart from yarn twist, fiber elongation has a major impact on yarn elongation. In conjunction with fiber tenacity, it influences the processing behavior of the yarn. Yarn with a high processing value will typically perform better subsequently in the weaving mill. For this reason it was obvious to include fiber elongation in future USTER® *STATISTICS*.

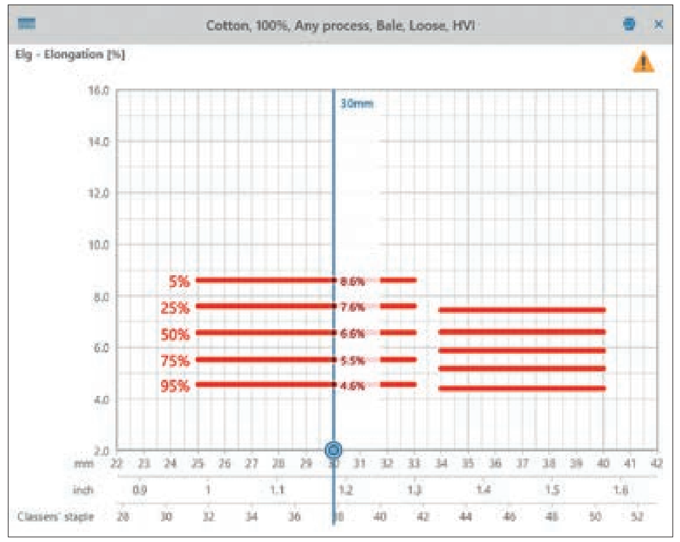


Fig. 22 New fiber elongation as displayed in USTER® *STATISTICS 2018*

However, analyses of USTER databases showed that the correlation between fiber elongation and yarn elongation of a combed cotton ring yarn is at a level of 85 % **Fig. 23**. Although we know that the twist multiplier and the yarn production speed also have a huge impact on yarn elongation, the basis for high elongation actually comes from the fiber.

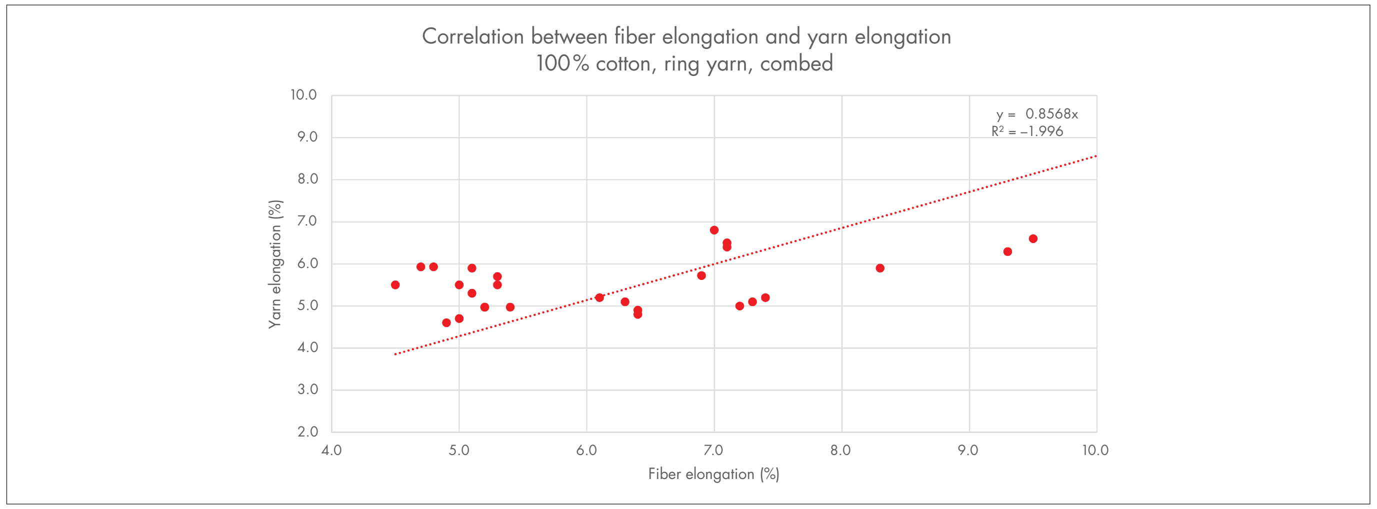


Fig. 23 Correlation of fiber elongation with yarn elongation in 100 % combed cotton ring yarns

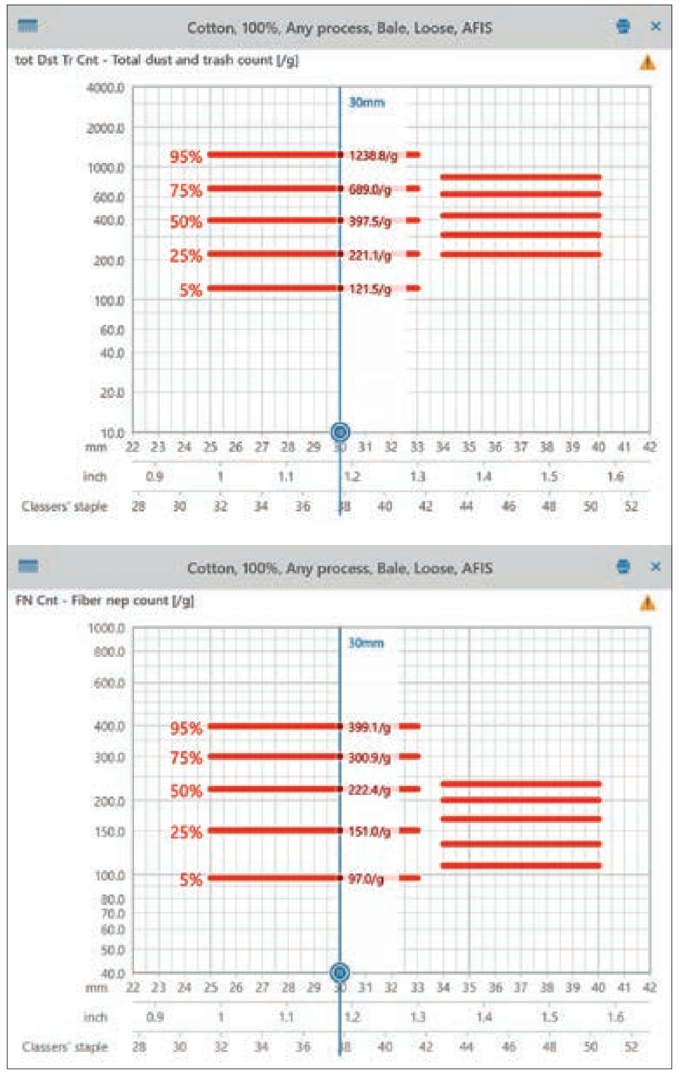


Fig. 24 New graphs for total dust and trash count, as well as fiber nep count

3.1.2 Distinctions between total dust, trash count and fiber nep count

The inclusion of total dust and trash count, as well as the fiber nep count, is based on market observations. Until now, only the total nep count was considered. The trash and dust content has been indicated separately so far. **Fig. 24** shows the newly-created graphs.

Considering the total nep count alone is now regarded as insufficient. The total nep count is the sum of fiber neps and seed coat neps. High nep counts indicate aggressive ginning, low maturity, and poor maintenance at mechanical harvesting and ginning. This correlation led Uster Technologies to include these characteristics in USTER® *STATISTICS*. Ginning mills today increasingly focus on productivity rather than quality. Moreover, the required upgrading of ginning mills has not proceeded to the same degree as the increased volumes of cotton. A more accurate evaluation of cottons is now possible with the separate assessment of fiber neps and seed coat neps. Now, the manager of a spinning mill is able to compare the seed coat nep and fiber nep levels.

With this kind of clear detail on nep measurements, a spinning mill can optimize its laydowns to manage a specific nep component. It can also optimize for efficiency in removing the nep components during further processing. The spinner can, for example, more accurately predict the amount of white spots on fabrics after dyeing. The example **Fig. 25** shows a 100 % carded cotton fabric with many white spots on the surface. The root cause of these white spots is a high level of fiber neps with a high proportion of immature fibers. The raw cotton in the yarn from which the fabric here was produced had a result of 260 fiber neps per gram. According to the STATISTICS, this is already a high level at USP™ 75 %.

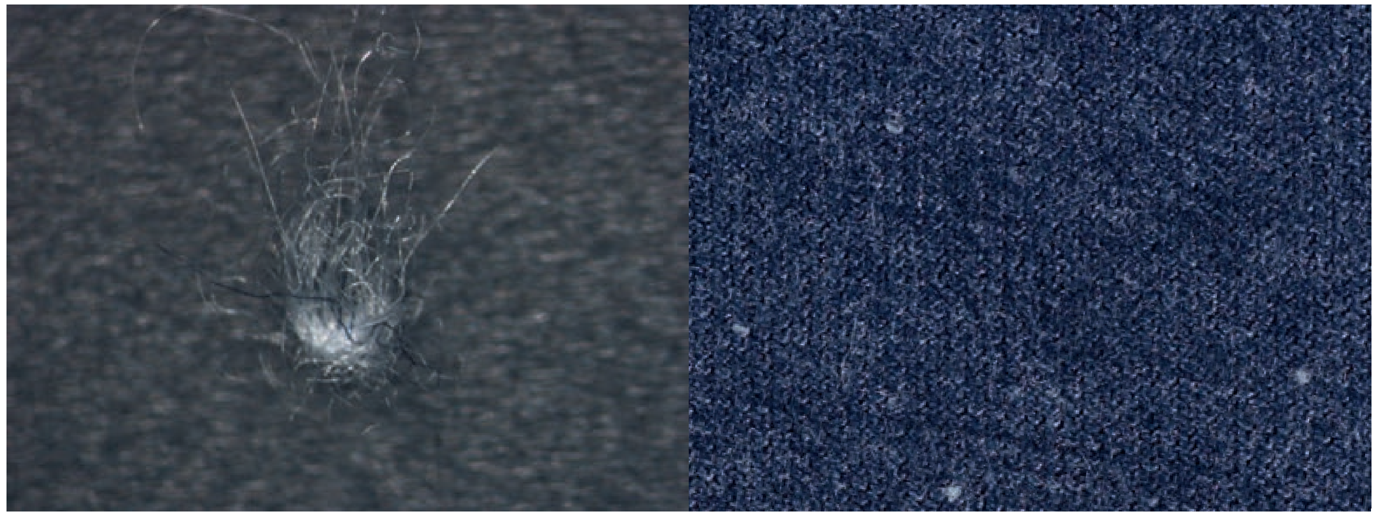


Fig. 25 Fabric with a fiber nep count of 260 per gram in the raw cotton. This represents USP™ 2018 value of 75 %

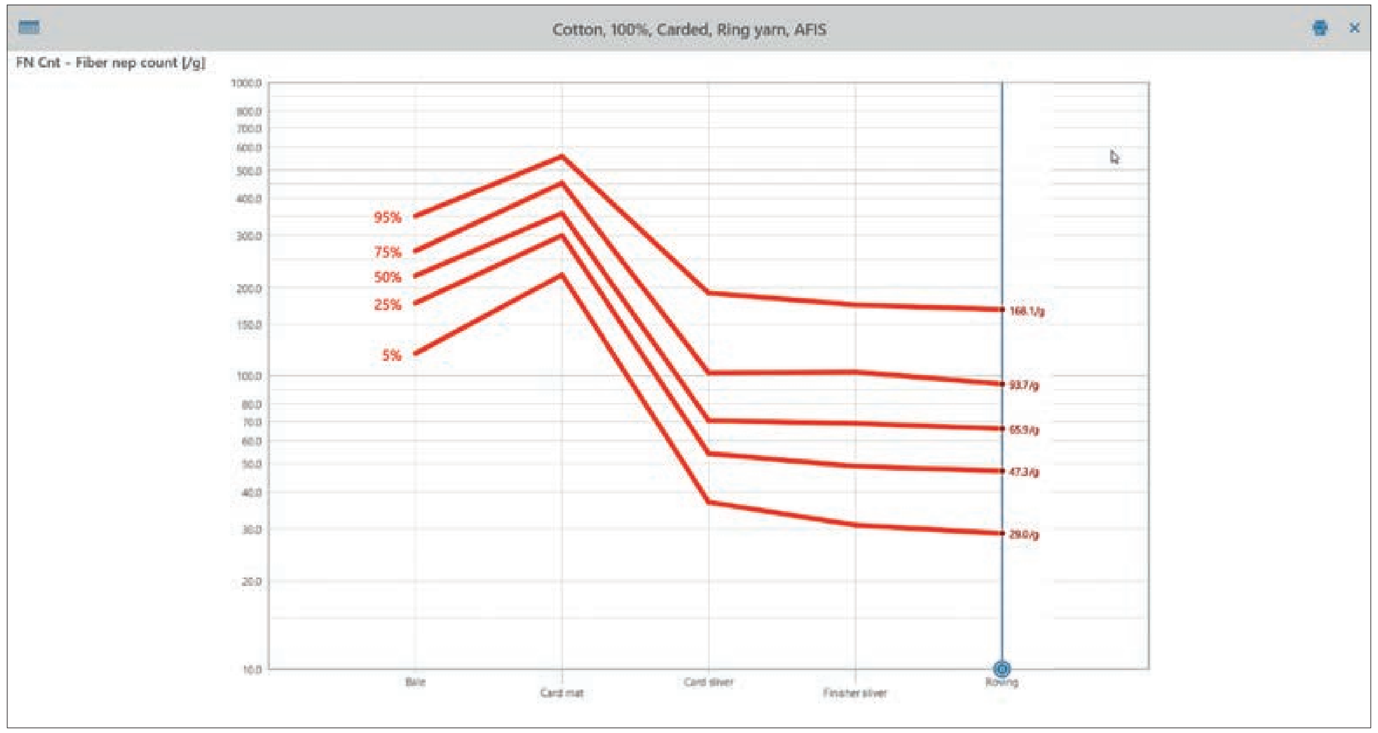


Fig. 26 Process chart showing 'change in spinning preparation' for fiber nep count

Obviously, in this example, the spinning mill management has not considered the fiber nep level – otherwise they would have adjusted their processes. **Fig. 26** shows the fiber processing chart for fiber neps – which is also new in the STATISTICS. The roving of the yarn in this fabric example had a fiber nep count of 150 per gram. This is rated by the USP™ 18 neps per gram at a level of 95 %. Thus, this spinning mill could improve its quality, because there was the potential to reduce fiber neps by up to 30 per gram. As shown in the fiber process chart, the carding process is the best point to focus on fiber nep reduction. It is recommended to adjust the carding machine and compare the sliver data with the fiber nep chart, in order to benchmark the data with other spinning mills. In conjunction with monitoring maturity, spinning mills can avoid fabric white spots. If discovered during processing, the yarn can be redirected into a different application such as bleached white t-shirts, where immature fiber neps are less disturbing.

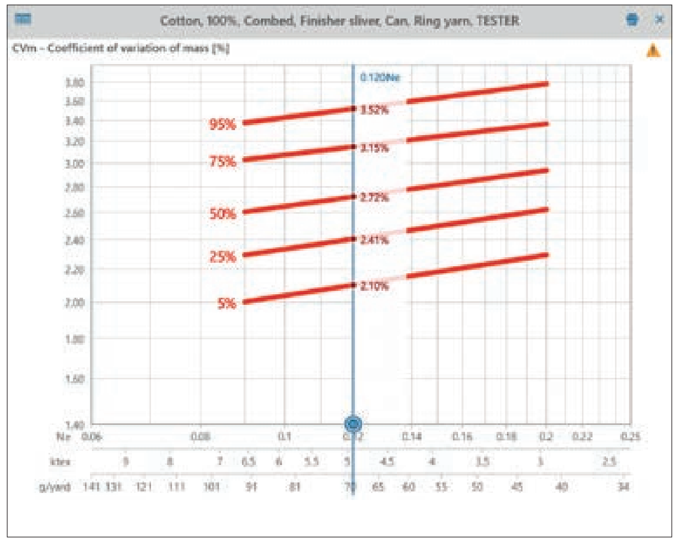


Fig. 27 Sliver evenness measured with the USTER® *TESTER* in industrial applications

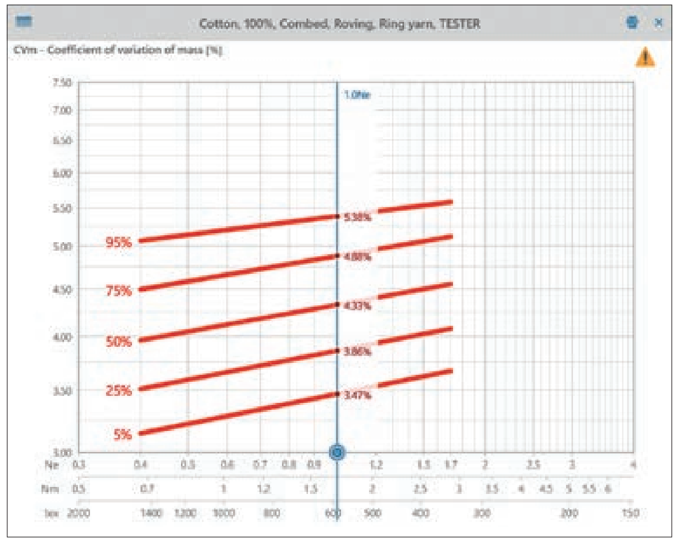


Fig. 28 The roving range by combed qualities has been adjusted from Ne 0.6 to 3.0 for USTER® *STATISTICS 2013* to Ne 0.4 to 1.7 in 2018. A clear trend for coarser rovings is noticeable

3.2 New source for sliver and roving quality

USTER® *STATISTICS 2018* offers spinners ground-breaking new data on slivers and rovings, which are now measured using the USTER® *TESTER* of generations 5 and 6 **Fig. 27**. Previously, sliver data was generated based on USTER® *SLIVERGUARD* results from the market. It is a major logistical challenge to provide sliver and roving materials to USTER laboratories. Transportation alone would affect the properties, so that the results would not be accurate or reproducible. For that reason, Uster Technologies opted to record and collect sliver-relevant data systematically at customers' sites. Numerous textile technologists and service engineers of Uster Technologies around the globe collected measurement data from customers, based on USTER® evenness testers in the market. Indications of the humidity and temperature at measurement enabled Uster Technologies to 'separate the wheat from the chaff' – and include in the STATISTICS only data based on tests conducted under correct climatic conditions with calibrated equipment.

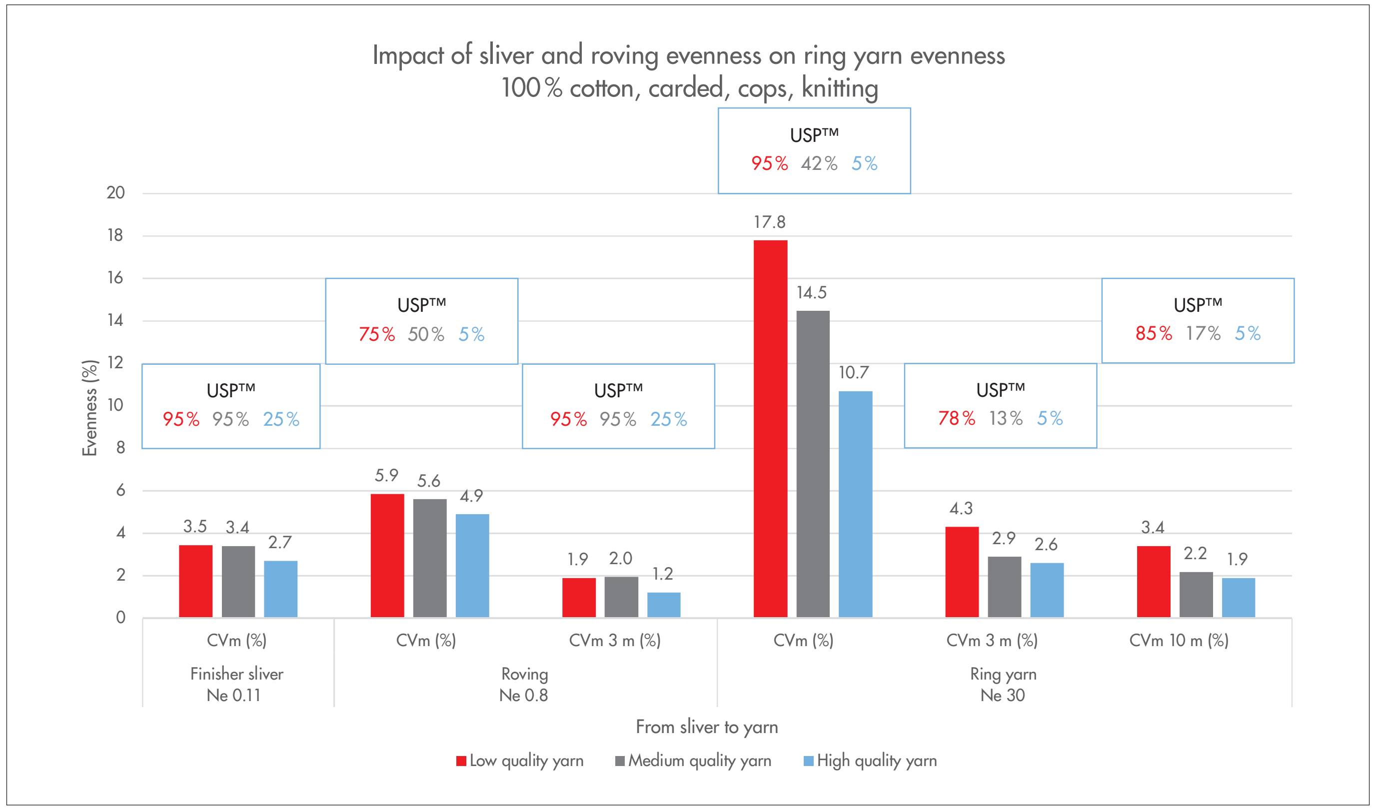


Fig. 29 Impact of sliver and roving evenness on ring yarn evenness. It is difficult to produce a high quality yarn from a low quality sliver

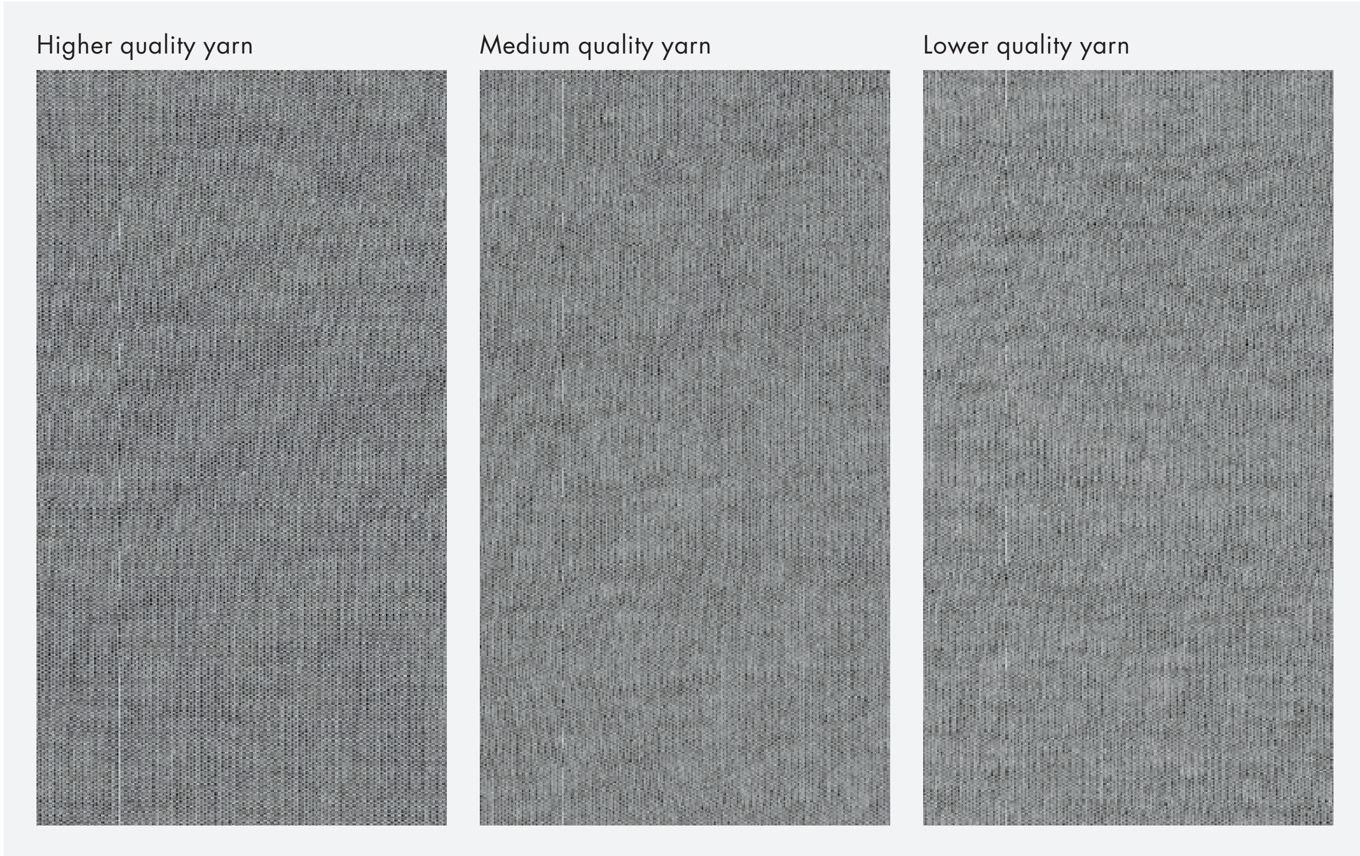


Fig. 30 Fabric from yarns of high, medium and low evenness quality (from left to right)

It is interesting to note that slivers are produced slightly coarser, while rovings are produced significantly coarser, in the industry today **Fig. 28**. The fact that drawframe outputs have increased enormously over the past few years could be a reason for this. Higher outputs are possible owing to higher speeds and coarser sliver counts. Consequently, the rovings are also coarser. Since yarn count distribution has remained stable or become even finer during the past few years, we can conclude that the drafts on ring spinning machines have risen significantly. Obviously, drawframes have improved in recent years thanks to mechanical engineering developments and the leveling of variations, since the quality of yarns has not dropped, but can be considered stable.

Uster Technologies recommends greater use of the STATISTICS to evaluate sliver and roving quality with respect to evenness. A finisher sliver with poor evenness, as reflected in the STATISTICS, will be incapable of producing a yarn with good evenness. This statement is proved by the example shown in **Fig. 29**.

From a low quality finisher sliver (red columns) a low quality roving was produced, which ended up as a yarn of low quality based on the eveness (CV_m). It is interesting that the second finisher sliver (grey column), with a similar low quality, resulted in a medium quality roving. It appears that the mill has done a good job at the roving machine. If we compare the CV_m 3 m of the rovings, it is clear that the sliver in the red column already has a problem, due to the CV_m 3 m being at a low quality level. The medium quality roving ended up in a medium quality yarn, while the blue column shows a high quality finisher sliver, resulting in a high quality roving and subsequently an extremely even knitted yarn quality.

Fig. 30 helps to evaluate the relevance of the displayed differences. The appearance of the knitted fabric from the high quality yarn is much more even, compared to the medium/high quality and the low quality yarn. The fabric quality is affected by the yarn evenness, which has been influenced by the sliver and roving evenness.

Analyzing sliver, roving and yarn data, as shown in the example here, gives the spinning mill clear guidance on where to focus improvements on, by optimizing process and quality characteristics, to produce the best quality yarns meeting customer requirements. In this way, the spinning mill can set KPIs for sliver and roving, based on USTER® *STATISTICS*.

3.3 New characteristics for yarn testing

The yarn testing possibilities have increased by adding new characteristics such as the USTER® *TESTER 6* hairiness length classification, USTER® *ZWEIGLE TWIST TESTER* twist multiplier and the USTER® *CLASSIMAT 5* top classes – now shown as candlestick charts. The benefits are described in the following sections.

3.3.1 New hairiness length classification

USTER® *TESTER 6* – featuring the HL sensor – offers a new hairiness length classification. The new values S3*u* **Fig. 31** and S1+2*u* were introduced at ITMA 2015, and are now available in USTER® *STATISTICS* for the first time. With the introduction of length classification along with the conventional USTER® *TESTER* procedure, Uster Technologies has decided to no longer publish analyses based on USTER® *ZWEIGLE HL400*. Trials have clearly shown that the new length classification provides a more accurate assessment of a yarn, because of its better correlation to subsequent processing properties, as well as its impact on textile surface properties. The HL module therefore clearly supports yarn development processes, and the hairiness index H of USTER® *TESTER 6* is the descriptive quantity in yarn trading terms.

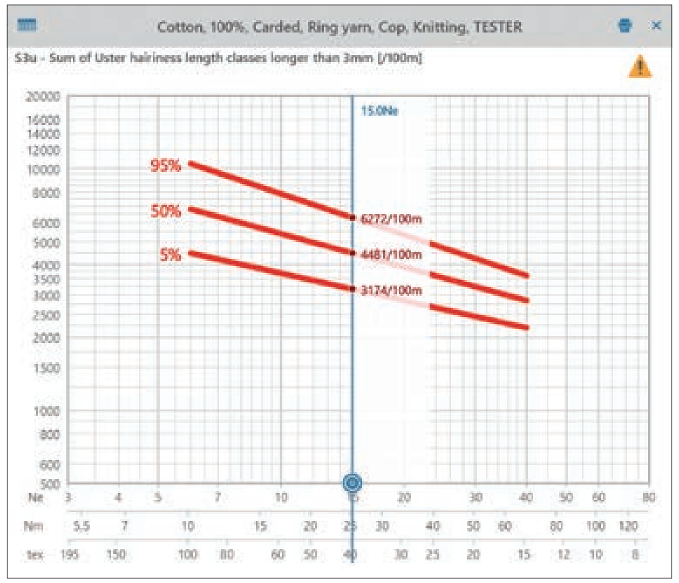


Fig. 31 Hairiness length classification S3*u* determined with the HL sensor of USTER® *TESTER 6*

Hairiness values indicated by the HL sensor of USTER® *TESTER 6* will play an essential role in the future.

The following statements apply when all newly-formed hairiness graphs are taken into account:

- The finer the count, the lower the S3*u* value, due to the number of fibers in the cross-section of the yarn
- The difference between cop and package is greater for knitting than for weaving, due to the lower yarn twist in knit yarns
- The difference between cop and package is greater for carded than for combed yarns, due to the short fiber content of combed yarns
- The difference between cop and package is smaller for compact yarn than for ring yarn, due to the effect of compacting.

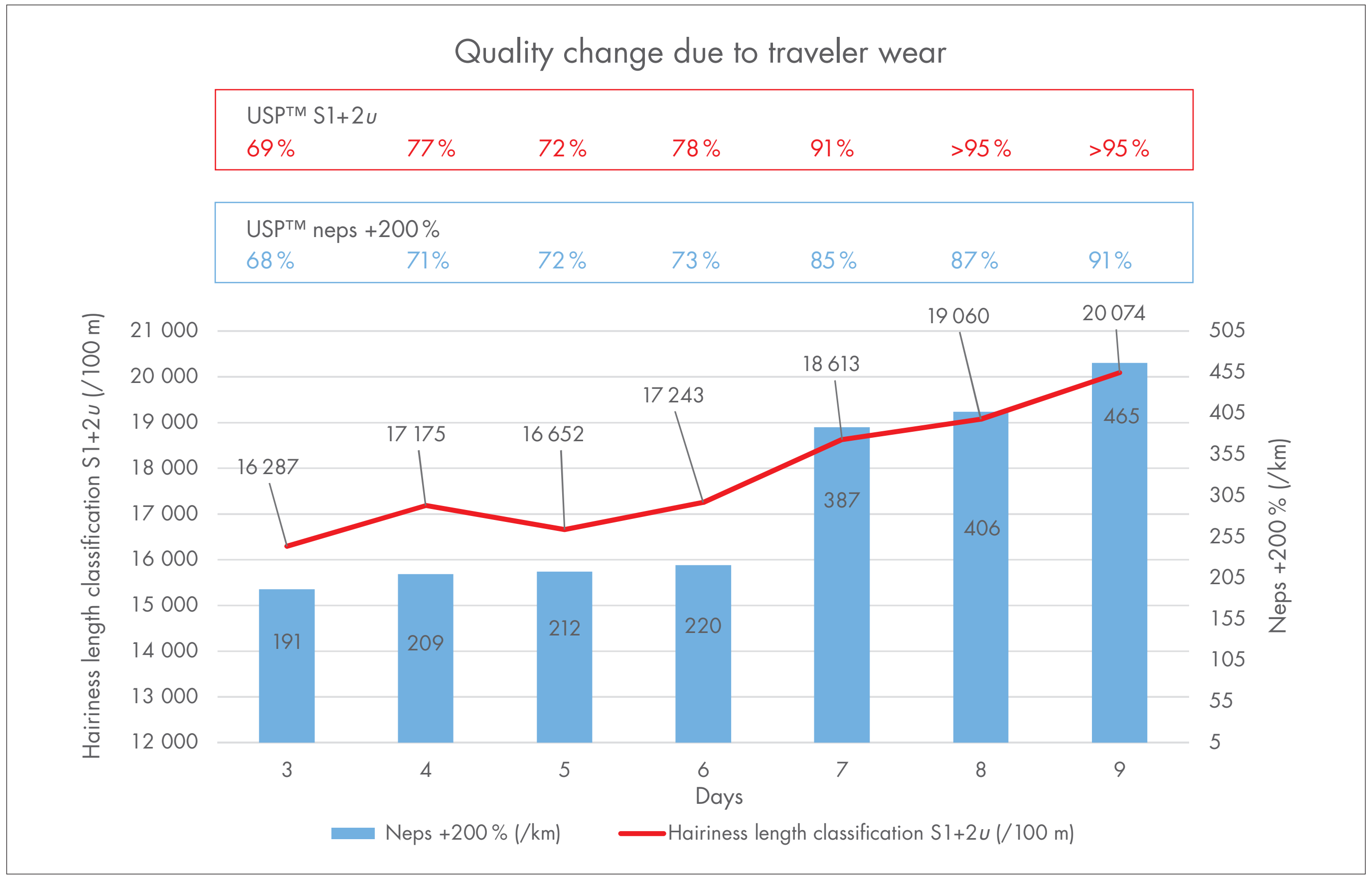


Fig. 32 Traveler lifetime analysis with the help of S1+2*u*

Fig. 32 shows a practical example of how a spinning mill can benefit from the new S3*u* and S1+2*u* values in USTER® *STATISTICS*. Spinning mills will optimize traveler change times, in order to guarantee constant quality, but also to minimize spare part costs. In this example, a Ne 40 ring knitting yarn from 100 % combed cotton is produced, with a traveler lifetime of 10 days, according to the traveler producer. A trial was conducted, with 10 cops from identical spindles of the same machine, tested once per day. The averages of the 10 cops are shown in the graph. Testing was started two days after a traveler change and subsequently every day until day 9. The graph clearly shows that the hairiness increased from day 5 to 6.

However, the question is whether change is already enough to alarm the mill manager and reduce the traveler running duration. The yarn starts with a USP™ value of 69 % on day 3, which is rather on the hairy side. In the first few days, the level varies between 69 and 78 % USP™. On day 7, the USP™ value increases to 91 % and further to USP™ > 95 % on days 8 and 9. This indicates that there is a real quality change, beginning on day 7. Additionally, the +200 % neps USP™ level also rises significantly. This confirms that, with this traveler-ring combination and yarn count, the traveler change should be carried out before the planned and recommended 10 days.

3.3.2 Interpretation through USTER® *CLASSIMAT 5*

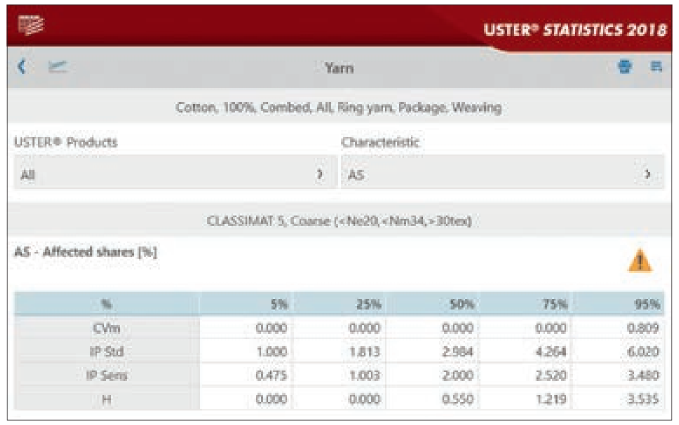
With the publication of USTER® *STATISTICS 2013*, values based on USTER® *CLASSIMAT 5* were introduced. A milestone for the USTER® *STATISTICS 2018* edition is the further distinction into affected shares and the inclusion of top classes.

With the USTER® *CLASSIMAT 5* test, outlier limits for the measured characteristics of evenness (CV_m), imperfections (standard and sensitive) and hairiness (H) are automatically defined. The lengths of yarn where the measurements are beyond outlier limits are referred to as 'affected'. An affected share is the percentage (%) value of the affected yarn length as compared to the total length tested. For example, if 2 km of yarn in a USTER® *CLASSIMAT 5* test were affected by outlier evenness (CV_m) measurements within a length of 200 km, the affected share percentage value would be 1 %.

Until now, there was only one value for the affected share in the USTER® *STATISTICS*. Uster Technologies received many questions and feedback about this value, indicating that it is not fully understood and would not be used. In USTER® *STATISTICS 2018* **Fig. 33**, the affected share of the yarn is now broken down into:

– Evenness (CV_m)
– Imperfections (standard and sensitive) and
– Hairiness index (H)

Uster Technologies believes that this breakdown is more helpful to yarn traders.



%	5%	25%	50%	75%	95%
CVm	0.000	0.000	0.000	0.000	0.809
IP Std	1.000	1.813	2.984	4.264	6.020
IP Sens	0.475	1.003	2.000	2.520	3.480
H	0.000	0.000	0.550	1.219	3.535

Fig. 33 Affected shares broken down into individual characteristics of a yarn

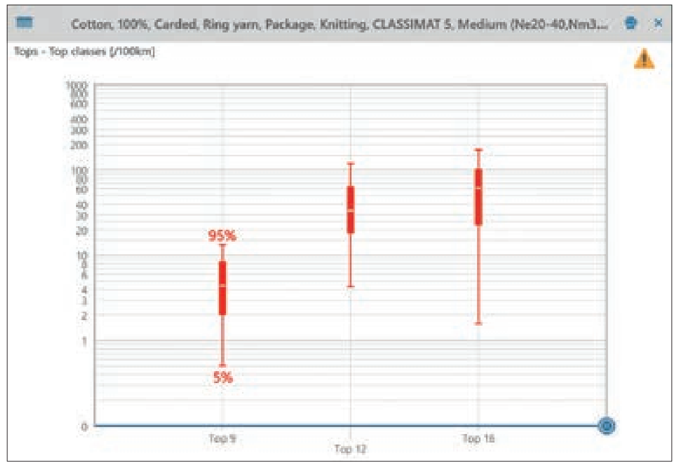


Fig. 34 New graph for top classes 9, 12 and 16

Many users reported that the sheer number of individual classes covered by USTER® *CLASSIMAT 5* was a deterrent. For that reason, specific individual classes are now summarized into top classes **Fig. 34** in USTER® *STATISTICS 2018*.

The individual classes are summarized into three top classes as follows:

– Top 9 =
  sum of A4, B3, B4, C3, C4, D2, D3, D4, E
– Top 12 =
  sum of A3, A4, B3, B4, C3, C4, D2, D3, D4, E, F, G
– Top 16 =
  sum of A3, A4, B2, B3, B4, C1, C2, C3, C4, D1, D2, D3, D4, E, F, G

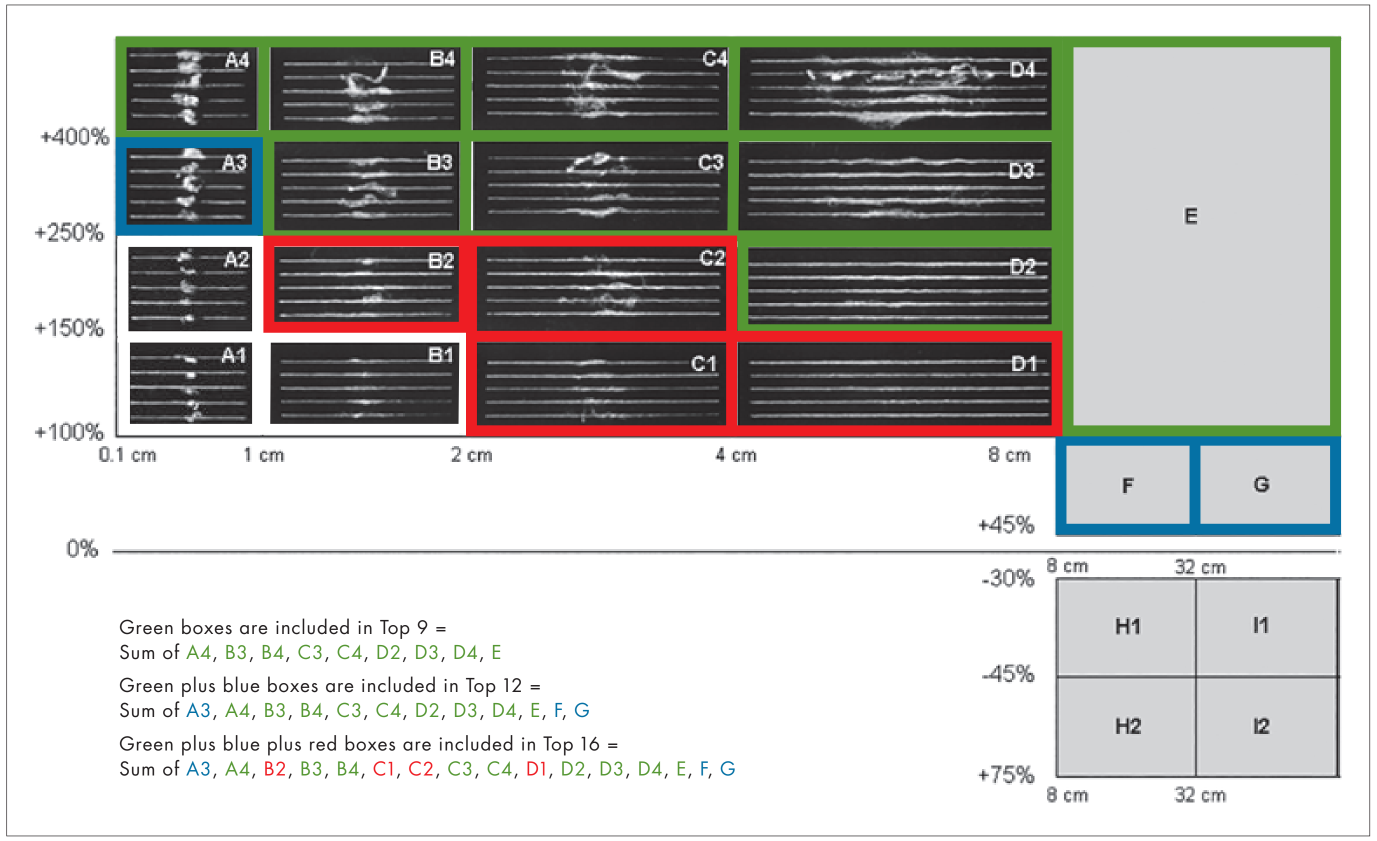


Fig. 35 Classification matrix of USTER® *CLASSIMAT 5* showing the top classes

As more classes are combined, more sensitive thick places in a short, medium and long length are included. **Fig. 35** illustrates the meaning of the classes. The displayed yarn faults are included in the classes. Based on this diagram, it is easier for a spinning mill or yarn purchaser to decide which top class is important. For example, the choice of whether a higher amount of a B2 is acceptable or not will largely depend on the final end-use of the yarn.

Until now, information related to top classes 9, 12 and 16 has been available only in interactive charts. Now, the following characteristics are also available for a yarn profile description:

– Outliers
– YARN BODY™
– Dense areas

The USTER® *CLASSIMAT 5* is used for interpretation and display of yarn characteristics with the aid of the YARN BODY™. The system analyzes the yarn fault distribution and displays the yarn profile, which is called 'YARN BODY™'. Put simply, the YARN BODY™ is the regular yarn with its set of expected natural variations, representing the nominal yarn with its tolerable yarn faults. The YARN BODY™ is always wider in the direction of short staple yarn variations, as short staple yarn faults occur more frequently. In contrast, the YARN BODY™ becomes smaller in the direction of long staple yarn variations.

The dense area (reflectance versus length) indicates a section where foreign fibers and vegetable matter occur very frequently, but can hardly be detected in fabric due to their small size. The dense area depends on the raw material. If a yarn is produced from cotton with a lot of foreign matter or vegetable matter, then the dense area will be wider and a high number of cuts has to be expected.

The outliers for thick and thin places, foreign matter, polypropylene, mass evenness, imperfections and hairiness are determined by means of fixed limits.

USTER® *STATISTICS 2018* no longer contains USTER® *CLASSIMAT QUANTUM* data. As may be gathered from previous reports, USTER® *CLASSIMAT 5* and USTER® *CLASSIMAT QUANTUM* data do not lend themselves to comparison. Intelligent algorithms in the USTER® *CLASSIMAT 5* enable the indication of approximate values relevant to USTER® *CLASSIMAT QUANTUM*.

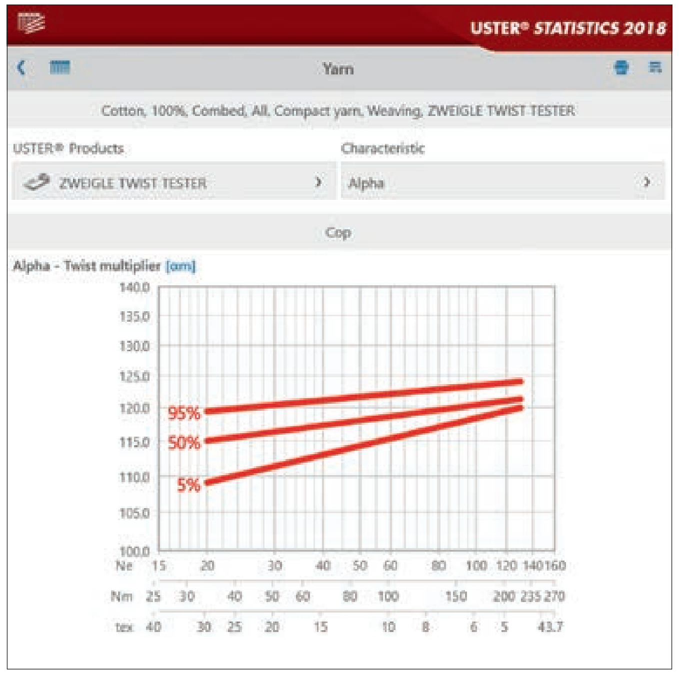


Fig. 36 USP™ of twist multiplier for the example of 100 % combed compact yarn for weaving

3.3.3 Yarn twist optimized for commerce and production

In the previous USTER® *STATISTICS* publication, two graphs were offered which differed only in their measurement units: the presentation of the absolute twist in revolutions per meter or per inch. The only difference between the values was how they were converted. The new publication includes the absolute twists and twist multiplier. The user can select both characteristics by measurement unit as required **Fig. 36**.

The twist multiplier is included as a further test variable. This should be helpful for the yarn trade. The twist multiplier is mostly used to describe a yarn, whereas the revolutions per meter (T/m) are more likely to be used for the settings of a spinning machine. The spinning mill can evaluate if the worldwide competition is producing the same yarn with a higher or lower twist. This means that if a mill is producing yarn with a twist level at USP™ 95 %, its product may need a higher twist for some applications, such as a viscose crepe yarn. Alternatively, for a standard application, the mill might see the potential to reduce the twist level and gain production. If a lower twist level has too much influence on other quality characteristics, a mill could try to improve its fiber quality selection accordingly. This example shows clearly that it is not a question of good or bad: every STATISTICS evaluation needs to be taken in context, so as not to misinterpret the values.

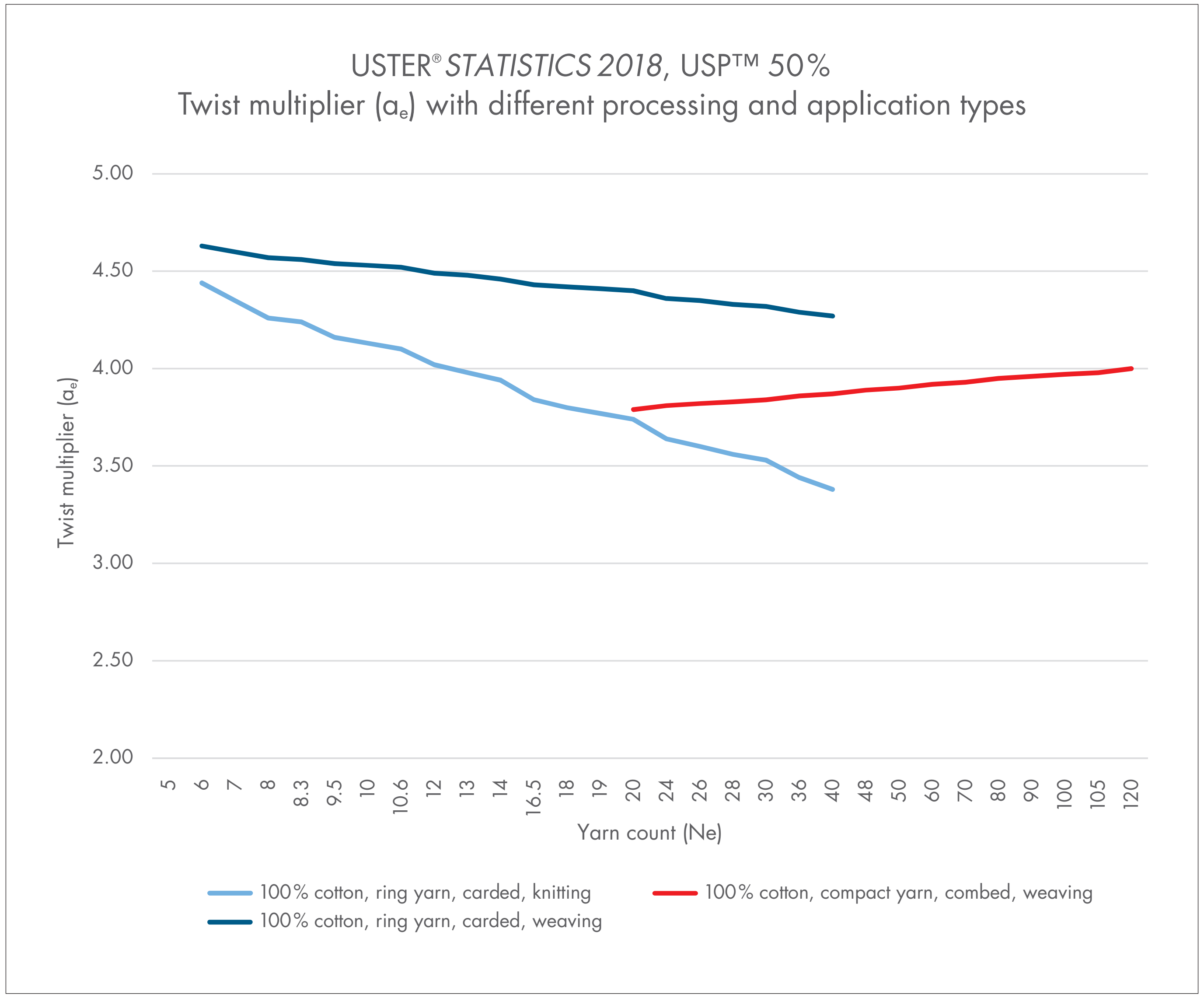


Fig. 37 Twist multiplier differences for a 100 % cotton yarn depending on yarn type and application

A ring yarn, whether for a weaving or knitting application, follows the trend of the finer the count, the lower the twist multiplier **Fig. 37**. A compact weaving yarn shows the opposite trend: the finer the yarn, the higher the twist multiplier. Additionally, the longer, finer and stronger fibers that normally make up fine count yarns cannot compensate for the requested yarn tenacity, so a higher twist multiplier is needed.

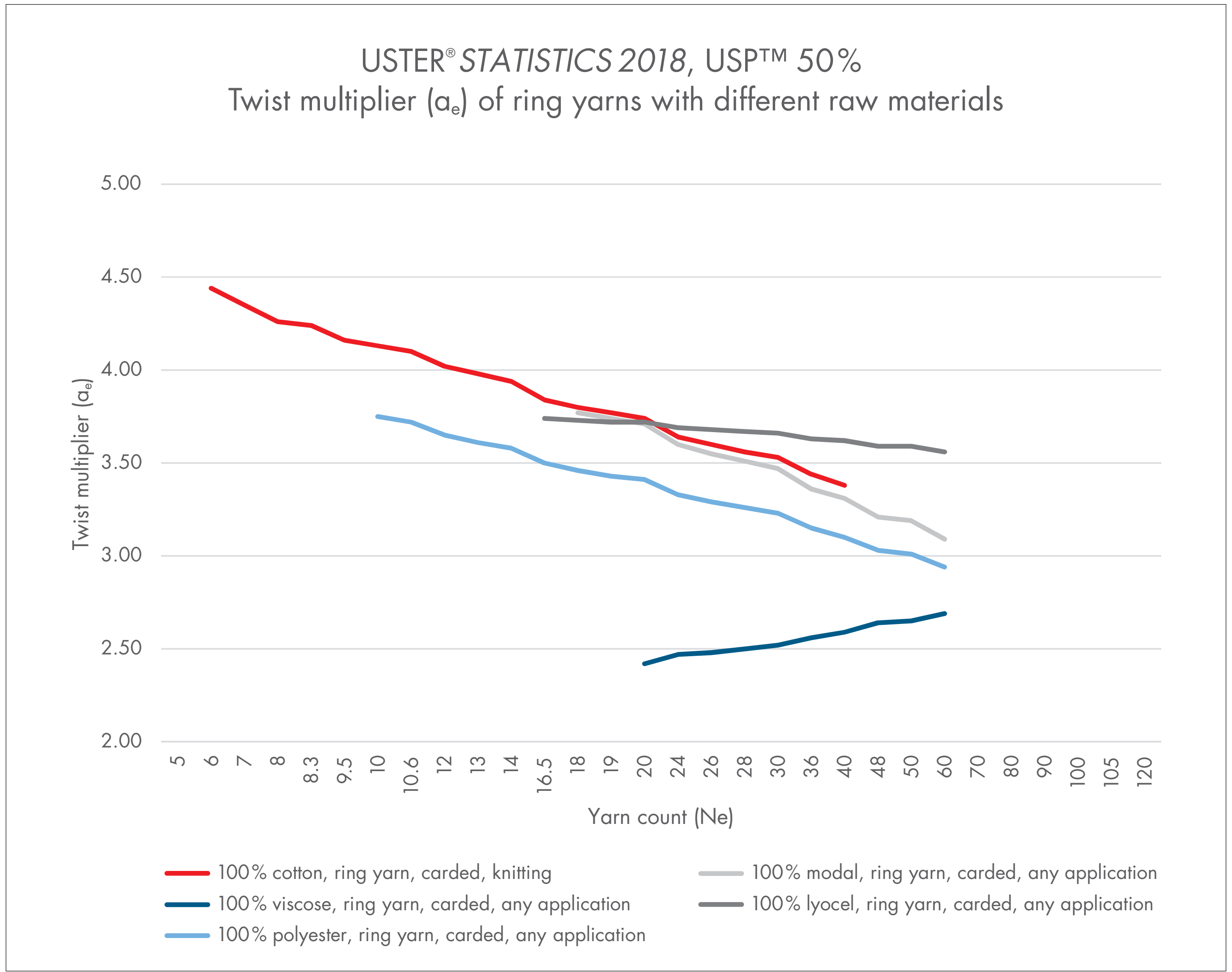


Fig. 38 Twist multiplier for a ring yarn from different raw materials

Ring yarns from different raw materials show an interesting trend regarding the twist multiplier **Fig. 38**. For example, cotton, polyester and modal yarns all follow the same trend, showing more or less the same gradient angle: the finer the yarn count, the lower the twist multiplier. Ring yarn made from lyocell shows a flat gradient. Viscose yarn is outstanding here, but the absolute value is already very low in the medium count range. It could be that finer counts need the twist in order to reach the required yarn tenacity. In general, ring yarns made from man-made fiber require a lower twist level than cotton yarns.

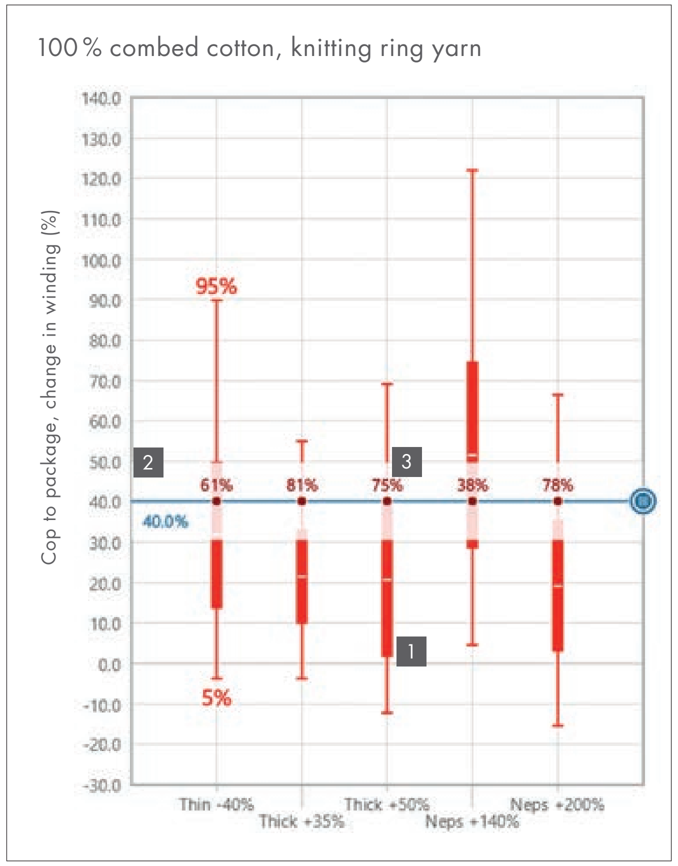


Fig. 39 Changes in imperfections due to the winding process

3.4 New characteristics for yarn processing

Additional data on yarn processing parameters is included in USTER® *STATISTICS 2018*, with new imperfection classes such as +140 % neps and +35 % thick places.

Why are -50 % thin places not integrated here? This is a good question, requiring a detailed answer. It is noted that most yarn types show a very low level of thin places. For example, a typical cop from spinning might show only a single thin place, and the winding machine package containing yarn from that cop might have three thin places in total. This would equate to a change of 300 % between spinning and winding. But this figure of 300 % would actually be misleading, as it would give the impression that the winding process had a negative impact on yarn quality. This would be incorrect, as proved by the absolute figures. Uster Technologies therefore decided to exclude the -50 % thin places value, to prevent any such false conclusions.

Now, any imperfections, including standard imperfections and corresponding changes due to the winding process, can be assessed. Standard imperfections relate to yarn trading and sensitive imperfections have a focus in yarn development. Winding machine settings and basic yarn types can be checked. Ring yarn changes through the winding process are unavoidable. For this reason, Uster Technologies recommends users to take account of the process statistics for yarn development. This allows fast assessment of whether changes in yarn properties from cop to package are at a normal, low or high level.

The example **Fig. 39** of an imperfection change in a knitting yarn due to the winding process demonstrates the practical application of this data. The slider function of the USTER® *STATISTICS* app makes it easy to compare USP™ values of yarns worldwide. As shown in the graphic:

1. Only 25 % (USP™) of all knitting ring yarns in 100 % combed cotton quality have no +50 % thick place changes due to the winding process.
2. If a yarn indicates a change of 50 %, this means, for example, that the cops will have 20 +50 % thick places per km yarn, while the packages will have 30.
3. When almost 75 % (USP™) of yarns reach a high change level of 40 %, it indicates that there is improvement in either winding parameter settings or yarn design – since 75 % (USP™) of yarns being produced can achieve the same or lower level of thick places.

4 Epilogue

USTER® *STATISTICS 2018* is the 10th edition of this unique benchmarking tool – further testament to the ongoing commitment of Uster Technologies to drive textile quality improvements worldwide. Our motivation is a passionate belief that objective quality data is of great benefit to the industry.

We are gratified and encouraged by the way that our efforts are received by key players throughout the textile value chain. This is what energizes our determination to push the boundaries of quality measurement still further. We are always seeking to extend understanding by translating raw data into clear practical guidance for mill management focused on both quality and profitability.

USTER® *STATISTICS* is more relevant than ever to the spinning industry. The concept began when local spinners requested a neutral method of matching quality levels to yarn selling prices. That was 60 years ago. Since then, USTER® *STATISTICS* has become an indispensable aid to quality and productivity. The advantages are widespread, across yarn production, trading communication and business progress. Investments in machinery, raw materials and marketing are also judged against trends identified in USTER® *STATISTICS*.

For spinning mills, USTER® *STATISTICS* touches every stage of the process and every level of personnel. From owners, managers, and quality specialists to service technicians – there are real benefits to everybody in the mill. Ultimately, it provides yarn producers with a guarantee of quality, recognized throughout the industry. It also enables process improvements and Key Performance Indicators to be implemented, for optimized profitability and business sustainability.

Buyers and users of yarn in downstream processes also gain enormously. Quality profiles allow yarns to be precisely specified and selected, ensuring the right properties and performance for the next manufacturing stage. Designers and fabric makers gain an overview of global yarn trends and availability. Most importantly, clear yarn quality data is the basis for agreeing fair prices to match the quality being offered.

For machinery producers, benchmarks keep them in touch with the latest quality and production requirements of their customers. This knowledge is vital in planning new technological developments and improved components. With USTER® *STATISTICS*, machine builders can more easily appreciate the increasingly important balance between product quality and production rates.

Obviously, benchmarks change over time, and Uster Technologies realizes the importance of continuous contact with partners throughout the industry, to match our vision with theirs and stay in tune with innovation as we move into the seventh decade of USTER® *STATISTICS* and beyond. A good example is the way changes in production equipment affect quality (see section 2.3.7 USTER® *CLASSIMAT 5* outliers).

What will never change is the absolute need for accuracy and reliability in the test results on which our benchmarks are based. The reputation of USTER® *STATISTICS* as an established global standard – and of USTER as a trusted and neutral source – depend on the 'quality' commitment of our staff, customers and business partners. We believe in our approach, starting with testing and monitoring from fiber to fabric and extending to a total quality concept for business success. (In that regard, we recommend USTER® *NEWS BULLETIN No. 50* 'Managing a spinning mill with quality in mind' as an introduction. Please download via this QR code or via www.uster.com/unb50.)

At Uster Technologies, we live every day by our 'Think Quality' slogan, and USTER® *STATISTICS* is a perfect reflection of that. We will never stop providing this fount of knowledge, as the ideal platform for progress. A textile industry without USTER® *STATISTICS* is simply inconceivable.

Thomas Nasiou
CEO
Uster Technologies AG

The standard from fiber to fabric

USTER is the world's leading supplier of total quality solutions from fiber to fabric. USTER® standards and precise measurement provide unparalleled advantages for producing best quality at minimum cost.

Think Quality™

Our commitment to state-of-the-art technology ensures the comfort and feel of the finished product – satisfying the demands of a sophisticated market. We help our customers to benefit from our applied knowledge and experience – to think quality, think USTER.

Broad range of products

USTER occupies a unique position in the textile industry. With our broad range of products, we have a wide reach across the textile chain that is unmatched by any other supplier in the market.

Optimal service

Know-how transfer and instant help – we are where our customers are. A total of 215 certified service engineers worldwide grants fast and reliable technical support. Benefit from local know-how transfer in your specific markets and enjoy our service à la carte.

USTER® *STATISTICS* – the textile industry standards

We set the standards for quality control in the global textile industry. With USTER® *STATISTICS*, we provide the benchmarks that are the basis for the trading of textile products at assured levels of quality across global markets.

USTERIZED® – brand your products with quality

USTERIZED® stands for 'defined quality assured' within the textile chain. We invite selected customers to join the USTERIZED® Member Program. More information at www.usterized.com.

USTER worldwide

With four technology centers, four regional service centers and 50 representative offices around the world, USTER is always sure of delivering only the best to its customers. USTER – committed to excellence, committed to quality. And that will never change.

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