International Committee on Cotton Testing Methods (ICCTM)

Progress Report 2022

Proceedings of the Meeting of the ITMF International Committee on Cotton Testing Methods (ICCTM) in Bremen, September 27, 2022

Bremen Cotton Exchange

Wachtstrasse 17-24, 28195 Bremen, Germany

Chair: Axel Drieling, Faserinstitut Bremen e.V., Germany

Vice Chair: Mona Qaud, Uster Technologies AG, Uster, Switzerland

Preface

The International Committee on Cotton Testing Methods (ICCTM) is a non-profit technical subcommittee of the International Textile Manufacturers Federation ITMF. The main function of the Committee is:

- To encourage research into the basic science needed to develop commercially useful tests.
- To encourage the development of enhanced testing methods.
- To recognize instruments and testing methods that are beneficial for the cotton value added chain, being able to perform within allowable tolerances, and achieving results that correlate with a reference method.
- To identify suitable reference methods.
- To harmonize cotton testing results by means of
    - proposition and support for the international standardization of test methods
    - development of guidelines for testing
    - technical evaluations using world-wide round tests.
- To discuss problems related to testing of cotton fiber properties and their relations to cotton processing.

Welcome

Christian Schindler and Axel Drieling welcomed the participants to this meeting. For the first time after the pandemic, the meeting was held in person in Bremen again. It was performed in a hybrid format, i.e., having 25 participants in Bremen, but also 10 joining remotely (list of participants is attached at the end).

Interested parties are always welcome to ask for Committee membership by sending an email to ITMF secretariat@itmf.org. Additionally, Christian Schindler reminded the members of the special ITMF-ICCTM-Website, which allows the members of the Committee to find all relevant documents and addresses, including sending emails to all members.

Axel Drieling welcomed also all the participants to the Bremen Cotton Week and the International Cotton Conference Bremen.

Organizational

Axel Drieling shared the sad news that Andrew Macdonald as member of the ICCTM Steering Committee passed away in spring 2022. He will be deeply missed by all his friends in the cotton industry. With his profound knowledge, he contributed significantly not only to the Cotton Testing Committee, but also as the Chairman of the ITMF Spinners Committee.

Terry Townsend explained that the Steering Committee was founded 2009, and the input from the Steering Committee over the years was very valuable. Just to name the current and former members: Jan Wellman and Karsten Fröse (Bremen Cotton Exchange), Christoph Färber (formerly: Trützschler), Darryl Earnest (USDA AMS), Kai Hughes (ICAC), Terry Townsend, and of course our late Andrew McDonald. The aim was in the past to get the input from different sides from growing, cotton production, ginning, trading up to the spinning. Terry Townsend mentioned that since that time the conditions have changed, and the need of the Steering Committee is no longer seen. He proposed that the Steering Committee should be integrated into in the work/meetings of the Executive Committee, rather than having a separate meeting that reports to the chair. The proposal was accepted unanimously. Axel Drieling mentioned that the statutes will have to be amended accordingly to match this adaption. ITMF and the Executive Committee will change the statues and show the changes in the next meeting.

The ICCTM Executive Committee now consists of:

• Mr Axel Drieling	(Chairman) Faserinstitut Bremen (FIBRE), Germany, contact: drieling@faserinstitut.de
• Mrs Mona Qaud	(Vice Chair) Uster Technologies, Uster, Switzerland, contact: mona.qaud@uster.com
• Mrs Gretchen Deatherage	USDA AMS, Memphis, USA contact: Gretchen.deatherage@ams.usda.gov
• Mr Darryl Earnest	USDA-AMS, Memphis, USA (retirement 2023)
• Mr Karsten Fröse	Bremer Baumwollbörse, Germany (retirement 2023)
• Dr. Stuart Gordon	CSIRO, Waurn Ponds, Geelong, Australia, contact: stuart.gordon@csiro.au
• Dr. Jean-Paul Gourlot	CIRAD, Montpellier, France, contact: jean-paul.gourlot@cirad.fr
• Mr Kai Hughes	ICAC, Washington D.C., USA
• Dr. Malgorzata Matusiak	Institute of Textile Architecture, Lodz, Poland, contact: malgorzata.matusiak@p.lodz.pl → resigned with the end of this meeting
• Dr. Marinus (René) van der Sluijs	Textile Technical Services contact: renevandersluijs@gmail.com

- Dr. Terry Townsend — Cotton Analytics, USA
  contact: terry@cottonanalytics.com

Instrument recognition

At this moment no instrument recognition is pending.

One planned recognition was the Regain Tester from Branca, Italy. Eugenio Branca was unfortunately not able to join this meeting. The moisture regain tester is designed to measure the moisture regain of cotton and other fiber samples, but also yarn samples. Round trials with cotton have started. Other activities are given with wool fibers at INTERWOOLLABS with the oven method and Regain tester. Some systematic deviations of the results between different instrument types/manufacturers were observed, therefore a second round trial was initiated, and will be summarized later this year. The aim of INTERWOOLLABS is to evaluate the variation, investigating possible systematic influences between different kinds of instruments.

Instrument manufacturers

Axel Drieling stated that it is always a great opportunity to have so many instrument manufacturers participating in the meeting. Hence he had approached the manufacturers beforehand and had asked if they would like to share and report about the current status of their cotton testing instruments and recent developments, which will affect the market in the future.

Uster Technologies

Peyman Dehkordi reported that in the past few years since the last meeting there have been three areas that Uster has been active.

1. Continuous improvement of the products equipment – electronics, software, with the aim of enhancing the instruments. This includes the LVI, HVI and classing instruments used at USDA. Recently, the second generation of Auto-Mic has been rolled out to USDA facilities.

2. Investigation and continuous improvement of fiber testing products.

3. Uster is working on digital solutions – some have been already introduced, and Uster will continue to work on such solutions.

Premier

Three developments from side of Premier were presented by Mr. **K. Guruprasath** on a few slides and are available as presentation 1.

- True Maturity: Maturity is available in ART 2 / 3 models, and values are traced to image-based maturity analysis. Correlation to image-based reference by Bremen is high, and correlates as well to dye uptake and fabric appearance. Also, trials with Sircot India were done.
- Gravimetric Trash: Requires a higher sample size, as customers asked for a higher sample size than previously 10 g only with G-Trash. Now the system is capable of handling up to 100 g of material. Physical quantification with physical filters, that enable to measure the fiber fragments, dust and microdust of the samples as well.
- aQura2 – includes an Expert Software: As aQura is a process control system, it is now analysing and interpreting the data in a new software platform, so they can interpret the data from raw cotton up to the finisher slivers and rovings. Trends and deviations in % are visible in this process Expert Software. Customers then can decide on which machines they want to intervene, e.g. for the Short Fiber or Neps.

MAG Solvics

Mr. **Dhandayuthapani (**CD) of MAG Solvics presented their MAG developments, available in presentation 2.

- HVT Genius 2 – fully automated HVI testing. Tower type – with three locations of the tests. “Roto-sampler” with six combs for automatic preparation for the L/S test in order to improve testing capabilities without operator influence.
- Mic module is automated, by weighing and placing it on Mic tray, then just pressing the start button.
- Inbuild bar code reader, rh and temperature sensor, balance.
- Gravimetric trash: AccuTrash can be integrated into the HVT Genius 2+, with trash, dust and micro-dust separation. Tests are based on 100 g samples. More than 175 instruments have been sold.
- Bale Management software: BaleMAN, including the data from different instruments.

Mesdan / VandeWiele

Gabriele Salvinelli was not able to attend, so the slides in presentation 3 were presented by Axel Drieling. Now Mesdan and the Savio Group are part of VandeWiele Group (since 2021).

- Contest-S – Stickiness only, based on former FCT of Lintronics, and classification of the sticky particles according to their sizes.
- Contest-F2 – continued from Loepfe Fibermap (based also on the formerly Lintronics FCT instruments) – as high volume testing of raw cotton and lint of Length, Strength, Elongation, Color, Mic and maturity ratio.
- NATI - Advanced for measuring neps and trash particles in sliver form, and class them into 3 size categories, can be connected to the Contest F2.
- No other new development, but they consolidate the efforts on these three instruments.

Loepfe does not continue its work in cotton testing instrument development, this is followed up by Mesdan only, as they belong under the same company umbrella.

Textechno

Stefan Fliescher prepared his slides on company activities in presentation 4.

Textechno is active not only in natural fibers and single fiber testing, but also in filament testing and composite testing. The FCS – Fiber Classifying System – formerly known as CCS (Cotton Classing System) – was renamed as it applies to other staple fibers as well.

They are able to apply it to a wide spectrum of fibers and materials, such as colored fibers, fiber blends, hemp, linen, PES, blends, CV fibers, as spinners tend to go also in the area of blending materials.

Research

Axel Drieling asked the research organizations to show their fields of activity. Besides e.g. CSIRO and USDA-ARS, also Cotton Incorporated are typically active in this field and were asked if they like to share their current work / fields of interest.

Vikki Martin from Cotton Inc. reported that there is still strong interest in instrument testing over all. Cotton Inc. continues to look for faster and robust measurement of fiber cross section, for assessment of maturity and fineness. They like to have a better understanding of length uniformity and more reliable length uniformity measurements from high volume instrument testing. The research is especially important for the breeding communities.

HVI – Chair: Axel Drieling

USDA AMS and its Quality Management Program (QMP) were presenting their work in presentation 5. **Darryl Earnest** reported that in 2021 17.2 Mio Bales of cotton were tested in their facilities. The crop of 2022 is way smaller with only 12 Mio bales. In their facilities, USDA operates a total of 220 HVI 's of different generations, all from Uster Technologies in a total of 10 classing offices. Half of the offices have newly installed automated conveyor systems. Lubbock Texas was just opened with a decoupled operation (L/S and C in different locations) with a capacity of testing 50.000 – 60.000 samples per day. The plan is that 4 other offices will be automated until the 2025 season. Essential is also that all instruments are operational at all times.

Gretchen Deatherage continued the USDA presentation on the Quality Management Program (QMP). In 2015 USDA started a new approach for result verification instead of retesting a subset of samples in the central laboratory. According programs are given for instrument performance management and manual classification performance. For the instrument performance, periodically every two hours in each shift, every instrument will test known value cotton standards and specific color/trash tiles. The results are analyzed with Tipco-Spotfire analytic system to verify the performance in real time - and not with 2 days delay as previously with the re-test system. The analysis shows bias and reproducibility for each instrument and each property.

For the manual classing – about 1% of samples are re-assessed, with a subset of them sent to the Quality Assurance Division, and the other samples/result checked in-house for immediate feedback. Weekly operational meetings are given to discuss the performance of QMP data.

In the discussion, Terry Townsend asked for the testing costs per bale. Darryl Earnest answered that testing is charged to the farmers with 2.50 $/per bale / sample. Terry asked, if the main aim of the improvements is efficiency or quality improvement. Darryl answered that both is addressed: Automation is increasing the efficiency - and present the subsamples without human intervention, reducing operator influence. Human preparation is only to remove the samples from the bags they were received in, and place them in trays or individual carriers. Still automated systems need to be calibrated manually - with RFID technology some inhouse samples can be tested in desired testing frequency to find out level of instruments. All calibration routines are the same, just the transport of cotton samples is optimized.

On the additional questions, Darryl answered that not much roller ginned cotton is received in the USDA operation, except in the California office. The spinnability is not checked, only at ARS or Cotton Incorporated. Rapid conditioning systems are used for the past 25 years in all 10 locations. Rapid conditioning is in the new systems included – the subsamples are now conditioned in about 2 min before the testing - instead of 20 min on the previous systems. Each bale has a two-part sample taken from the 2 sides of the bale. Both samples of the bales with jointly one tag in the middle are typically given for the USDA operations. The customized equipment is contracted by automation providers and would have to be developed separately for other labs worldwide. Interest for automatic systems is given in other countries, too.

Vikki Martin asked on steps for instrument classing of extraneous matter. Currently all extraneous matter is classed manually at USDA – there have been attempts to automate it, but so far not successful. So USDA reached out for some examples outside the textile industry (food industry, airline industry) to find solutions.

Gretchen explained that checking with known-value samples got the capability of replacing re-testing at USDA, saving costs and time. Darryl meant that a combination of both would be ideal.

Spinnability – Chair: René van der Sluijs

In this presentation, **René van der Sluijs** from Textile Technical Services asked "Why the continued fuss about color?" (presentation 6), specifically, why some cottons are heavily discounted due to their color reading only. Major exporters of the world are USA, Brazil, West Africa, India and Australia, which amounts to the largest share of all cottons traded internationally. The most important fiber properties for spinning (varying depending on the spinning system), are length, strength, fineness and trash content. In opposition to this, 30% of the price of cotton is based on the color.

Color differentiates with cotton from different countries. However, mills have so called trunk blending stages to blend the fibers at intimate state. Or alternatively, they blend on draw frames. Typically, the material is scoured to get rid of the wax layer, and then bleached for lighter colors, or directly dyed for darker colored end products. Spinners need not necessarily cotton being "white as snow", as they can obtain the same quality even with a creme-colored material. Rd and +b results are certainly important for blending, but René's questions is, why are growers penalized for those values. Brighter and lighter does not always means better for cotton quality.

- Guntram Kugler added that weavers and knitters often have problems with the color and face issues with stripes.
- Vikki Martin mentioned that there are differences in the international trading market, as compared to the Domestic US market. Cotton Mills in the US process gladly the 31-41 cottons, as they obtain them with a price advantage. As long as the variation is in control it is not such a question. But especially, if we blend cottons from different origins with properties that are not tested with HVI, it is still a question of concern.
- Robert Young: In a lot of contracts, always grade and staple were used, with grade= color, trash and preparation. Later also the Mic and strength was included, now in few cases also neps and short fiber content. Although the color itself may not be important, the buyers rely on the assumption that a change in color relates to the overall quality and hence other properties.
- Iwona Frydrych: For dyeability also the maturity has a big impact for dye uptake, not only the color itself.
- Karsten Fröse: More yellow/spotted/tinged cotton is discounted, as a spinner is expecting more damaged fiber, and more short fibers. Reflectance is a difference issue, not as important. The number of claims relating to yellowness is much higher than relating to the reflectance value. In the international market, discount in Reflectance is lower than compared to the AUS-market.

Mona Qaud presented a summary on mixing and blending in textile spinning in presentation 7. Blends in the spinning mill are typically done either in the beginning as "intimate" fiber blending, e.g. 98% Cotton and 2 % PES if we want to have some heather effect. Or in the sliver form "sliver blending" – as there the blend share can be adjusted easily by the number of cans in front of the draw frames: e.g. 50% PES, 50% CO. In the yarn forming state, we can have 2 different roving (Siro), yarn flames of different color / material or simply twist two yarns to a ply-yarn, or core yarns with two materials. Also, when having different threads in the fabric, processing a “mix” of two or more materials on the material composition can take place, e.g. also the adding of Elastane has to be considered.

ISO 11827 is defining how to determine fiber composition – the main techniques utilized are via solubility or mechanical separation. The labeling of material has to be done with the precision of ±1-2%, with a confidence range of ±95%. The highest share (%) of material has to be listed first on the labels. Labeling is getting difficult in the case of full or partial utilization of mechanically recycled yarns, where the material share might vary or is not even known. Also, currently there is no indication or differentiation of “fresh” cotton or recycled cotton. So this is a challenge to label those post-consumer recycling materials correctly. For wool, a given labeling is “virgin wool”, which shows that it hasn’t been used before. This could be considered for short staple spinning fibers as well.

Guntram Kugler, Textechno presented new trends in spinning, specifically new requirements for testing the applied fiber material (presentation 8). He explained these trends:

- Development of new yarns for several new applications (technical spun yarn)
- Modification of existing yarns to improve the yarn quality (e.g. strength, evenness)
- Increased production of mélange yarns (blending of white fibers with colored fibers)
- Design of new yarns with special structures (e.g. fancy yarns, linen structure)
- Increased Airjet spinning
- Processing of recycled fiber with virgin cotton

For these purposes, new fiber materials are blended with cotton, e.g. Lenzing Modal, Tencel, Polyester or cottonized linen, even Kapok. But not only cotton fibers need to be tested, but also other fibers at the spinners level. Guntram presented the Textechno Fiber Classifying system (FCS) based on the Cotton classifying system. With this instrument, all fibers are tested in a comparable way without calibration cottons. Based on Micronaire also other fibers are tested (the full presentation was given at the Spinners seminar on Wednesday afternoon).

Justin Kühn from ITA Aachen presented on spinning and spinnability (presentation 9). Beneficial parameters for spinning are the reduction of thin and thick places, nep reduction, strength increase, fiber length increase, elongation increase and hairiness as a feel good factor. Especially in ginning there could be still improvement in utilizing the fibers that are remaining on the seed. On the example of a rotor spinning machine, some settings in spinning are relevant and can be set on the machines, such as twist, draft or Tpm. The technological elements in the spinning devices such as rotor type, nozzle type, torque stop, opening roller and adapter are impacting the yarn quality as well. Also in the start-up of the spinning, few parameters can be set that will impact the piecers, and so also the yarn quality. In addition, external impacts are e.g. temperature and humidity – which should be held constant for spinning, but are actually fluctuating during the day. Physical influences – the twisting has an optimal point for a certain strength, and it will decrease if we go lower or higher. Whereas the elongation increases with a higher twist. The spinner wants to have a high production with a maximum of 10 yarn breaks / 1000 rotor hours. The machine efficiency should be above 98%, and the production at least 7800 to 8200 hours per year. The trend is also for automation and digitalization.

Fineness and Maturity – Chair: Stuart Gordon

In this presentation 10, **Stuart Gordon** shared a list of standard test methods available for fineness and maturity. One source is ASTM; a new standard here is given for the cotton scope method being ASTM D8394-21 (2021). Additionally, he listed British and ISO standard test methods (see presentation).

Many instruments are working on the double compression for Micronaire (as Textechno or Premier).

Guntram Kugler explained that in a trial in Uzbekistan for Micronaire testing they obtained results for the influence of trash on Micronaire. With trash reading Mic 5.2, after cleaning Mic was reduced to 4.4. The procedure at Textechno is to run the material first through MDTA, and then test the Micronaire afterwards.

Theresa Ritter explained that there was an amendment in the ISO test method for Micronaire a year ago. Previously it was stated that trash particles have to be removed before Mic testing. The ISO test method was adapted that you either have to remove or keep the trash content in the samples, and mention it on the test reports accordingly.

Color – Chair: Malgorzata Matusiak

Axel Drieling read an e-mail that Malgorzata sent to the Committee. Malgorzata resigned from the executive committee and therefore from the chair of color due to changes in her professional activity.

Guntram Kugler mentioned that a discussion had been going on in the past on removing the trash before testing the color. E.g. Shoffner Technologies went into this direction. All definitions are still on the grading including the trash. René van der Sluijs mentioned that it would be good to get the input from the spinning side in the next meeting.

Recycling

Harald Schwippl reported about Rieter's recycling system (presentation 11). Rieter realized that they need a suitable testing instrumentation for testing recycled materials. Principally, Rieter distinguishes between virgin material, spinning waste and tear fibers. Recycling is principally also including the chemical resolving the fiber and re-spinning, but this was not part of this presentation.

Spinning waste is everything that is collected during the mill operation, be that from the blowroom, from the card or comber noil. Tear Fibers have to be distinguished into pre-consumer material (where the material composition is known) – and post-consumer material. It is easier to bring pre-consumer yarn rests into fiber state than using the post-consumer waste, where only material in fabric state is available.

Besides the question of handling the fabric pieces and yarn pieces in the material, the degree of opening has to be determined. It was also clear, that the materials have to be separated by color.

Required data –the fiber length has to include parameters for short fiber content, for medium staple length and for long fiber length. Another important criterion is the nep content as we obtain another yarn structure that contains more neps, which is also an indication how good the quality will be at the end application. The material composition is also relevant and needs to be known.

The current testing process at Rieter includes

- Removing the yarn and fabric pieces on Shirley or MDTA and to determine the opening degree
- Length testing on AFIS, Almeter or Fibrotest

Rieter is utilizing mainly AFIS for the length testing now – but a big challenge is the strength testing of the material due to the short length of the recycled materials. They cannot test it with the HVI, as the results are not correct due to the impact of non-opened fibers (yarn pieces).

Harald Schwippl made the point that we need standards to have everyone on the same page. For process optimization, the short fiber content by number is needed (not the by weight figures). In a comparison of AFIS, Almeter and Fibrotest it was seen that currently no testing device is sufficient to describe recycled materials. Without a recognized testing standard, classification of recycled material is difficult. When comparing the SFC (n), a good correlation between Almeter and Keisokki can be found. They realized that with the AFIS by number data they can set the machinery.

For the opening of the material, he explained the definitions that Rieter is using based on the Shirley Tester:

$$\text{Degree fabric opening DFO [\%]} = \frac{\text{fabric input} - \text{fabric output}}{\text{fabric input}} \times 100$$

This is relevant as the spinner either must open the remaining pieces or take them out.

$$\text{Efficency of fiber opening EFO [\%]} = \frac{\text{raw material} - \text{non-opened fibers} - \text{fiber fragments}}{\text{raw material}} \times 100$$

The fiber opening is essential for the amount of fibers in the received material. Also the card can open some of the yarn pieces into fibers. Rieter compared the results from Shirley with manual classification of yarn pieces and fabric pieces and found that Shirley provides suitable data.

Based on different samples they made a first classification into the data based on the fiber length by AFIS.

Fiber Key Parameters by number (n)	Short-Fiber Content	Mean Fiber Length	Long Fiber 5%
Cotton short staple (<1 1/8” as reference)	24%	21 mm	34 mm
Very good	45%	17 mm	31 mm
Good	55%	14 mm	29 mm
Medium	60%	13 mm	28 mm
Poor	78%	10 mm	22 mm

If the classification was up to medium the material can be utilized in the range of open end – rotor spinning process. If the material is classed in good and very good, there is a possiblity of utilizing the material even in the ring spinning process - not for fully recyled materials, but e.g. a blend of 25% virgin cotton plus 75% recycling material could be achieved.

This is based on the fiber length only – and any data on fiber strength is missing. For length Rieter is convinced that AFIS PRO II is working for them, but an instrument able to determine the strength is required.

Guntram Kugler explained in his presentation “Textechno: Fiber Classifying System FCS – Tool to characterize recycling fibers” (presentation 12) that Textechno’s Fiber Classifying system was renamed from Cotton Classifying system, a lot of modifications have been done in the past 4 years, and now it is able to classify also recycled fibers.

Recycling fibers were typically down-cycled into non-wovens in the past (geo-textiles, painter-matts). Now recycling is done by blending the recycled fibers with virgin fibers, producing yarns and clothes again.

FCS consists of a modular system including the following stations: Fibrotest, Fibroflow, Optotest and MDTA4, and an FCS-CPU. The stations are working independently from each other. The Fibrotest tests fiber length and strength based on bundles, in two test settings: absolute level & HVI-level, where HVI calibration cotton is required. Optotest determines the trash and classifies the color, Fibroflow determines Micronaire and Maturity via double compression method, whereas the MDTA4 is utilized for trash separation, single fiber length tests, opening energy and for forming a sliver. All instruments are connected with a central computer. The FCS is suitable for short and long staple fibers, such as cotton, wool, polyester, cellulosic fibers and acrylics, and including also short fibers such as recycling fibers and Kapok fibers.

Guntram Kugler mentioned the importance to create definitions to evaluate the recycling material. These are
- Long fibers within the material (1%, 5%)
- Mean length & variation of the fiber length distribution
- Short fiber content
- Fiber bundle strength
- Average linear density
- Average color
- Percentage of remaining yarn pieces

Many companies are already sorting the fabrics according to the color in order to save on the bleaching or re-dying process.

Remaining yarn pieces can be detected in the results by checking the Upper Quartile Length diagram of FCS.

Length results are given in Fibrograph setting (span lengths) and in Almeter setting (staple lengths) with the length values given by weight and by number. Textechno is combining these two methods to inform the spinners and producers on the most important results.

To determine the yarn pieces, the MDTA4 was used. With this, fibers are collected as a sliver, and the trash box collects yarn pieces. The lab achieved a good correlation of the manual removed samples and the yarn pieces removed by MDTA4.

On MDTA4 – the feeding roll speed, the opener speed and the suction can be changed (e.g. in fiber channel or dust channel direction). Different settings are necessary for different fiber materials. To get out all the yarn pieces in the trash box, they used the opening roller OS21, and adjusted the suction on MDTA4. During the creation of the rotor sliver, also the opening energy can be determined.

For Strength measurements, the samples are prepared first on MDTA4 (to remove the yarn pieces) and then the sliver is used for strength testing. An option is to take out the yarn pieces in the prepared fiber clamps.

Discussion: According to Harald Schwippl from Rieter, this process on MDTA 4 simulates the carding process, and is helpful. One disadvantage is that the material is already stressed on the carding / opening process before testing.

Guntram Kugler mentioned that the color is not impacting the testing – however the dyestuff (color) also could impact and damage the fibers. The absolute strength (not HVI strength) of virgin cotton is between 15 and 19 g/tex – in recycling material the absolute strength is 5-8 g/tex).

MDTA4 got different opening rollers depending on the type of fibers - OB20 for CO, OB21 for MMF PES and CV. For long fibers like linen, it is better to prepare the materials on a "mini-card" into a sliver format.

The amount of fiber fragments depends on cotton varieties – 0.8-1.2% fiber fragments in some fiber types. Neps, Trash and Seed Coat Neps are collected on MDTA4, and then are evaluated in the OPTOTRASH, and are classified by size.

Justin Kühn mentioned that yarn loses strength in re-dyeing. Guntram mentioned a study at Square Textiles, Bangladesh, to find out fiber damage in the dyeing stage.

During the past 2 years, **Axel Drieling and René van der Sluijs** took the chance to analyze the data from the past 20 years of Bremen Round Trial data (presentation 13). Each dot in the results refers to the average of about 100 different HVI lines, and to about 40 AFIS instruments.

The data of the different measurements are correlated and will show systematic differences between two methods. The Bremen Round Trials started in 1956, and participation is free for the participants. Currently 160 participants from 39 countries are registered.

The choice of origins in the Bremen Round Trials is wide, approx. 20 origins are included. Sticky samples are however not included, but this property is evaluated in a separate round trial. Gravimetric trash was included starting in 2022. The test methods included for length are e.g. HVI on ICCS and HVICCS calibration, Fibrograph, Comb Sorter, Almeter, AFIS and aQura. For the interlaboratory averages, outliers are excluded according to Grubbs method.

Good correlations were seen between (for details see the slides)

- HVI ICCS 2.5%SL and HVI HVICCS UHML
- Fibrograph 2.5% SL and HVI HVICCS UHML
- AFIS UQL(w) and HVI HVICCS UHML; AFIS slightly lower then HVI
- AFIS 5% Length and HVI HVICCS UHML
- AFIS 5% Length (n) and aQura 5% L(n) – systematic deviation of the two instruments, aQura lower
- AFIS ML (n) - ML(w) → expected good correlation with a systematic deviation of about 4 -5 mm
- AFIS ML(n) – Almeter ML(n) → low number of participants in Almeter
- HVI ICCS UR, vs HVI HVI UI – good correlation, however a line of "exceptions" to be investigated.
- AFIS SFC (n) and AFIS SFC (w), good correlation as expected, with always L(n) being higher
- AFIS SFC (n) and HVI HVICCS SFI → R^2 being 0.54

In a separate analysis, data from 16.000 samples from most available origins was analyzed. The findings are quite similar to what is seen in Uster Statistics. The main findings are that the Short Fiber Index and the Uniformity Index are clearly related to the Upper Half Mean Length (UHML). All the detailed data is given in the presentation slides.

René van der Sluijs mentioned that strength would be something he likes to consider for the next meeting.

Jean-Paul Gourlot mentioned that old fashioned methods are going to disappear. It is good for new techniques being developed to see how they correlate to former methods.

Guntram Kugler mentioned that definitions for parameters should also be used for other than cotton fibers, e.g. all natural fibers.

Jean-Paul Gourlot raised the question, who is working on the topic of elongation, as spinnability is also a matter of strength / elongation. Guntram Kugler answered that Eric Hequet had worked on the work to break, which is the integral of the force-elongation curve. René van der Sluijs added that Chris Delhorn has been working on a paper published by the Journal of Textile Institute.

Stickiness – Chair: Jean Paul Gourlot

Jean-Paul Gourlot summarized in his presentation 14 the results of the Stickiness Round Trials, which are conducted since 2017 jointly by CIRAD, Bremen Fibre Institute and the Bremen Cotton Exchange / ICA Bremen. Stickiness in spinning mills is given due to entomological sugars. These sugars, called honeydew, are mainly produced by Aphids and White Flies, but new insects like mealybug are upcoming.

There is a need for a reliable characterization (method, reference material) in order to predict problems in spinning. Necessary actions are to harmonize the test results within each test method and between different test methods, and to develop guidelines and also evaluate via round trials.

The first round test was done in 2013/14, including even micro spinning. It was seen that we need harmonization in this area, but also the creation of reference materials has been detected as an important topic. Since 2017, 11 regular Round trials have been conducted by CIRAD, FIBRE and the Bremen Cotton Exchange / ICA Bremen. Each time, 20-34 laboratories participated – some test methods disappeared over the years, some new ones were added. However, Jean-Paul Gourlot never got questions on the reports, although they are not only available for the labs, but also for the public on the ITMF website.

Hence, to simplify the reading of the reports, Jean-Paul Gourlot suggested to introduce Z-scores for the round trial results. He tried to apply this to the stickiness round trials. Thereby the laboratory performance could be evaluated in an easily readable way.

The different stickiness test methods show different scales. Jean-Paul Gourlot proposed a common scale, into which all other specific scales can be translated. If the common scale is applied to the maximum result of a value, mills outside could be alerted. Also we decided in 2021 on focusing on thermomechanical methods only, as solely those predict the issues in the spinning mills suitably.

Only a few labs would be alerted if the Z-score would be applied, some of the labs would need to be notified, however it is typically also just a few labs, as e.g. some methods have more outliers than others.

Regarding reference material, CIRAD produces a small quantity of reference materials e.g. for calibrating SCT and H2SD, which can be ordered via technologie.coton@cirad.fr, coton@cirad.fr . They were produced by Richard Frydrych, CIRAD, and are limited in stock.

cirad **Z-Scores: Example of annex of future RT reports**

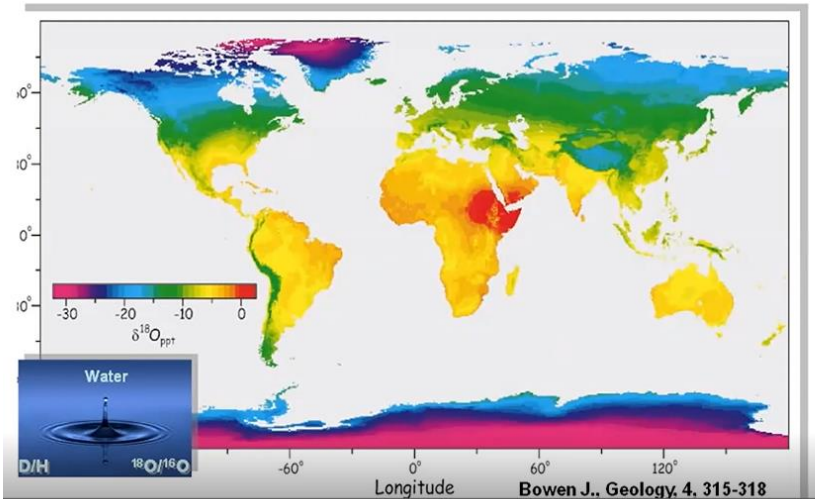
Meth	LabID	A	B	C	D	E
Caramelization	95	-0.92	1.73	0.24	0.52	-0.73
Caramelization	120	0.20	1.89	0.73	0.94	0.15
Contest-S	5	-0.06	2.50	0.16	1.83	-0.85
Contest-S	40	-0.07	-0.68	-0.27	-0.43	0.30
Contest-S	50	0.62	-0.15	2.00	1.75	2.77
Contest-S	60	0.43	-0.50	0.24	-0.17	1.02
Contest-S	70	0.54	-0.81	-1.20	-0.50	1.49
Contest-S	105	0.45	0.00	0.69	0.80	0.54
Contest-S	110	0.07	-0.05	0.88	0.89	0.89
Contest-S	135	0.05	-0.53	0.42	0.29	0.53
H2SD	25	-0.07	-0.34	0.29	-0.21	-0.05
H2SD	65	-0.33	-0.91	0.08	-0.83	-1.05
H2SD	80	2.08	1.76	1.81	0.75	0.17
H2SD	85	1.32	1.89	0.22	-0.68	0.68
H2SD	100	0.54	0.88	1.24	1.53	0.03
H2SD	115	0.15	1.03	0.77	1.65	0.23
H2SD	140	0.53	1.45	0.17	0.59	0.23
H2SD	150	2.02	-0.11	-0.46	-1.27	-1.17
KOTITI	30	4.16	4.37	5.63	5.12	3.91
Minicard	75	3.47	0.73	2.57	2.09	1.61
MinicardC	155	3.11	1.95	3.11	2.83	2.06
Quantitative method	55	-1.57	0.39	-1.35	-0.86	-2.57
SCT	10	-0.91	-0.14	-0.97	-0.37	-1.19
SCT	15	-0.29	0.10	-0.91	0.22	-0.28
SCT	20	-2.12	-1.08	-2.14	-1.67	-1.18
SCT	35	-0.04	-0.65	-0.87	-0.50	-0.05
SCT	45	-1.28	-0.67	0.17	-0.50	-0.94
SCT	90	-0.38	-1.03	0.46	-0.05	0.89
SCT	125	-1.44	-0.42	-1.20	-1.09	-1.21
SCT	130	-0.11	-0.84	-0.05	-0.92	-0.64
SCT	145	-1.68	-0.69	-1.54	-1.12	-1.16

RT2022-1 data, CommonScale results

ITMF-ICCTM-Stickiness meeting in Bremen - September 2022 17

Markus Boner from Agroisolab gave a report about stable isotope analysis as a basis for identifying the origin of cotton samples (presentation 15). He mentioned that stable isotope analysis is already used in the food industry and e.g. for timber for several years. Isotopic databases are available mainly for the food industry like for asparagus, pork, beef, eggs, vinegar or ivory.

Typical atoms like e.g. Oxygen in water have different amounts of the given stable / non-radioactive isotopes. For Oxygen it is e.g. atomic weights of 16 and 18. The proportions of the isotopes depend on the region, as can be seen in the image below for Oxygen (developed by the International Atomic Agency). Plants and animal are utilizing water for their growth, take up the water molecules and hence atoms into their material, so it is then reflected in the material as well. Besides Oxygen, other atoms can be measured, too, like Hydrogen, Carbon, Sulphur or Nitrogen. Every atom has its own typical isotope distribution around the world.



E.g. in the field of timber, illegal de-forestation is being checked, and the wood from those areas would also become illegal. With this method the origin can be detected. In laws relating to the deforestation of the EU it is stated, that the exact place where the relevant commodity or product was produced shall be listed, and include the isotope testing.

For cotton, up to 5 atoms with their isotopes can be used.

There are 3 database models.

a.) Closed database: Retailers and traders would have closed and exclusive databases to monitor their own supply chain
b.) Restricted database: Associations and consortiums: with controlled access
c.) Completely open database, where all data is available online

The question arose, which difficulties would raise for cotton as an annual crop. Markus Boner answered that growth water is very stable, as stated in many publications. There is some fluctuation – but we will have distinct signatures, especially in the water, that are very stable, and different e.g. for German, French or Spanish origin. So, such a database does not have to be built up from year to year. On the other side, there might be an overlapping between regions, as e.g. in Turkish or Greek origin.

Test size for cotton would be 1 mg, but a sample of 50 g would be suitable.

In the presentation in the main conference a paper was presented. In a study done in conjunction with Hochschule Niederrhein they show the impact throughout the processing of textile – raw fiber – yarn – even into the bleached fabric.

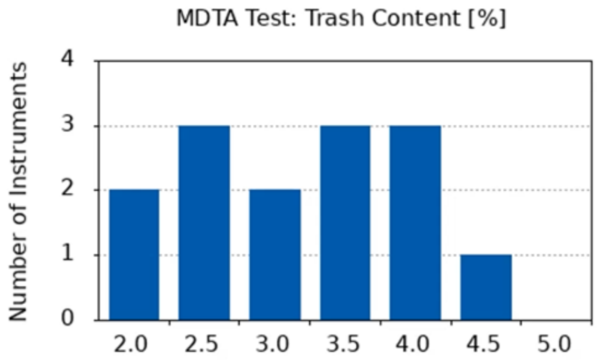
When a mixture of origins is given, only the main origin (>80%) will be testable. Even more difficult would be a mixture of cotton with recycled material. Man-made made fibers like PES need to be removed before the analysis.

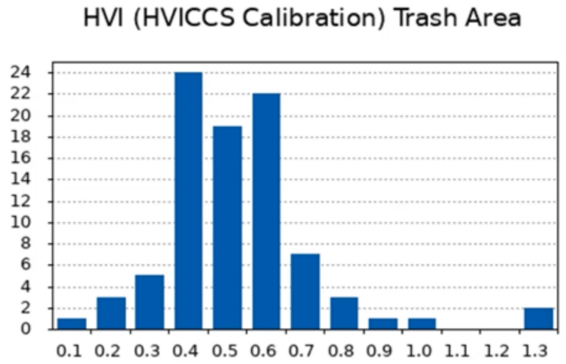
Neps and Trash – Chair: Gretchen Deatherage

Axel Drieling reported on the comparison of different test methods for trash (presentation 16) and showed correlations, influences and repeatability. The results are based on the bachelor thesis of Alica Malz at University of Bremen.

There are several different test methods available, which can be distinguished into mechanical separation with gravimetric testing, mechanical separation with additional analysis, optical test on the material surface, and the mechanical separation of neps and trash with additional analysis.

Mechanical trash testing has been included in the ICA Bremen Round Trials since 2022, using US MOT cotton and Central Asian cotton in 2022. Mechanical trash testing is given in two tables: a) separation into lint and trash and b) separation into lint, trash, dust, micro-dust and fiber fragments (MDTA). The results for the US MOT samples are given below for mechanical testing and HVI Trash Area testing. Interlaboratory CV of mechanical testing is 25%, and for HVI Trash Area 38%.





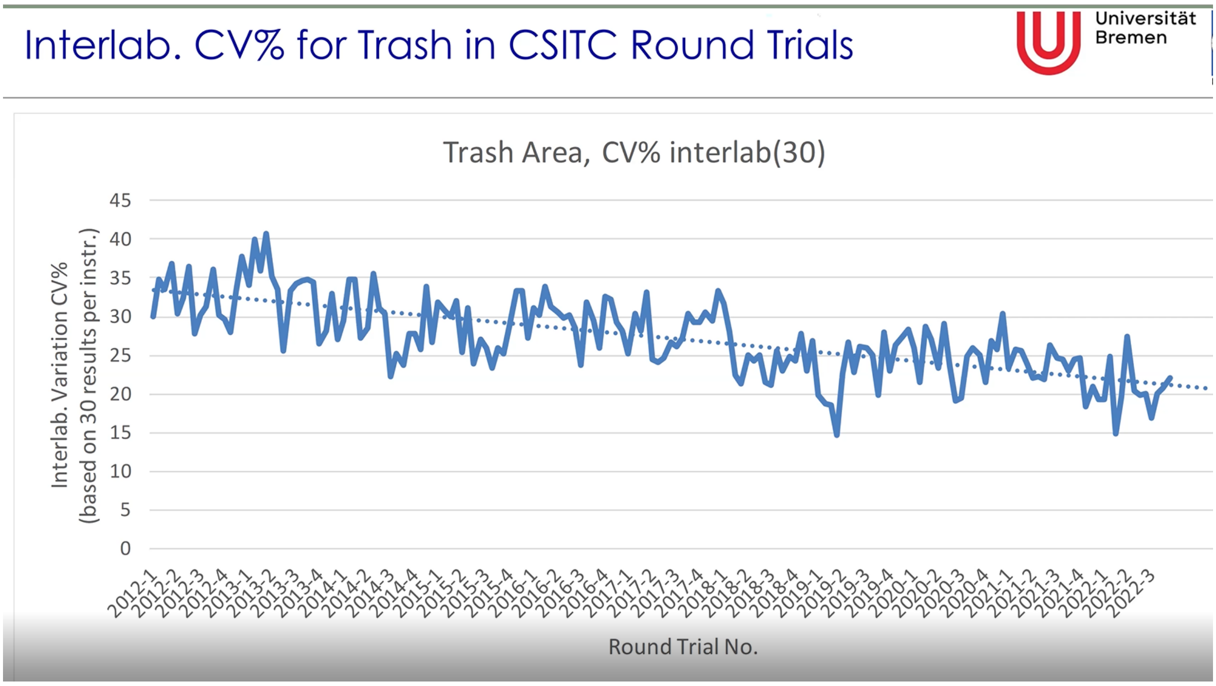
Additional studies were done with some cooperating laboratories, using a wide range of test methods and cotton origins. Trützschler, Saurer, Trützschler, Denkendorf, USDA-ARS, FBRI, Textechno and Groz-Beckert took part in this study.

Some findings were:

- Trash area from HVI and the gravimetric trash differ to a big extent. This was expected, as the methods differ totally from each other; the HVI does not give the same picture as it only analyzes the material surface.
    - R^2 ranges from 0.27 to 0.6.
    - The slope between HVI (x) and gravimetric (y) is approx. 2.7.
- High correlations are given between the different kinds of gravimetrical methods (MDTA3/4, Accutrash, G-Trash)
    - R^2 ranges from 0.8 to 0.92.
    - The slope ranges from 0.95 to 1.06, so close to the ideal slope of 1.
- AFIS has a lower correlation
    - but still R^2 between 0.6-0.79 is seen, even knowing that the sample size was only 0.5g x 5 reps.
    - The slope between AFIS (x) and G-Trash is around 1.6.

Tests for repeatability and reproducibility (based on improved pre-requisites compared to the Round Trials) were started. It can be seen that the repeatability is much better than the interlaboratory variation, so activities for harmonization should be intensified.

Independently, interlaboratory variation for HVI Trash Area measurements can be seen with the CSITC round trials. Here it can be seen that the CV of Trash area has improved over the past 10 years. From 30-35 % variation in the trash area an improvement was seen to 20-25% (see figure below).



Several influences on the correlation between the methods could be seen

- Dark spots: On the Tanzanian cotton some dark spots were interpreted as trash particles on HVI.
- The color of the trash particles, the number of seed coat fragments, size of particles, leaf vs. bark and grass, ginning method, and possibly also the fiber properties such as length and Micronaire can influence the correlations.

In the discussion it was noted that the preparation of the samples for interlaboratory comparisons is quite difficult, as e.g. handling of the samples may result in loosing trash particles.

Generally, if a higher amount is analyzed, then the results are more repeatable, this is also one reason that e.g. Premier increased the sample weight for the G-Trash now to 100g.

General

Based on the ITMF and CSITC committees, a test guideline was introduced about 10 years ago, which is widely used and has also been translated into several languages (presentation 17a). The current version is version 3.0. Please inform Axel Drieling with an email if you want changes or suggestions to add to the document.

The SCITC guide "Interpretation and use of instrument measured cotton characteristics" was published in 2021 by the two committees ITMF and ICAC. **Mona Qaud** presented the main content (presentation 17). In the Guideline, the authors look at different parameters and evaluate their impact on the textile process chain. Micronaire, maturity, length, short fiber content, neps, strength and color characteristics are considered. In addition, Uster Statistics charts for fibers are shown where applicable. The most important effects and influencing factors for spinning, but also for downstream processing have been presented in these tables.

The entire guide is now available in English, French and Portuguese - and will now also be available in Arabic. It is available on the ITMF homepage, the CSITC and the ICAC homepage.

Olivier Zieschank from ITMF summarized the the most important insights from ITMF Davos, which took place on September 27, 2022 in Switzerland (presentation 18).

Cotton production is expected to remain at a similar and stable level, polyester fibers are forecasted the greatest growth in the coming years.

Challenges and opportunities were discussed. One trend that was seen is traceability and sustainability. How can we trace the origin throughout of the value chain at a competitive cost because it may be more profitable or even desirable to blend fibers of different origins or types?

In the area of sustainability, the question is whether to invest in sustainable production if the return on investment is uncertain. Currently, fiber blends are still used, the origin of the fibers is difficult to trace, and traceable fibers are limited to niche markets and/or are either by the retailer or the fiber manufacturer. In the end, the question remains how to achieve sustainable mass production of textiles.

Recycling was also a big topic and mentioned in a few presentations. There are two main ways to recycle the fabrics: Mechanically or chemically. One question is how to increase the value of a lower quality fiber. Materials need to be sorted by color. In the mechanical sector, Rieter showed a solution to produce recycled fibers on the ring spinning with shares of up to 20% without loss of quality in the yarn. Also solutions from companies as Infinited, HeiQ and Worn Again were mentioned. According to the presenters, only 1% of textiles are recycled in Europe and this share should be increased.

In 2019 recycling was not yet on the agenda and was only a niche market. That has changed since - and is tackled not only from spinners but from machine manufacturers as well and includes testing of the recycled fibers. The variety of fiber types will increase, including new natural fibers and man-made cellulosics from additional sources. Another issue is integrating data and information into the value chain, and expanding networks.

The next meeting of the ITMF main conference will be held in November 2023 in Kequio, China.

Closing

The Executive Committee and Steering Committee will now be embedded into one Executive Committee. Recycling and traceability will continue to be topics in this committee.

We also need to replace colleagues on this committee who are retiring in the near future. Jean Paul Gourlot is planning to retire in the next two years, as are Karsten Fröse, Darryl Earnest and Guntram Kugler. We need to bring in new and young people from the textile industry to this committee.

The next meeting is planned during the International Cotton Conference Bremen week. Planned is the meeting for March 18 afternoon and 19 morning, 2024, again in Bremen in the building of the Bremen Cotton Exchange.

Christian Schindler closed the meeting and thanked all participants - online and on site - for the numerous contributions, fruitful discussions, and excellent presentations.

List of presentations
(File names start with the numbers given below)

No.	Company	Name	Topic
1	Premier	Guruprasath K.	Developments and current status
2	MAG Solvics	Dhandayuthapani	Developments and current status
3	Mesdan & Loepfe	Gabriele Salvinelli	Developments and current status
4	Textechno	Stefan Fliescher	Developments and current status
5	USDA AMS	Darryl Earnest; Gretchen Deatherage	Update on classing offices in the US; Quality management program
6	Textile Technical Services	Marinus v.d. Slujis	Why the continued fuss about colour
7	Uster Technologies	Mona Qaud	“Mixing and blending” in textile mills
8	Textechno	Guntram Kugler	Trends in Spinning
9	ITA Aachen	Justin Kühn	Spinnability in respect of OE Rotor
10	CSIRO	Stuart Gordon	Fineness and Maturity report
11	Rieter	Harald Schwippl	Recycling standards and classification
12	Textechno	Guntram Kugler	FCS – Fiber Classifying system – Tool to characterize recycling fibers
13	FIBRE, Textile Technical Service	Axel Drieling / Marinus v.d. Slujis	Round trial results – correlation between length test methods
14	CIRAD	Jean Paul Gourlot	Stickiness Round Trial
15	Agroisolab	Markus Boner	Stable Isotope analysis
16	FIBRE	Axel Drieling / Alicia Malz	Comparison of different test methods for trash
17 17a	ITMF / CSITC / ICAC	Mona Qaud	CSITC interpretation and use of instrument measured cotton characteristics
18	ITMF	Olivier Zieschank	Take-aways and summary of ITMF conference in Davos in Sept. 2022

Participants – onsite

Country	Company	Name
France	CIRAD	Jean Paul Gourlot
Germany	BBB	Carsten Fröse
Germany	FIBRE	Axel Drieling
Germany	FIBRE	Lennard Meyer
Germany	FIBRE	Mareike Woestmann
Germany	ITA RWTH Aachen	Justin Kühn
Germany	Textechno	Felix Liebhold
Germany	Textechno	Guntram Kugler
Germany	Textechno	Stefan Fliescher
Hongkong	Puma	Howard Williams
Israel	Israel cotton Board	Matanya Zuntz
Poland	Gdynia cotton association	Iwona Frydrych
Sudan	ARC	A.H. Latif
Switzerland	ITMF, Zurich	Christian Schindler
Switzerland	ITMF, Zurich	Olivier Zieschank
Switzerland	Uster Technologies	Mona Qaud
UK	ICA	Robert Jiang
UK	Wakefield inspections	Peter Wakefield
USA	Cotton Analytics	Terry Townsend
USA	Cotton Inc	Neha Kothava
USA	Cotton Inc	Vikki Martin
USA	Texas ATM University	Robert Hardin
USA	USDA AMS Cotton Program	Darryl Earnest
USA	USDA ARS, Cotton Program	Gretchen Deatherage
USA	Uster Technologies	Peyman Dehkordi

Participants - remote

Australia	CSIRO	Stuart Gordon
Australia	Textile Technical Services	René van der Sluijs
India	MAG Solvics	CD Pani, cdpani@magsolvics.com (not member)
India	Premier Evolvics	K. Guruprasath, guruprasath.k@premier-1.com (not member)
India	Premier	D. Ramakrishnan, drk@premier-1.com (not member)
Italy	Mesdan	Gabriele Salvinelli
Switzerland	Rieter	Harald Schwippl
Switzerland	Uster Technologies	Theresa Ritter
Germany	Agroisolab	Markus Boner, m.boner@agroisolab.de (not member)
USA	USDA	Carlos ?
Greece		Eleni Zaleki
South Africa	Cotton SA	Gerd Klint
Poland		Malgorzata Matusiak

Developments in Fibre Testing

PREMIER

True Maturity: Increasing demand by Spinners

- “True Maturity”, available in ***PREMIER ART2 / ART3*** models. Values are traceable to Image based maturity values.

- Thanks to the joint project with Bremen Institute - for testing and providing values for reference samples.

- **High correlation** with dye update, fabric appearance and handle values.

Developments in Fibre Testing

PREMIER

True Maturity: Increasing demand by Spinners

Correlation between Image based Maturity vs. True Maturity

Cotton	Category	**Maturity** (Image analysis method by Bremen)	**True Maturity** (ART2 / ART3)
Mix 1	**Low Mic, Low Mat**	0.72	0.74
Mix 2	**High Mic, Low Mat**	0.81	0.81
Mix 3	**Low Mic, High Mat**	0.95	0.95
Mix 4	**High Mic, High Mat**	1.06	1.06
Correlation (r^2)		**0.99**	

Developments in Fibre Testing

PREMIER

Gravimetric Trash: Increase in sample size

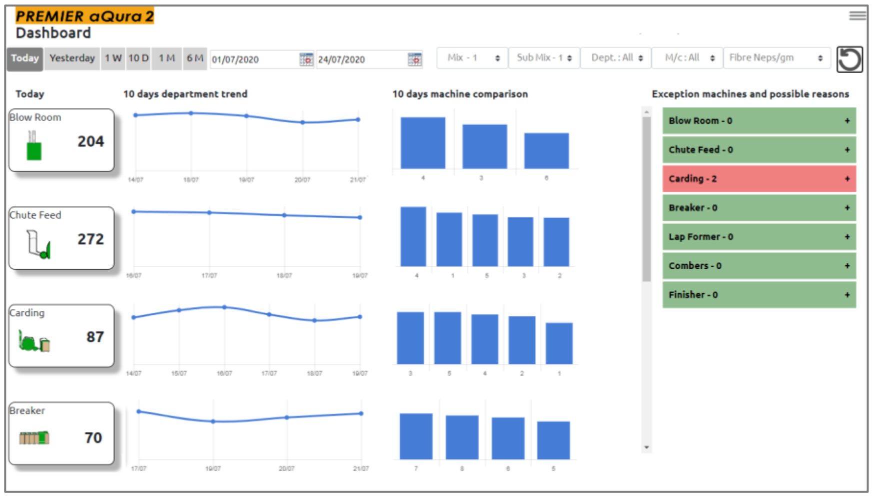
- Now, latest ***PREMIER G-trash*** instruments **can be able to handle upto 100g sample size**
- This step was taken as many spinners demand for a larger sample size. (demand is more for standalone devices)
- **Physical quantification of Dust & Micro Dust** is an added enhancement.

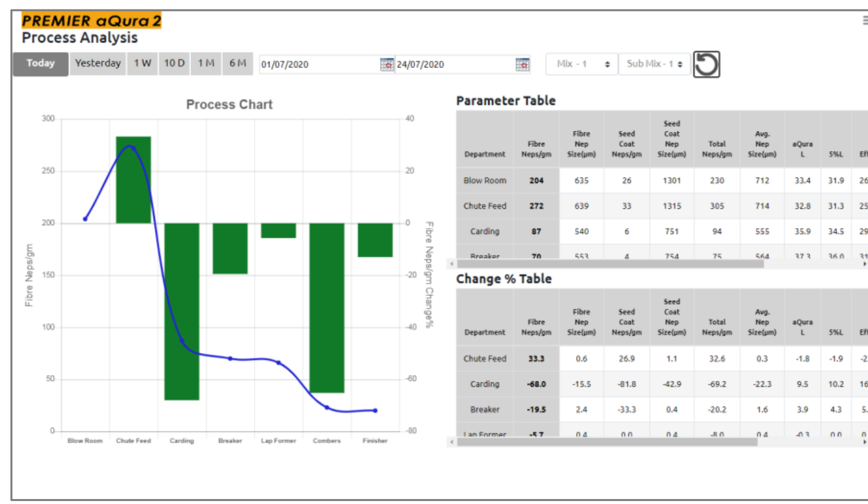
PREMIER

Developments in Fibre Testing

Process Expert Software of *PREMIER aQura2*

Nep, Length & Short Fibre Content properties interpreted across the spinning preparation process with highlighting of critical quality deviation areas.





MAG™
beyond quality

HVT Genius 2

FULLY AUTOMATIC HIGH VOLUME FIBER TESTING

HVT Genius 2

30+ YEARS Quality & Innovation

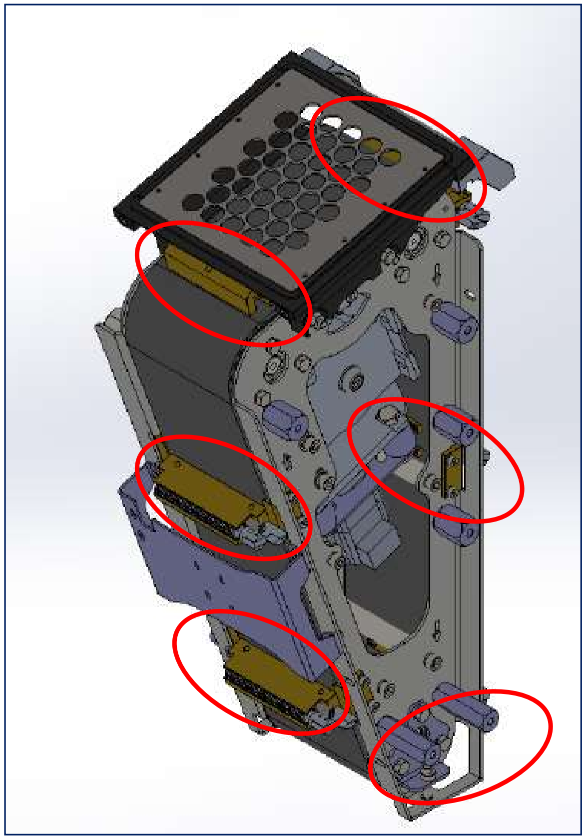
MAG™ beyond quality

HVT Genius 2

HVT Genius 2 is designed with following features

- It occupies less space.
- Operator can test in all modules without movement
- System testing covering all modules & Module testing for specific parameter.
- Simultaneous testing in system testing.
- Automation on L & S Module and Mic. (Fineness) Module

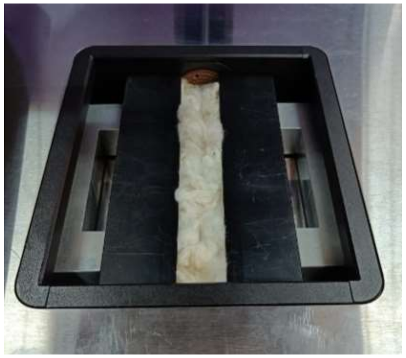
HVT Genius 2 – Length & Strength Module



- Six combs Roto Sampler – for preparing the combs automatically.
- Prepared comb will automatically placed for testing L&S.
- Tested comb will be cleaned and presented for next cycle of sample preparation automatically.
- Operator influence on comb preparation is avoided.

HVT Genius 2 – Micronaire Module

- Sample can be weighed in the desktop balance and can be placed in the Mic. tray.
- Testing can be proceeded by pressing the start button.
- No need to insert the sample in cotton chamber and close the Mic module lid by operator. It is atomised.



HVT Genius 2 - Features

Tower type construction

Touch screen display & Wireless Integration with printer

Inbuilt Barcode System

HVT Genius 2 - Features

- Inbuilt industrial grade balance
- Inbuilt RH % & Temperature sensor
- Inbuilt Air booster & Reservoir

HVT Genius 2 – Sample Placement

Length and Strength

Micronaire

Colour, Trash & Moisture

HVT Genius 2 – Options

Bale Management Software - BaleMAN

Integration with AccuTrash – HVT Genius 2+

MAG AccuTrash

- Sample feeding size with max. of 100 grams per test.
- Inbuilt with option of dust & micro dust apart from trash
- More than 175 instruments running in the field
- Recently installed at Bremen Fibre Institute Laboratory, running in the fullest satisfaction of the laboratory

marketing@magsolvics.com

+91 7667844803

MAG Solvics Private Limited

Textile Testing Solutions & Online Monitoring System

In 2021 **MESDAN** with SAVIO Group
have been joined to **VANDEWIELE**

VANDEWIELE is an international group
with headquarter in Belgium and production sites
based in Europe, China and North Africa

50 companies and around 4000 employees

Business Areas:

YARN EXTRUSION
WINDERS
HEAT SETTING
CARPET-VELVET-JACQUARD WEAVING
FINISHING
SEWING
YARN JOINING
LABORATORY
COMPONENTS
SOFTWARE

MESDAN

Mesdan Lab has developed 3 stand-alone instruments, which substituted the Loepfe Fibermap, in order to enhance flexibility to meet our customers' needs.

CONTEST-F2

Classification of cotton: length, strength, elongation, colour grade and trash, micronaire, maturity ratio, for raw cotton or lint.

NATI Advanced

Connectable with Contest-F2 for Neps and Trash content characterization.

CONTEST-S

High volume testing equipment designed to measure, classify and grade cotton stickiness.

Textechno H. Stein GmbH & Co. KG

made
in
Germany

Application Fields for Textechno's Testing Instruments

Man-made Fibres

Individual fibres and filaments

Filament Yarns

POY, FDY, DTY, ATY, ITY, BCF

Spinning Mills

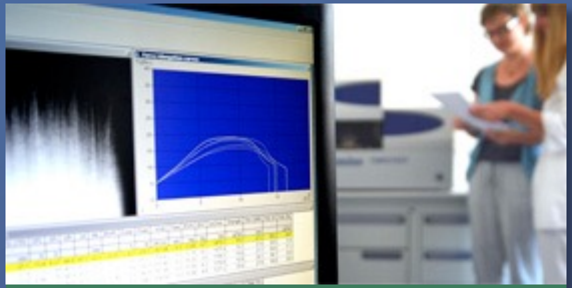
Natural fibres, blends, slivers, rovings, secondary –spun yarns

Composites

Reinforcement fibres and fabrics

Recycling & Natural Fibres

Any type of fibre, regardless of material and colour



Complete Laboratories

Layout and supply, training of operators, consulting

© Textechno Germany

The Fibre Classifying System FCS

FIBROTEST:
Fibre length and bundle strength (absolute)

FIBROFLOW:
Micronaire and maturity (double compression)

OPTOTEST:
Trash analysis and colour grade

MDTA 4:
Trash separation, fibre length, opening work, sliver generation

© Textechno Germany

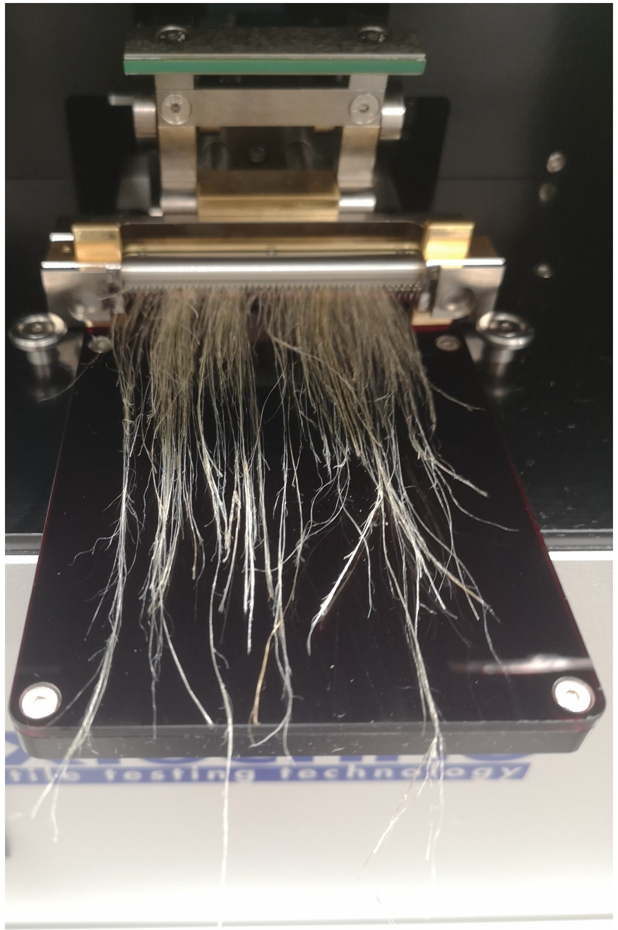
FIBROTEST

Fibre Bundle

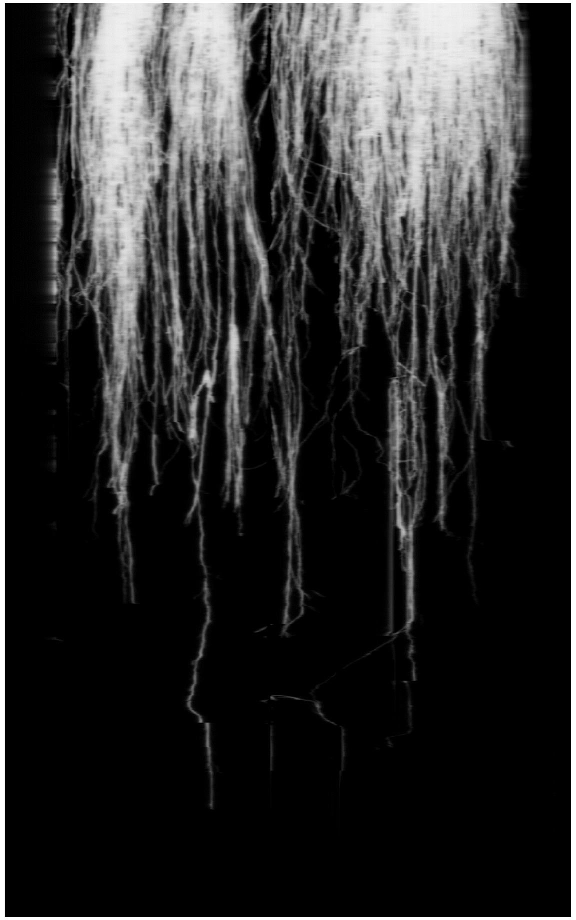
Length and Strength

Example:
Hemp fibres

photo of fibre bundle



line camera image



*Measures **fibre length distribution** and **fibre tenacity** on all types of fibres*

Textechno
textile testing technology

© Textechno Germany

The Fibre Classifying System FCS

FIBROTEST:
Fibre length and bundle strength (absolute)

FIBROFLOW:
Micronaire and maturity (double compression)

OPTOTEST:
Trash analysis and colour grade

MDTA 4:
Trash separation, fibre length, opening work, sliver generation

© Textechno Germany

United States Department of Agriculture

Agricultural Marketing Service

COTTON & TOBACCO

CULTIVATING A LEGACY OF EXCELLENCE

USDA, AMS, Cotton & Tobacco Program Update

September 27, 2022

Darryl W. Earnest

Deputy Administrator

Gretchen Deatherage

Director, Standardization & Engineering

Cotton Classification Update

- 2021 U.S. Crop – 17.2 million bales classed
- 2022 U.S. Crop will be smaller than recent years (12+ million bales expected)
- Possible further impact from hurricanes
- We’ve classed 817,000 bales (7-8 percent) so far

Cotton Classification Update

- USDA High Volume Instrument Fleet:
  - 220 HVIs across 10 Classing Offices
  - Largest – Memphis, Tennessee
    - (54 – 44 Memphis Classing; 10 Quality Assurance)
  - Smallest – Abilene, TX (8)

- Automated Cotton Conveyance Systems (Automation) – installed in 5 Classing Offices:
  - Abilene, TX
  - Lubbock, TX
  - Memphis, TN
  - Rayville, LA
  - Florence, SC

Grading - Automation

Memphis, Tennessee Classing Office

USDA

Grading - Automation

Cotton Tobacco

Lubbock, Texas
Classing Office

Grading - Automation

Rayville, Louisiana Classing Office

Automaton Plans - 2022

- Memphis, TN – 2022 season
  - Major laboratory renovation followed by installation of two new automation systems

- Florence, SC – 2022 season
  - Minor laboratory renovation followed by installation of one new automation system

Automaton Plans - Future

Equip all remaining Classing Offices with automation equipment by 2025 season. Facilities remaining would require lab renovation or prep before installation:

- Lamesa, TX;
- Corpus Christi, TX;
- Macon, GA:
- Visalia, CA;

This work is dependent upon available funding being available

Automation

- One of the keys to utilizing automation successfully is de-coupling the HVI and operating the color/trash cabinet in one part of the operation and the Length/Strength cabinet in another.

- The key to automaton is the delivery of cotton samples to the instruments when each component is ready for another sample. This optimizes the operation of the HVI.

- One important factor to essential automation is keeping all instruments running accurately and efficiently at all times.

Automation

One of the keys to utilizing automation successfully is de-coupling the HVI and operating the color/trash cabinet in one part of the operation and the Length/Strength cabinet in another.

New Lubbock, TX Facility

- Grand Opening – Conducted September 14, 2022

- Newest Automation System (2)
- State-of-the-Art HVAC
- Energy Conservation
- Interactive Analytics
- Flex Space for Research, New Technology, and/or Expansion
- Teaching/Learning Facility
- Capable of testing 50,000-60,000 samples per day

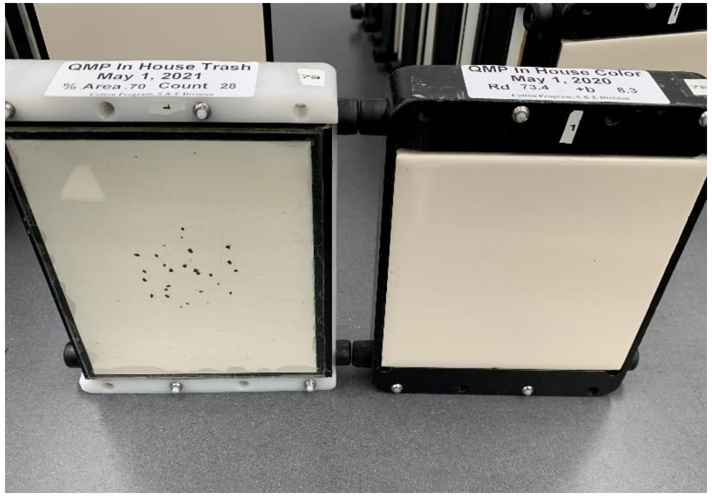
Quality Management Program (QMP)

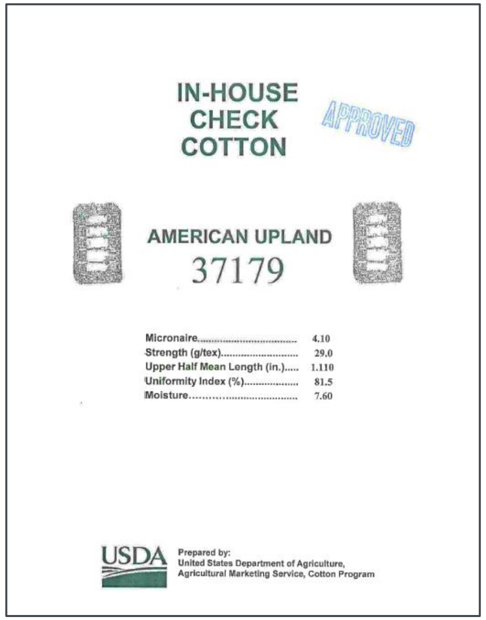
Quality Management Program

- Two – pronged Approach
  - **Instrument Performance Management**
  - **Manual Classification Performance Management**

Monitoring Instrument Performance

Periodically throughout each shift, every instrument will test known-value cotton standards.

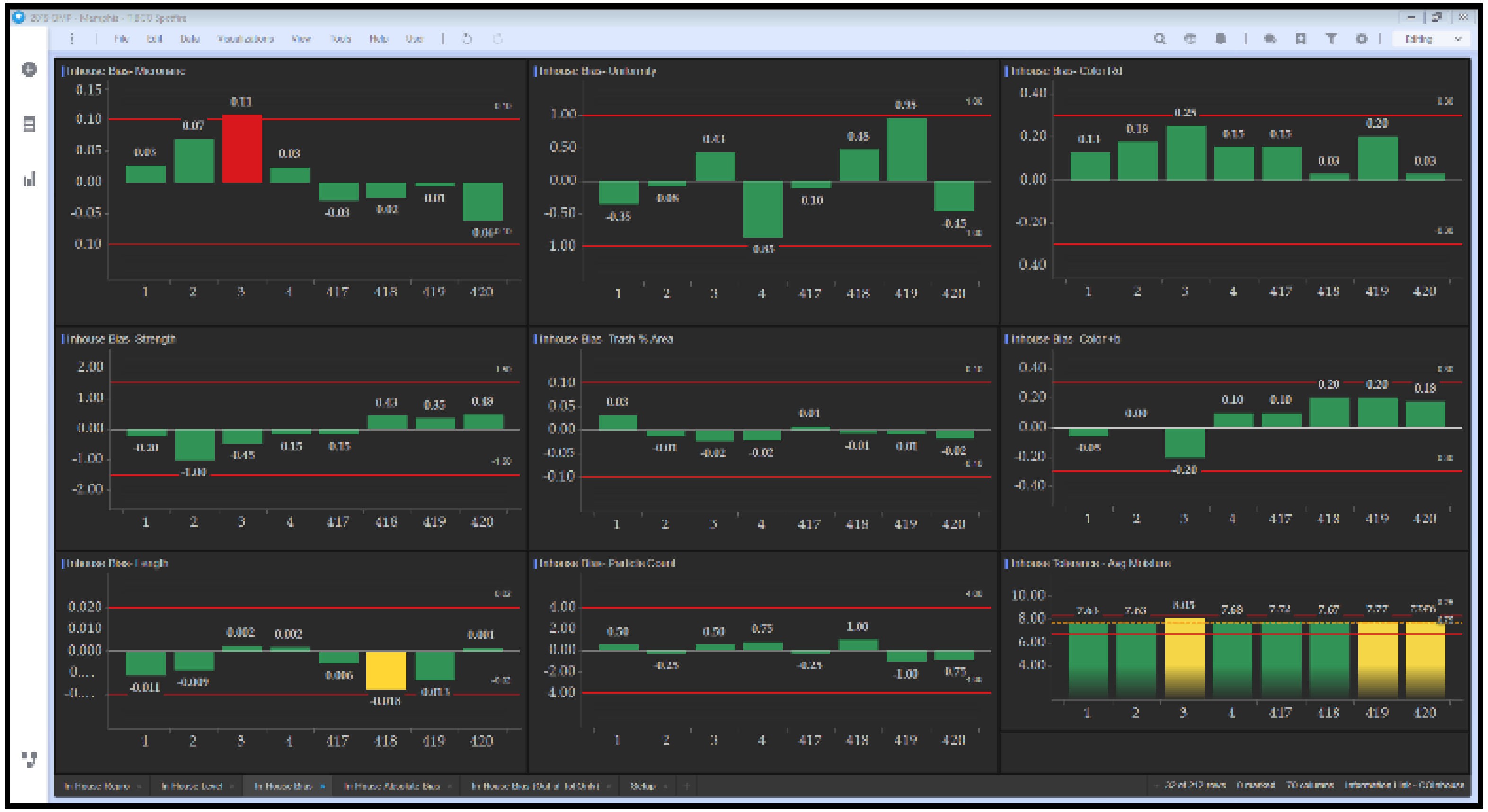




Monitoring Instrument Performance

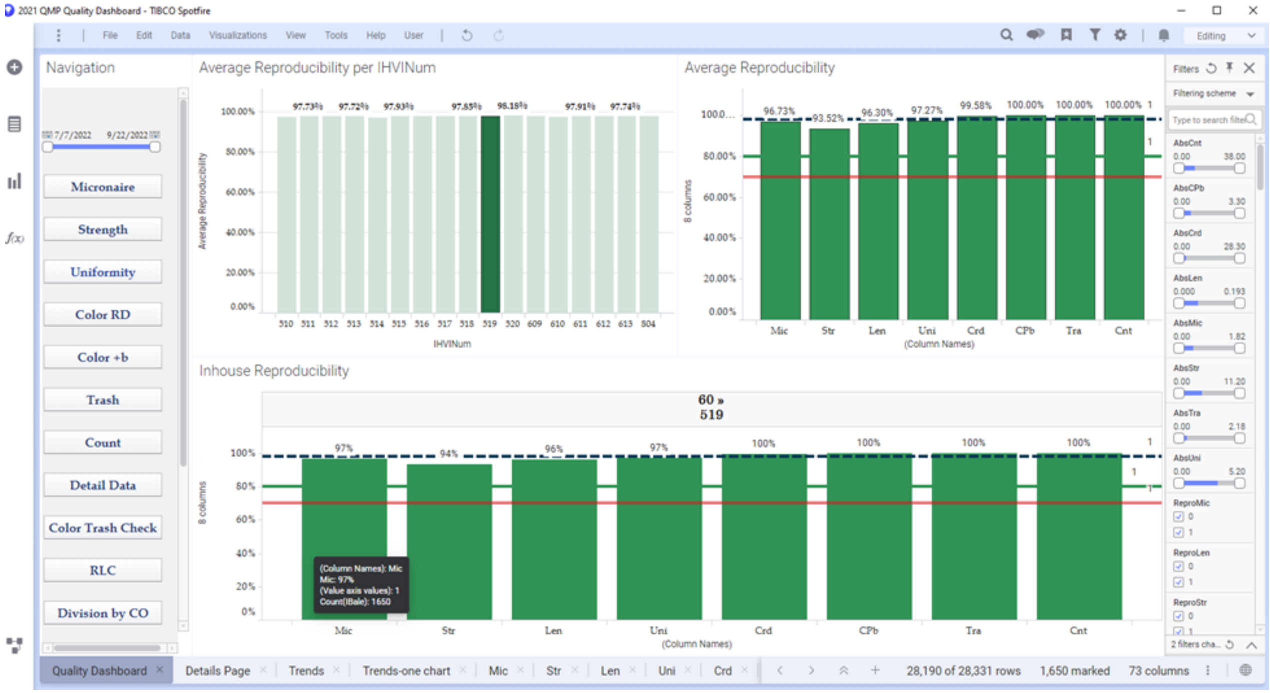
The results are analyzed in real time using the Program's Business Analytics platform. These results are displayed on large monitors in the labs and on managers' computers for quick assess.

Monitoring Instrument Performance



Several different analyses are shown graphically in rotation to provide as much valuable information as possible.

Monitoring Instrument Performance

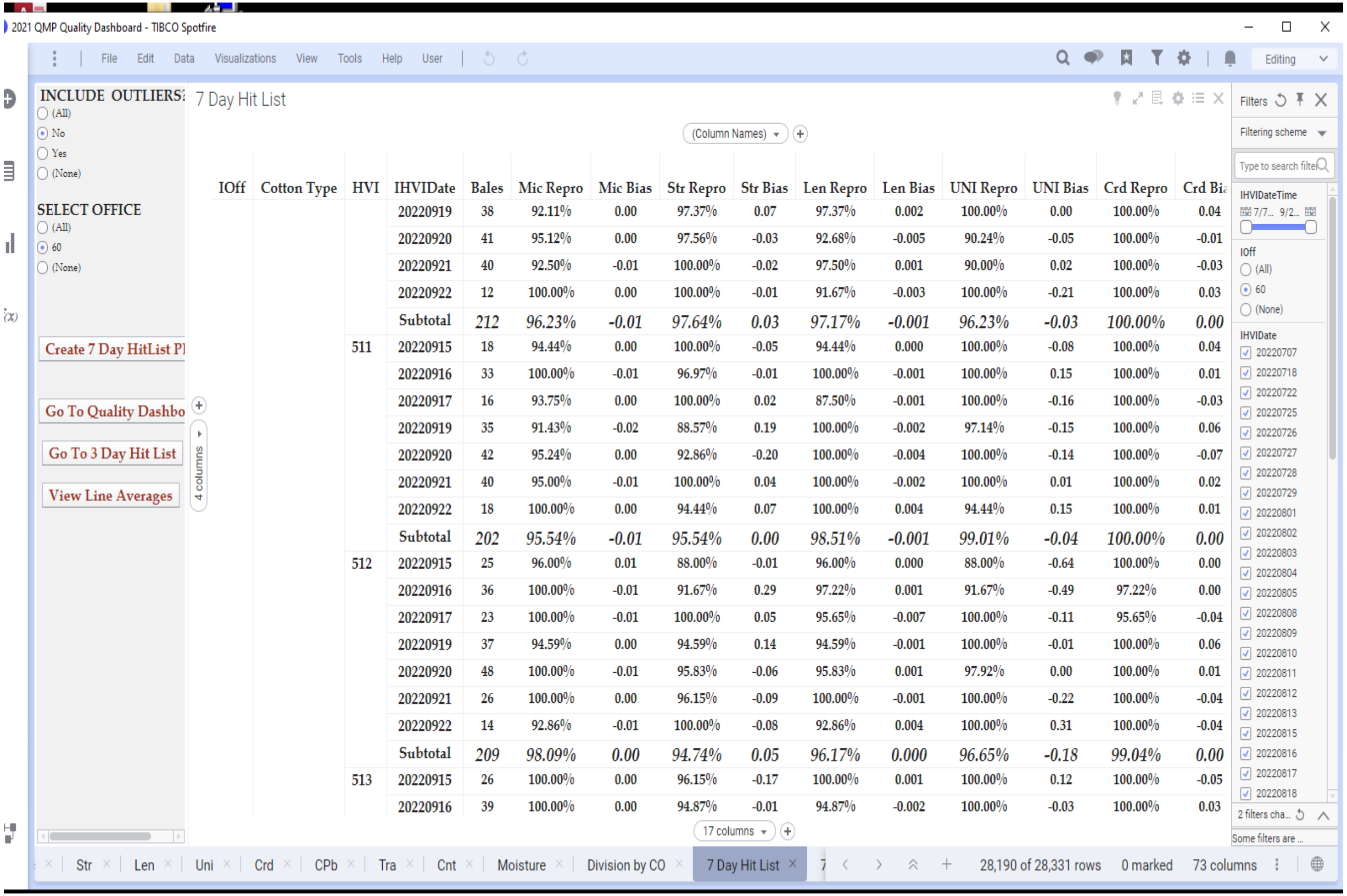


- Each manager has the capability to drill down into the quality data by instrument and/or fiber testing property.

Quality Management Program

Cotton & Tobacco

Monitoring Instrument Performance



IOff	Cotton Type	HVI	IHVIDate	Bales	Mic Repro	Mic Bias	Str Repro	Str Bias	Len Repro	Len Bias	UNI Repro	UNI Bias	Crd Repro	Crd Bia
			20220919	38	92.11%	0.00	97.37%	0.07	97.37%	0.002	100.00%	0.00	100.00%	0.04
			20220920	41	95.12%	0.00	97.56%	-0.03	92.68%	-0.005	90.24%	-0.05	100.00%	-0.01
			20220921	40	92.50%	-0.01	100.00%	-0.02	97.50%	0.001	90.00%	0.02	100.00%	-0.03
			20220922	12	100.00%	0.00	100.00%	-0.01	91.67%	-0.003	100.00%	-0.21	100.00%	0.03
			Subtotal	*212*	*96.23%*	*-0.01*	*97.64%*	*0.03*	*97.17%*	*-0.001*	*96.23%*	*-0.03*	*100.00%*	*0.00*
		511	20220915	18	94.44%	0.00	100.00%	-0.05	94.44%	0.000	100.00%	-0.08	100.00%	0.04
			20220916	33	100.00%	-0.01	96.97%	-0.01	100.00%	-0.001	100.00%	0.15	100.00%	0.01
			20220917	16	93.75%	0.00	100.00%	0.02	87.50%	-0.001	100.00%	-0.16	100.00%	-0.03
			20220919	35	91.43%	-0.02	88.57%	0.19	100.00%	-0.002	97.14%	-0.15	100.00%	0.06
			20220920	42	95.24%	0.00	92.86%	-0.20	100.00%	-0.004	100.00%	-0.14	100.00%	-0.07
			20220921	40	95.00%	-0.01	100.00%	0.04	100.00%	-0.002	100.00%	0.01	100.00%	0.02
			20220922	18	100.00%	0.00	94.44%	0.07	100.00%	0.004	94.44%	0.15	100.00%	0.01
			Subtotal	*202*	*95.54%*	*-0.01*	*95.54%*	*0.00*	*98.51%*	*-0.001*	*99.01%*	*-0.04*	*100.00%*	*0.00*
		512	20220915	25	96.00%	0.01	88.00%	-0.01	96.00%	0.000	88.00%	-0.64	100.00%	0.00
			20220916	36	100.00%	-0.01	91.67%	0.29	97.22%	0.001	91.67%	-0.49	97.22%	0.00
			20220917	23	100.00%	-0.01	100.00%	0.05	95.65%	-0.007	100.00%	-0.11	95.65%	-0.04
			20220919	37	94.59%	0.00	94.59%	0.14	94.59%	-0.001	100.00%	-0.01	100.00%	0.06
			20220920	48	100.00%	-0.01	95.83%	-0.06	95.83%	0.001	97.92%	0.00	100.00%	0.01
			20220921	26	100.00%	0.00	96.15%	-0.09	100.00%	-0.001	100.00%	-0.22	100.00%	-0.04
			20220922	14	92.86%	-0.01	100.00%	-0.08	92.86%	0.004	100.00%	0.31	100.00%	-0.04
			Subtotal	*209*	*98.09%*	*0.00*	*94.74%*	*0.05*	*96.17%*	*0.000*	*96.65%*	*-0.18*	*99.04%*	*0.00*
		513	20220915	26	100.00%	0.00	96.15%	-0.17	100.00%	0.001	100.00%	0.12	100.00%	-0.05
			20220916	39	100.00%	0.00	94.87%	-0.01	94.87%	-0.002	100.00%	-0.03	100.00%	0.03

All the data is also summarized into reports that can be referenced at any time.

Cotton & Tobacco

Quality Management Program

Monitoring Manual Classification Performance

- A number of randomly selected samples are collected during every shift. (~1% of samples classed)
- Samples referred to as “ check lots”

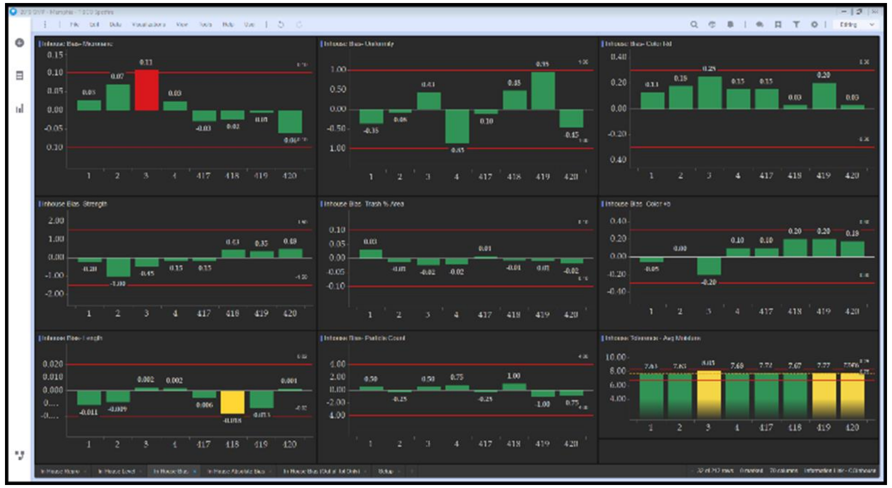
Cotton Tobacco

Quality Management Program

Monitoring Manual Classification Performance

- A portion of theses selected samples are re-evaluated by the Quality Assurance Division for verification of results.
- The remaining check lot samples are reviewed in the respective classing office by supervisory personnel.

Quality Management Program



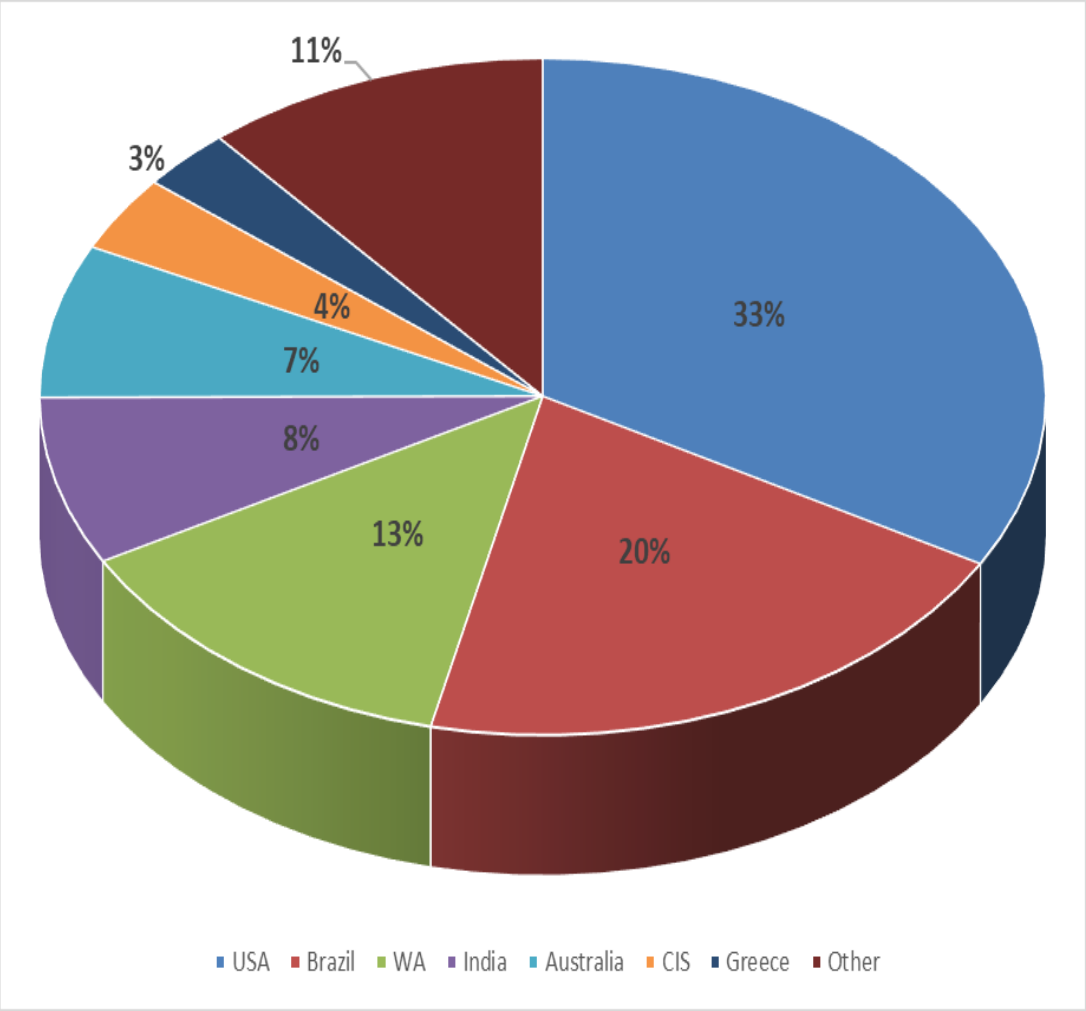
- At least weekly, Program operational management will meet in a “Quality Meeting” and review QMP data for instrument and manual classing and assess the Program’s overall performance.

Why the continued fuss about colour?

Marinus van der Sluijs |Principal Consultant
Textile Technical Services, Geelong, Victoria, Australia

ICCTM Spinnability
September 2022

TTS



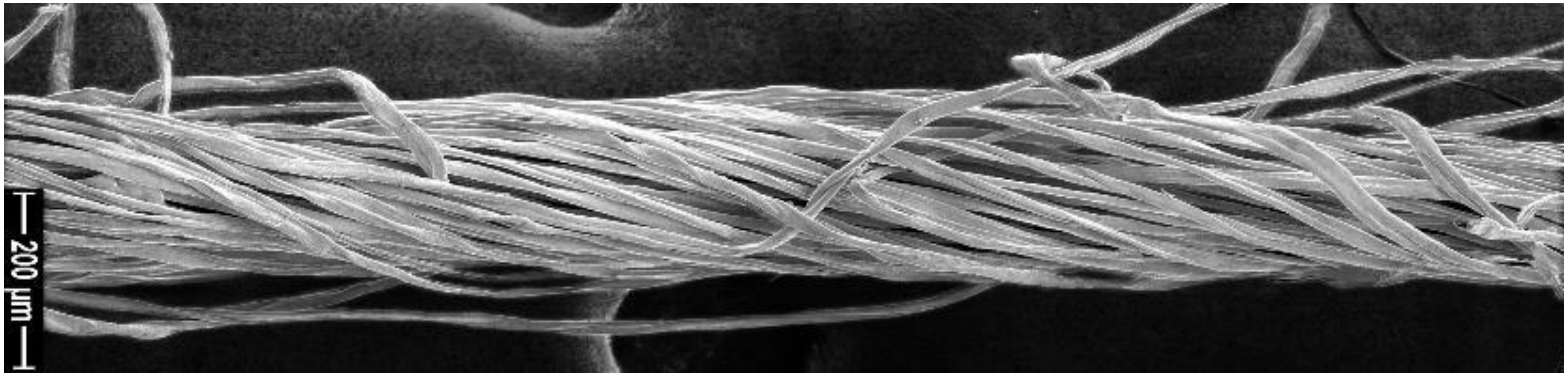
Top Exporters (kt)		
USA	3375	33%
Brazil	2064	20%
WA	1353	13%
India	816	8%
Australia	746	7%
CIS	369	4%
Greece	299	3%
Other	1131	11%
World	10153	

30 to 40%

World Cotton Statistics ICAC

Important Fibre Properties

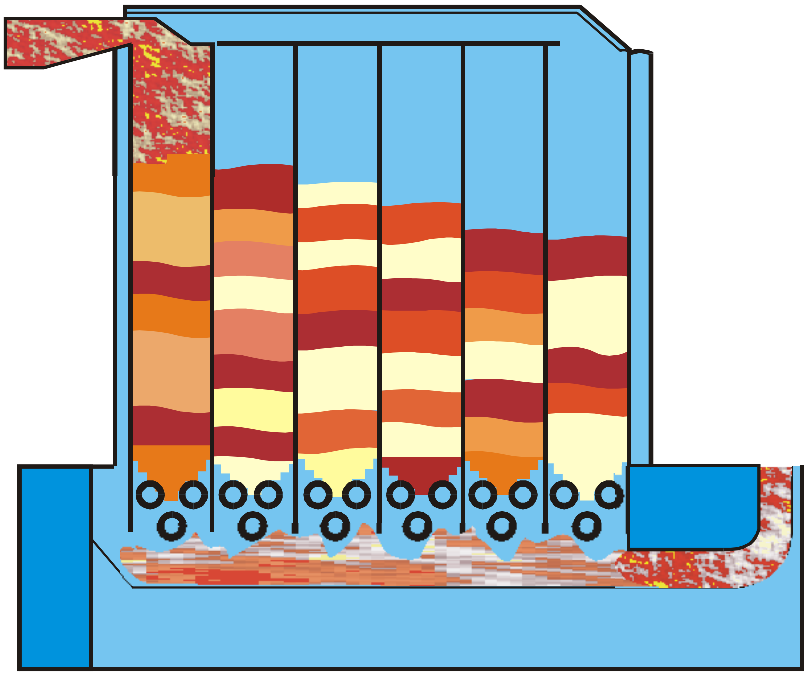
Ranking	Ring	Rotor	Air - Jet
1	Length	Strength	Length
2	Strength	Fineness	Cleanliness
3	Fineness	Length	Fineness
4	Cleanliness	Cleanliness	Strength
5	Other	Other	Other



COLOUR

Bale Laydown

Trunk Blending



Courtesy Trützschler GMBH & Co. KG

Sliver

Dyeing

Spinners want cotton to be

Mention of product or trade names does not constitute an endorsement by TTS over other comparable products. Products or trade names are listed for reference only.

Thank you

Marinus van der Sluijs (MSc, MBA, PhD)
Principal Consultant

Textile **T**echnical **S**ervices

t + 61 408 885 211

e sluijs@optusnet.com.au

TEXTILE TECHNICAL SERVICES

Overview on blending in a spinning mill

ITMF Committee on Cotton Testing Methods

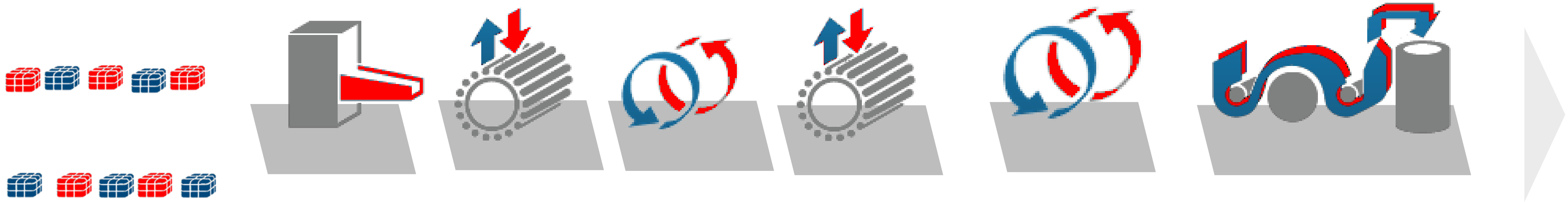
Spinnability

Mona Qaud, September 2022

USTER®
Think quality

Blending / Mixing - CO

at Laydown (different cotton proveniences)



… Spinning

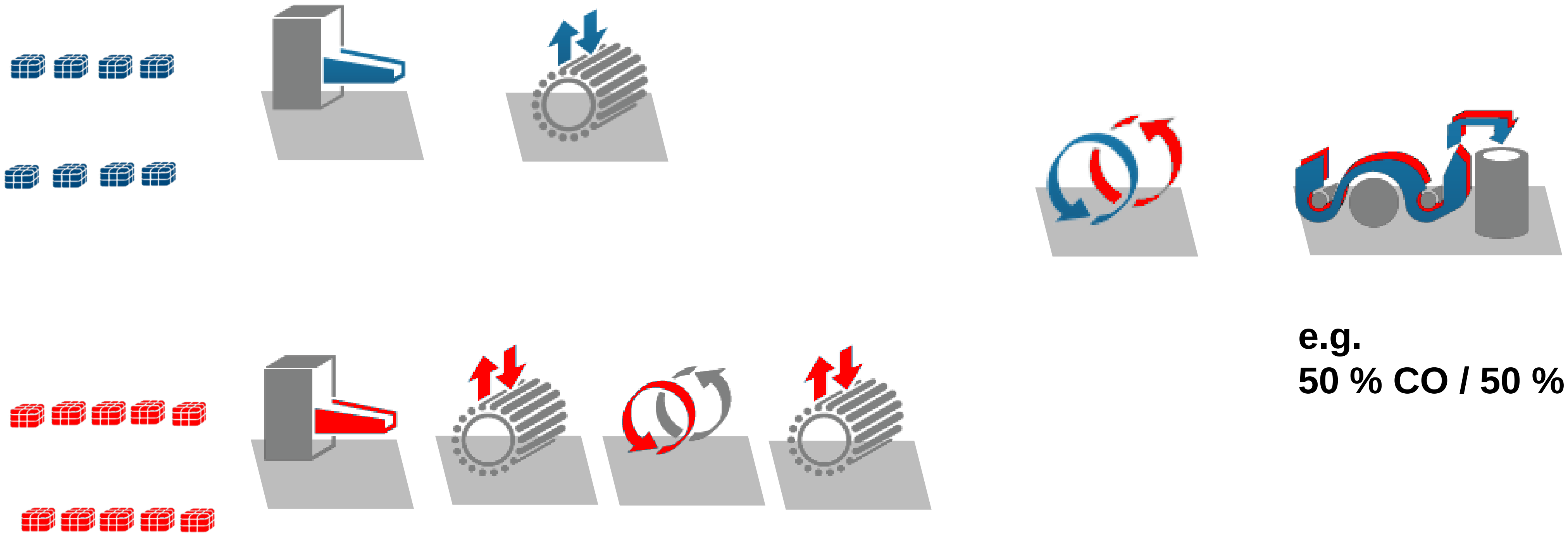
100% CO
e.g. different proveniences

 © Copyright 2022 by Uster Technologies AG

USTER® Think quality

Blending

at Flock state / intimate blending



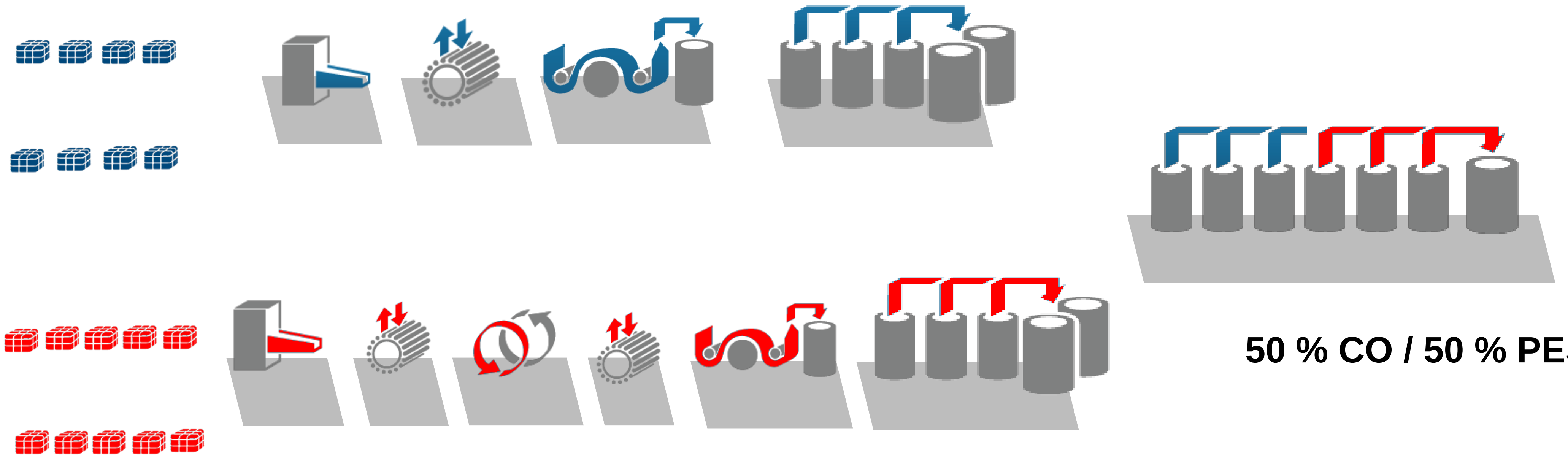
e.g.
50 % CO / 50 % PES

 © Copyright 2022 by Uster Technologies AG

USTER® Think quality

Blending – PES/CO

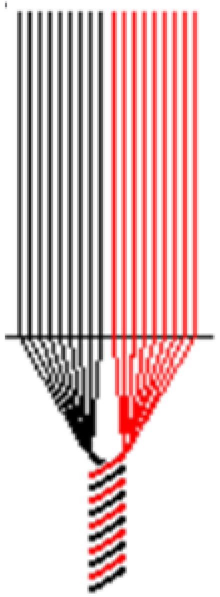
at Sliver state – draw frame blending



50 % CO / 50 % PES

© Copyright 2022 by Uster Technologies AG

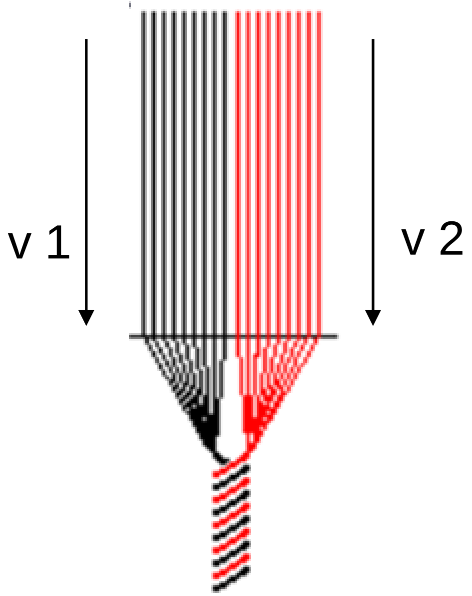
«Blending»
at Yarn state



Two folded yarns
«Siro»

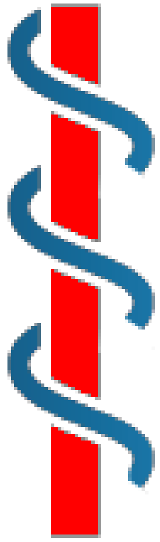
100% CO

50% CO / 50% PES



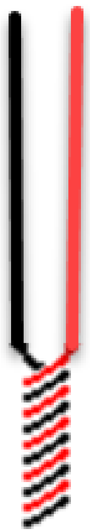
fancy / colored flames

100% CO / PAC



Core yarn
e.g. Elasthan 3 - 10%

97% CO / 3% EL



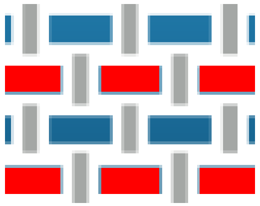
Plied yarn

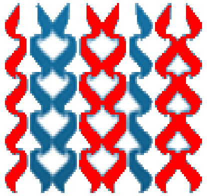
100% CO

50% CO / 50% PES

© Copyright 2022 by Uster Technologies AG

«Blend»
at fabric forming





Weaving:
- different weft yarns
- Different warp

Knitting:
- different yarns
- Knit pattern

 © Copyright 2022 by Uster Technologies AG

USTER® Think quality

Standards for determining blends

ISO/TR 11827:2012(en)

Textiles — Composition testing — Identification of fibres

The correct identification of fibres in textiles and the accurate determination of the composition of each fibre present is a legal requirement in many countries throughout the world for imported textile goods and at the point of sale to the public.

Fibre identification can be carried out by a number of different techniques, e.g.

- **Microscopy**
- **Solubility**
- **Spectroscopy**
- **Melting point**
- **Pyrolysis**
- **Density**
- **Refractive**
- **Or even mechanical separation**

© Copyright 2022 by Uster Technologies AG

Standards for determining blends

REGULATION (EU) No 1007/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 27 September 2011
on textile fibre names and related labelling and marking of the fibre composition of textile products and repealing Council Directive 73/44/EEC and Directives 96/73/EC and 2008/121/EC of the European Parliament and of the Council

Labeling of textiles

Sorting by xx% of material, 95% CO, 5% EL.. (ascendingly sorted)
Label according to the ISO abbrev. : 100% CO, 100% Cotton, only for plain: pure cotton

Accurracy 1-2 % of blend percentages, with confidence range of Q95%

Challenge for post consumer recycling materials (knitted, woven) to be labelled correctly.

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011R1007&from=DE

© Copyright 2022 by Uster Technologies AG
USTER® Think quality

USTER®

Think quality

New trends in Spinning – New requirements for testing the applied fibre materials

Within the last years new trends in spinning were observed:
- Development of new yarns for several new applications (technical spun yarns),
- Modification of existing yarns to improve their quality (increasing of strength/elongation, better evenness),
- Production of Melange yarns has been increased (blending of white fibres with colored fibres),
- Design of new modern yarns with special structure (Fancy yarns, yarns with linen structure etc.),
- Also the percentage of Airjet spinning frames (VORTEX) in many countries is increased (Turkey !).
- Processing of recycled fibers with virgin cotton etc.

For these purpose new fibre materials are blended with cotton, for example Lenzing Modal, Tencel, cotton type Polyester or cottonized Linen fibers etc. In several countries also KAPOK fibers are applied to be blended with cotton.

For the fiber materials which are blended with cotton, new requirements for the fiber testing are existing ! Unfortunately, the classic testing methods for man-made fibers for example are single testing methods, in which the quantity of tested fibers is not higher then max. 50 fibers. This is not enough to evaluate the spinning behavior of these fibers. Also, the test methods for cottonized linen fibers are not applicable to evaluate the spinning behavior: The classic test methods for such fiber materials are very time consuming and do not match with the requirements of a modern spinning mill.

The requirements of the spinners what follow these new trends in spinning, are as follows:

- All short staple fibers, such like cotton, Polyester, Tencel, Viscose Modal, cottonized linen, Kapok, recycled fibres etc. should be tested on the same way by using fiber bundle testing methods!
- In order to be able to compare the quality/properties of these fiber materials (Polyester, Tencel, Viscose Modal, cottonized linen and Kapok) what are blended with cotton, such test parameters/results should be used, what allows a direct comparison of the cotton properties with the properties of these other fiber materials. Only this is the way to describe the spinnability of all fiber materials together!

The lecture gives some examples, how to test man-made fibers and very special fiber materials, including recycled fibres, with bundle tests methods and what parameters/test results allow a direct comparison of the fiber properties with each other.

Spinnability

Justin Kühn – Staple Fibre Technologies
Institut für Textiltechnik of RWTH Aachen University

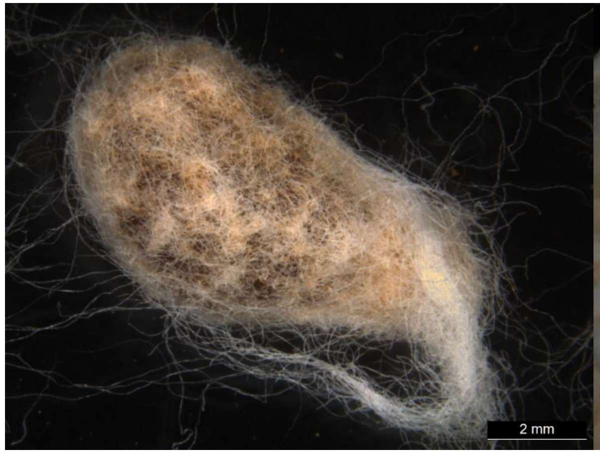
International Committee on Cotton Testing Methods

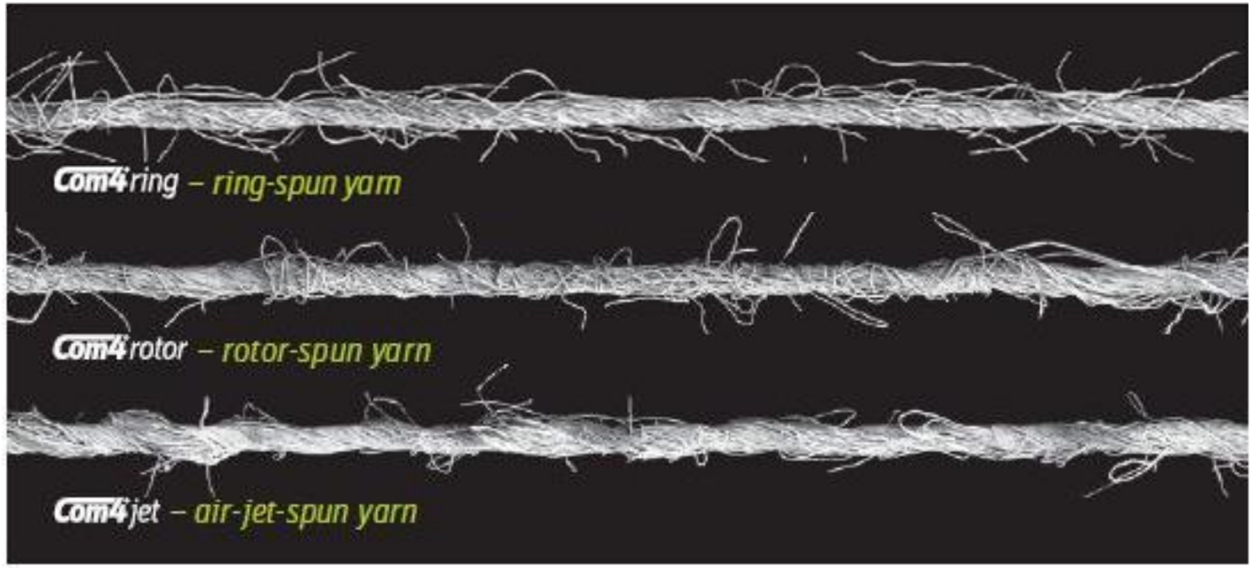
By ITMF

Spinnability

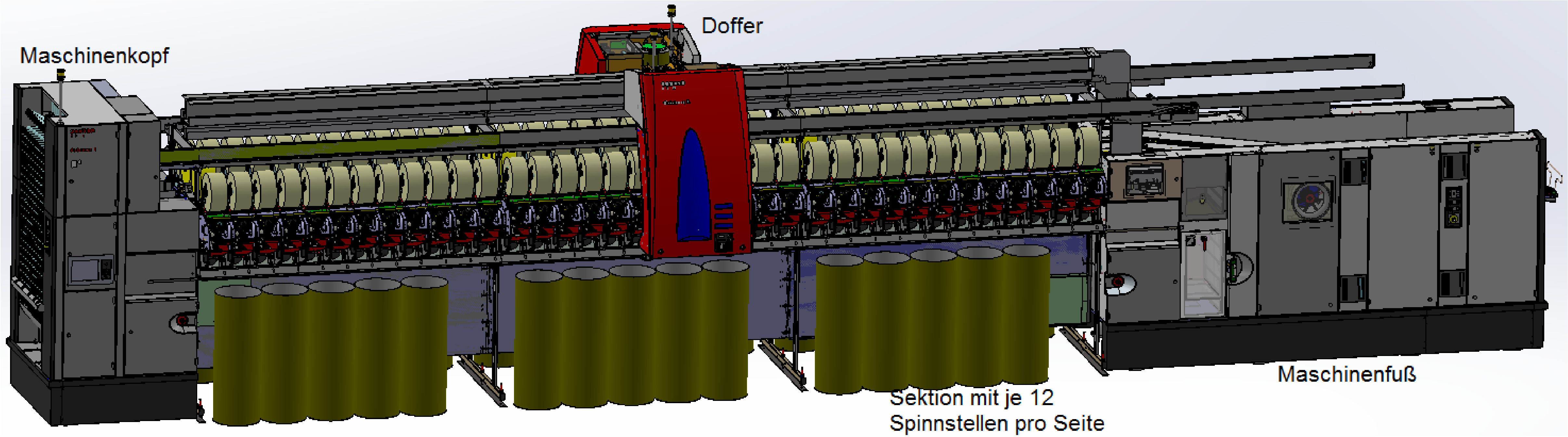
Beneficial parameter

- Thin/Thick place reduction
- Neps reduction
- Strength increase
- Fibre length increase
- Elongation increase
- Hairiness as feel good factor





Machine Overview



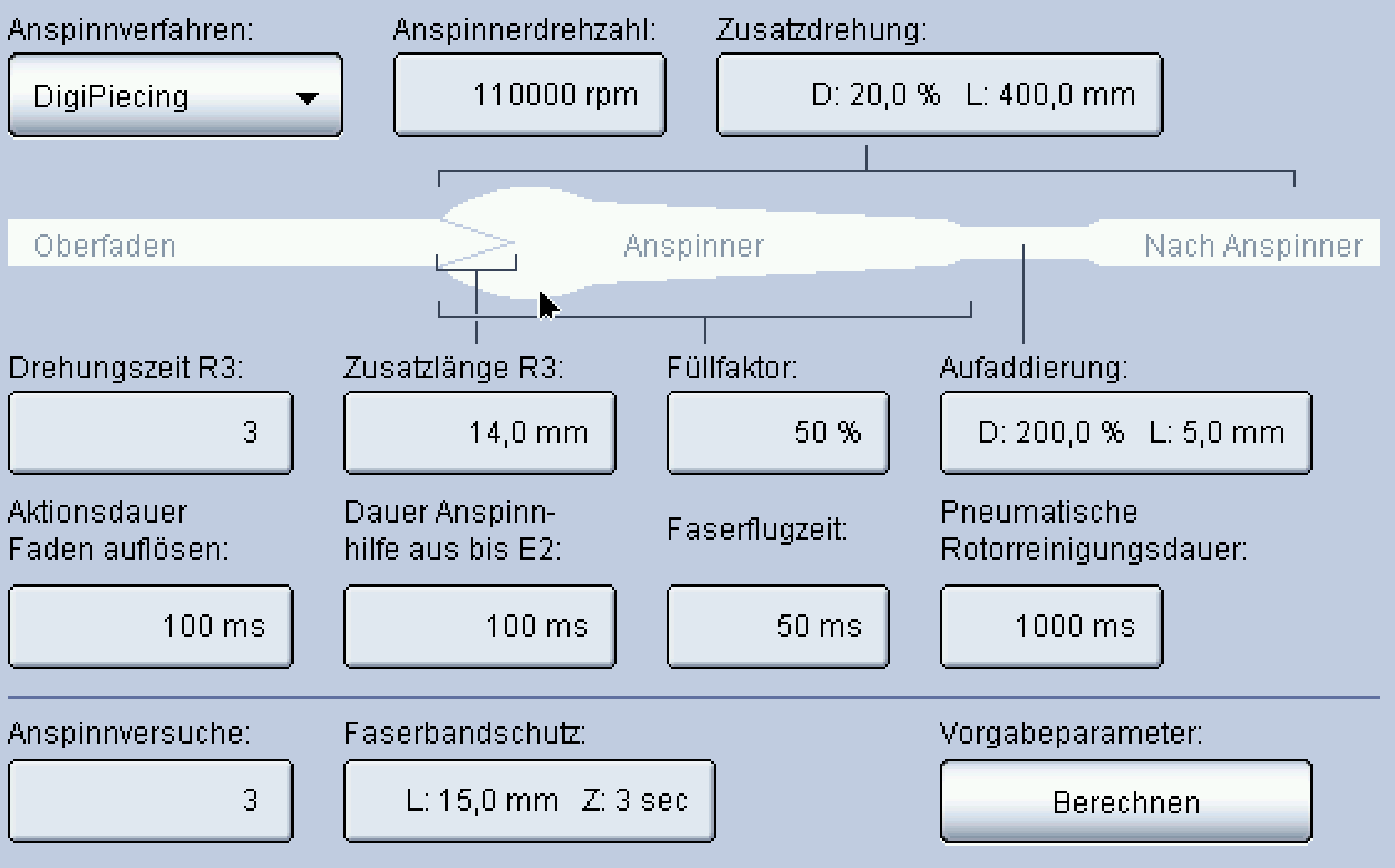
Spinning settings

Garnnummer:	50,0 Nm	Spinn-Unterdruck:	85 mbar
Drehung:	989,9 t/m	Kanneninhalt:	25,0 kg
Drehungs-beiwert:	140,0 alpham	Bandfeinheit:	0,200 Nm
Verzug:	250,0	Faser-bezeichnung:	Kipas
Rotordrehzahl:	150000 rpm	Fasermaterial:	Baumwolle
Auflösewalzen-Drehzahl:	9200 rpm	Stapellänge:	28,0 mm

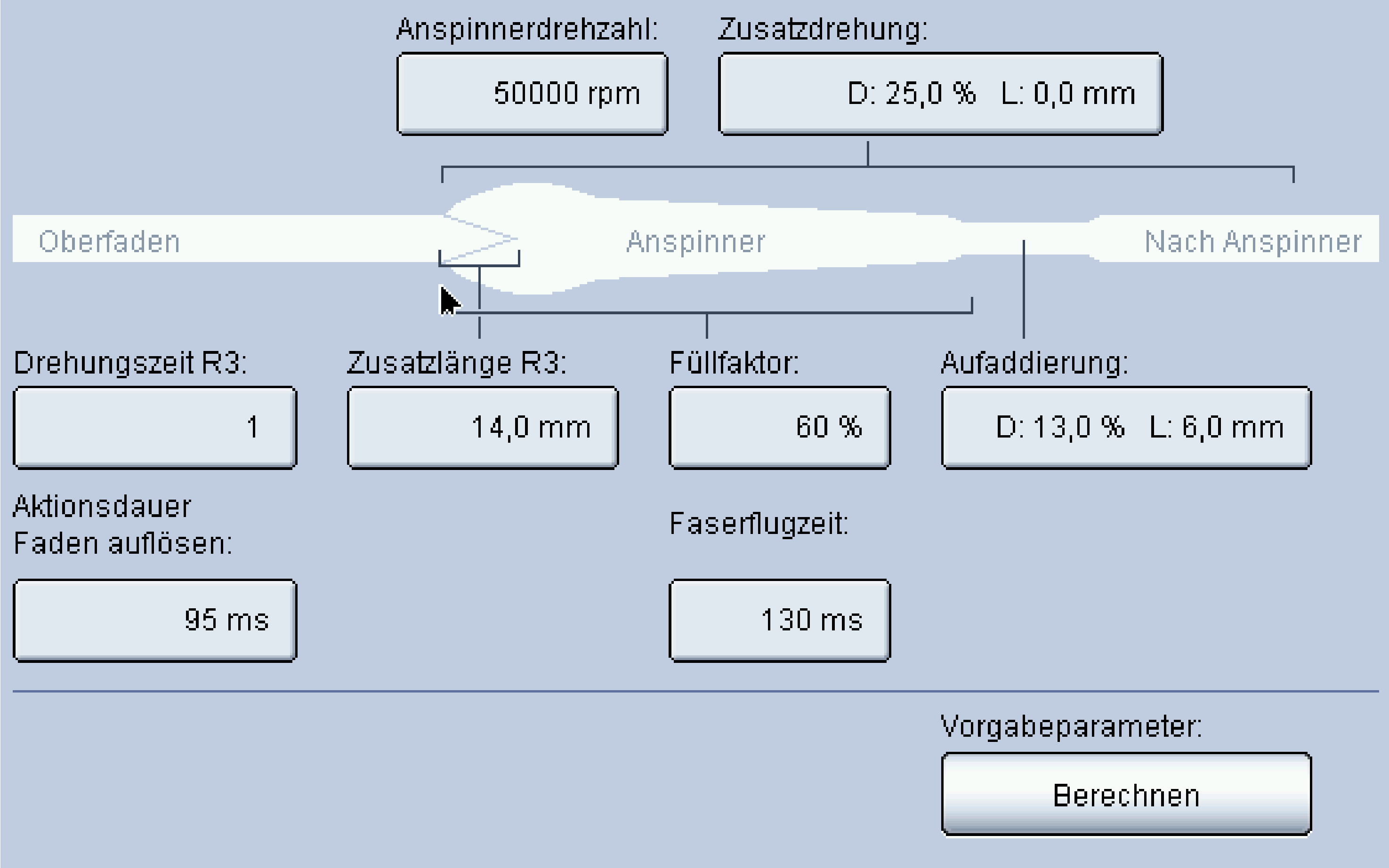
Spinnability

Spinning devices

Quality of spinning start

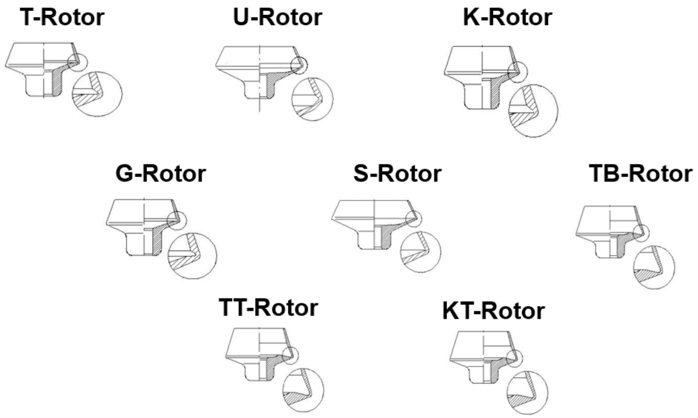


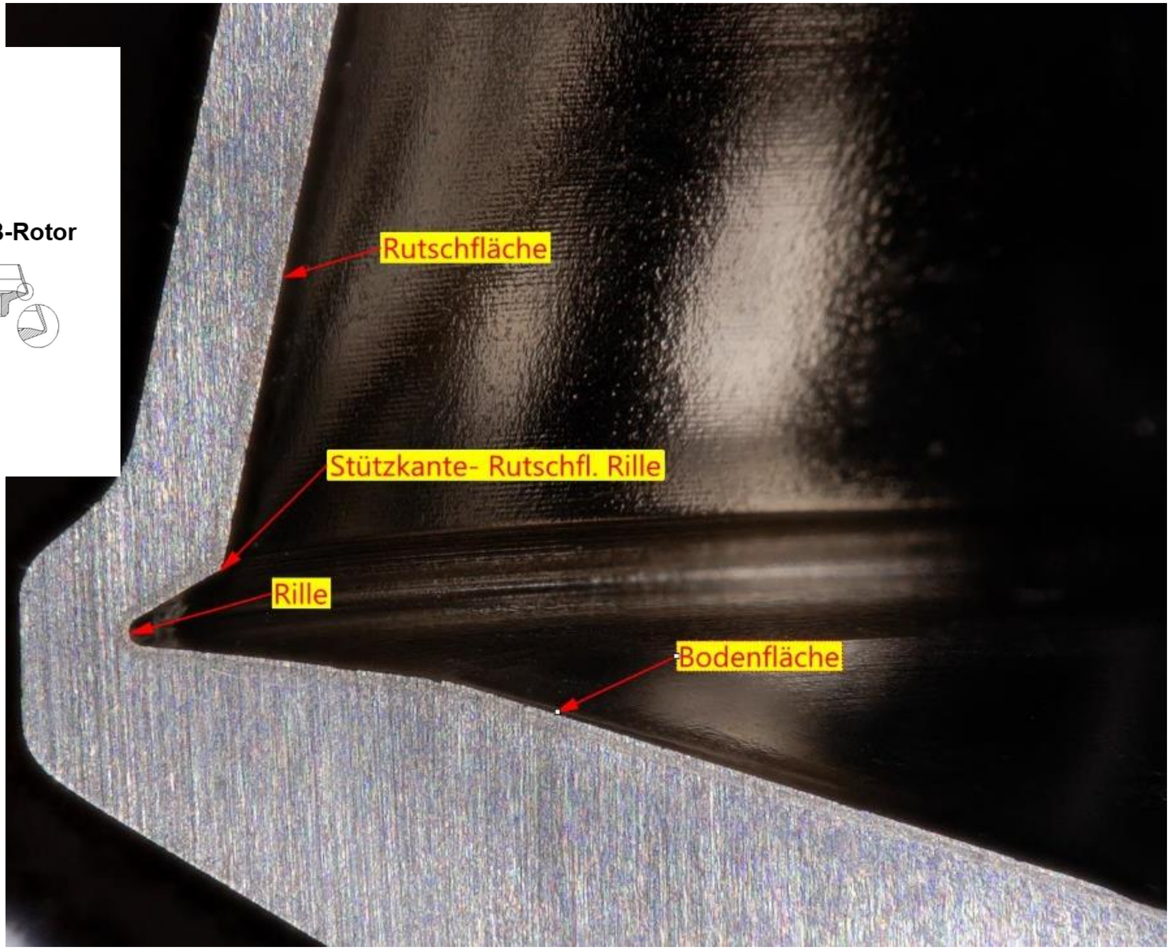
Safety of spinning start

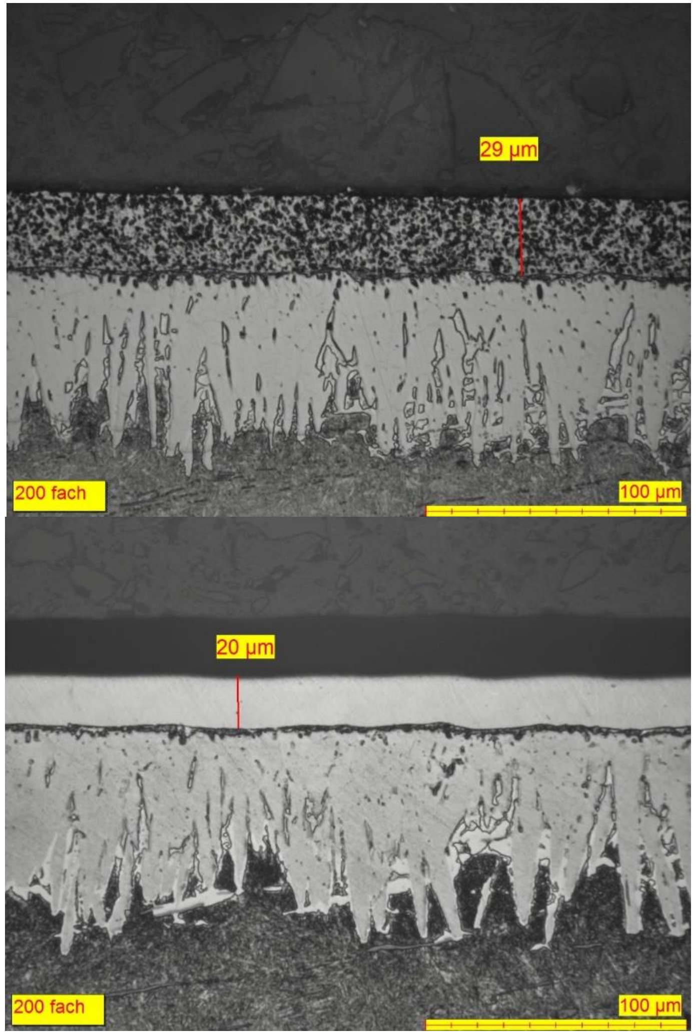


Spinnability

Tribological influences

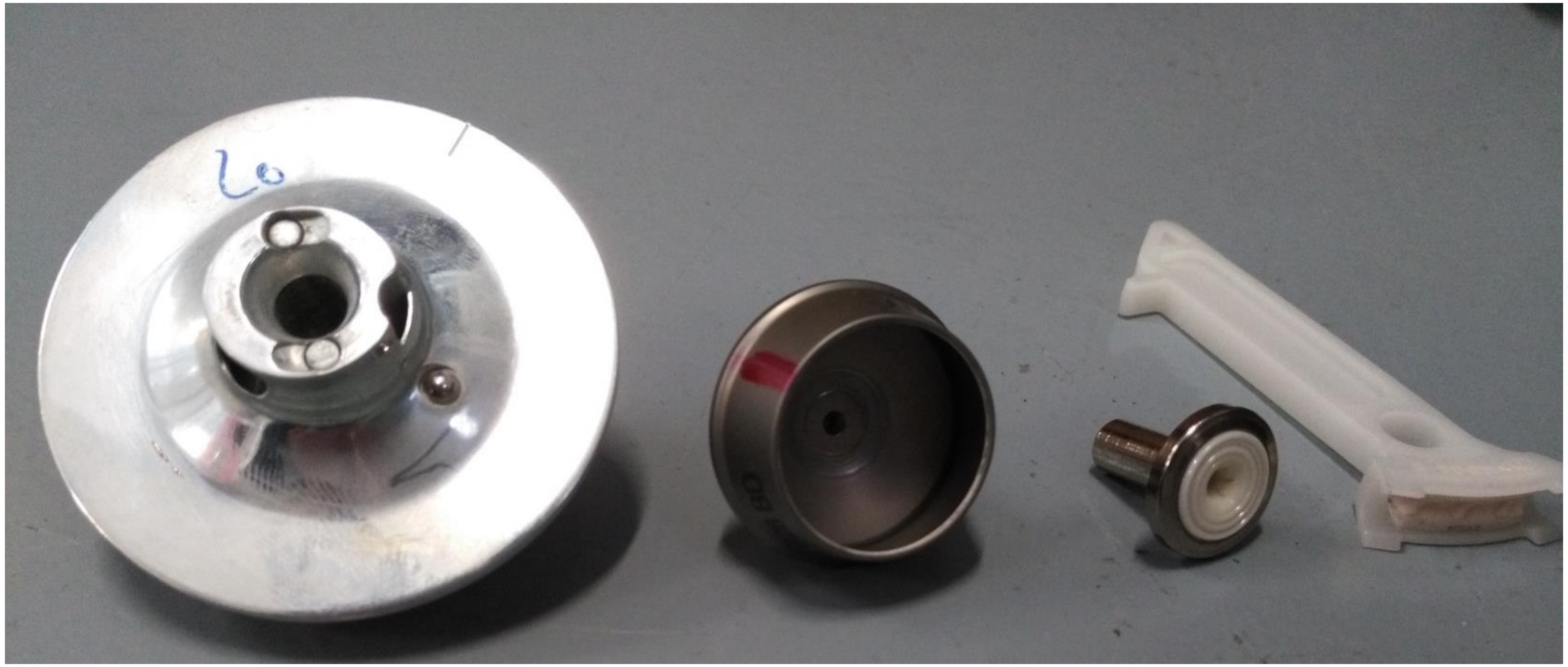


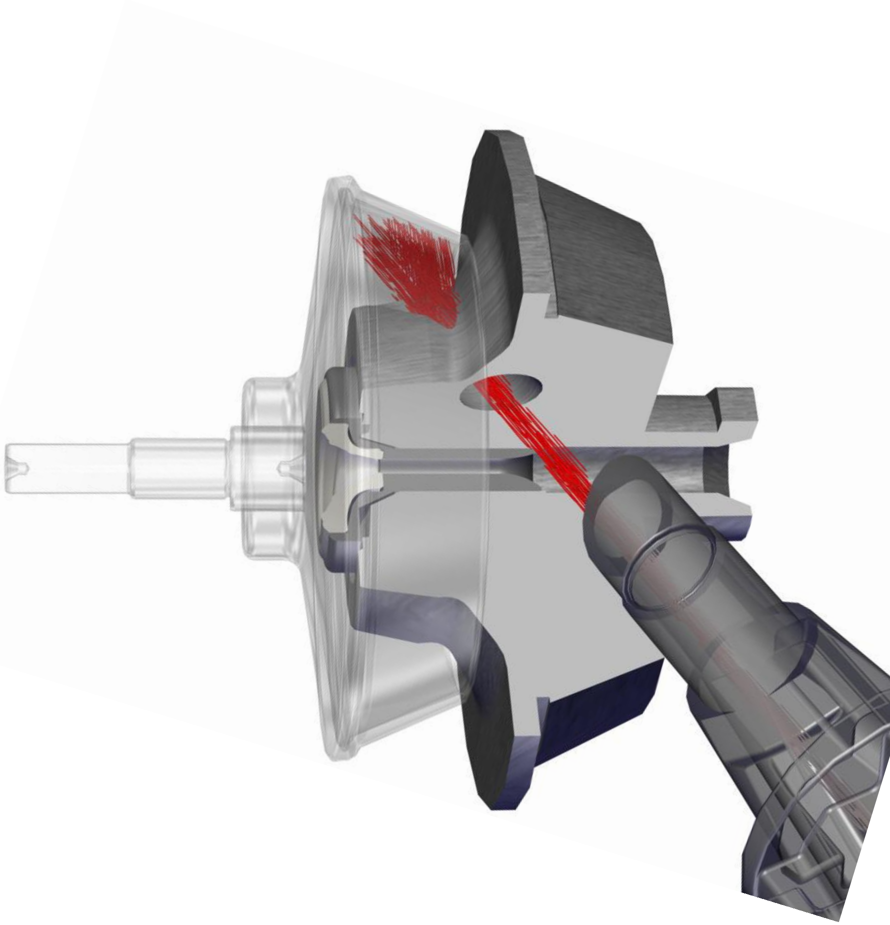




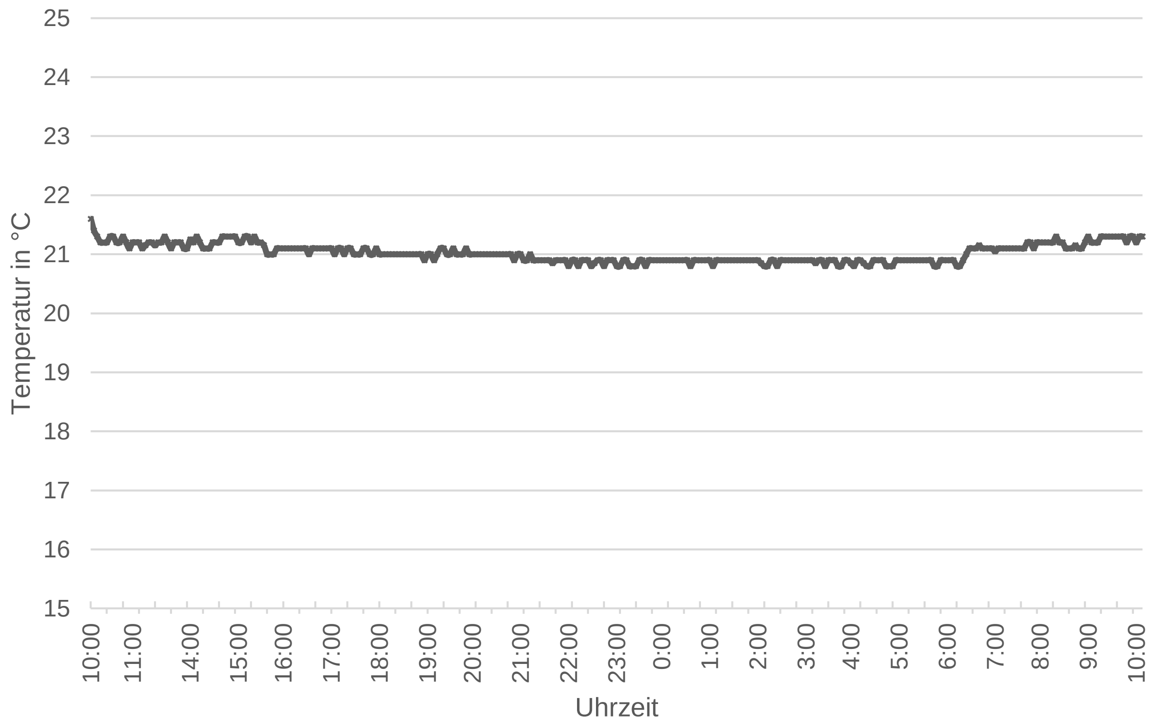
Spinnability

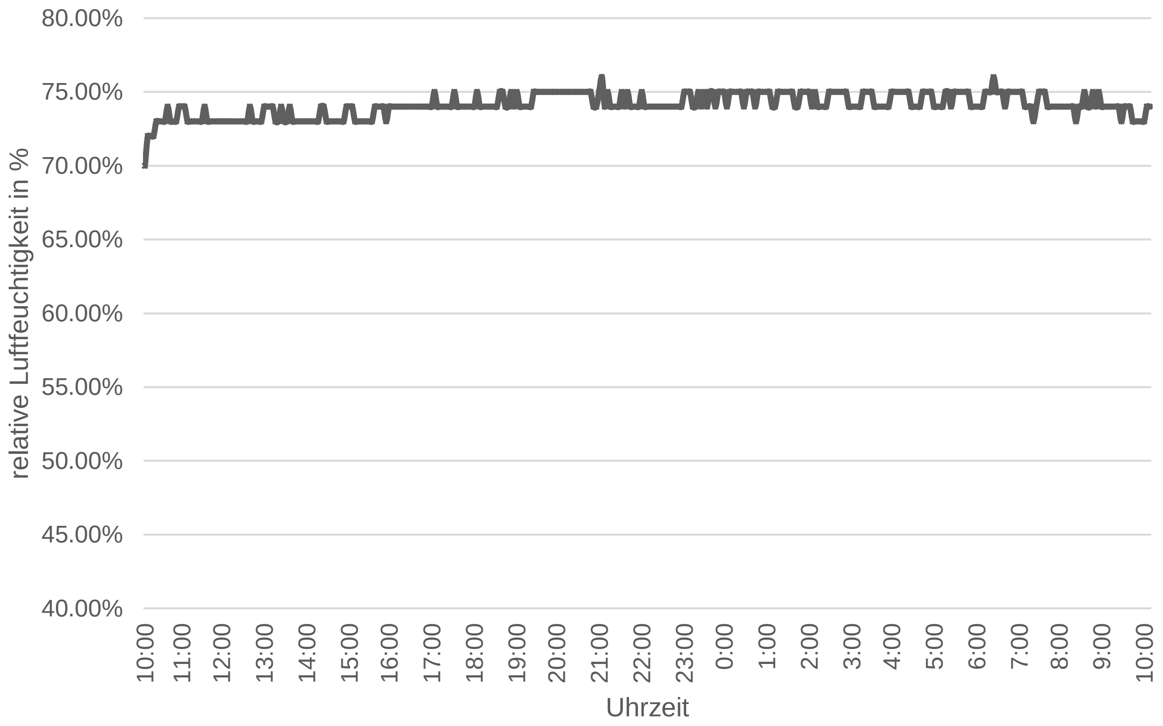
Tribological influences



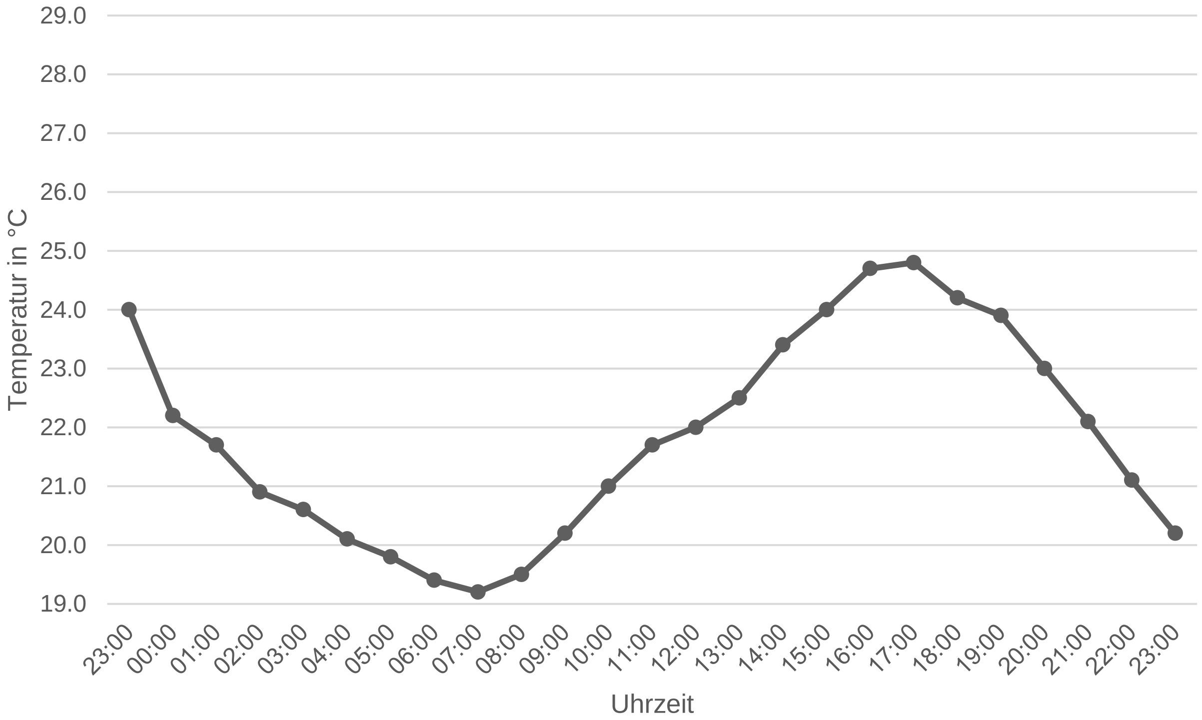


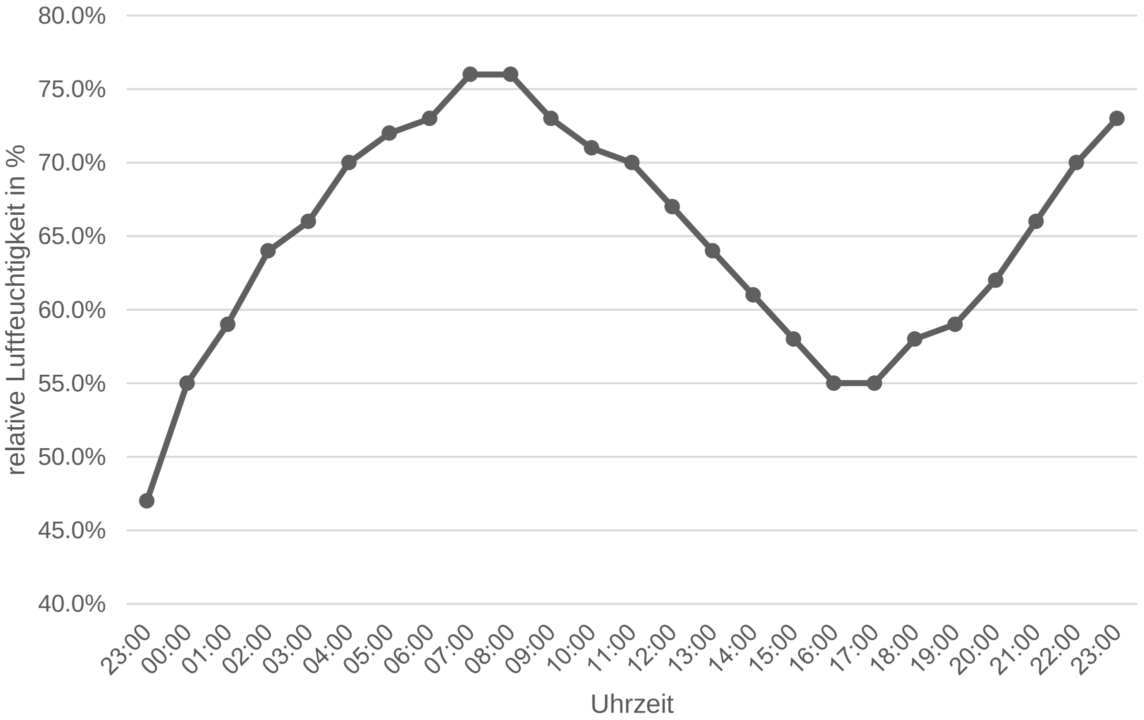
External influences optimum



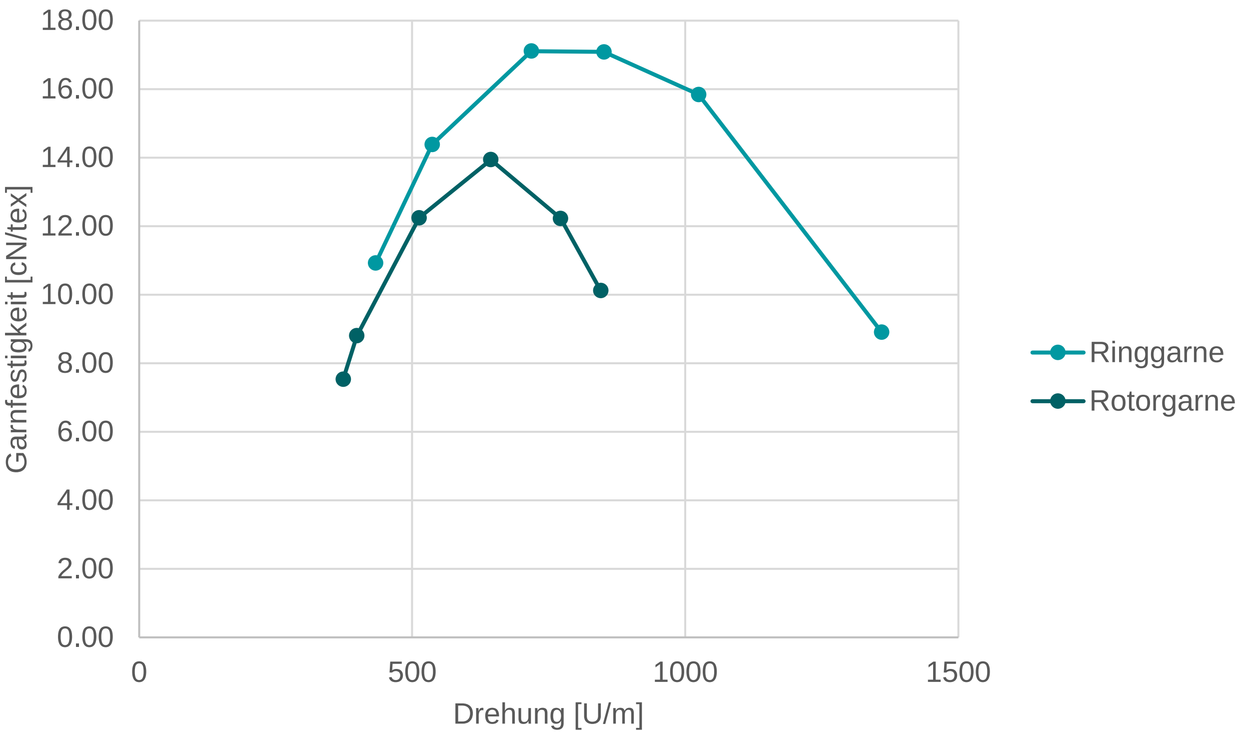


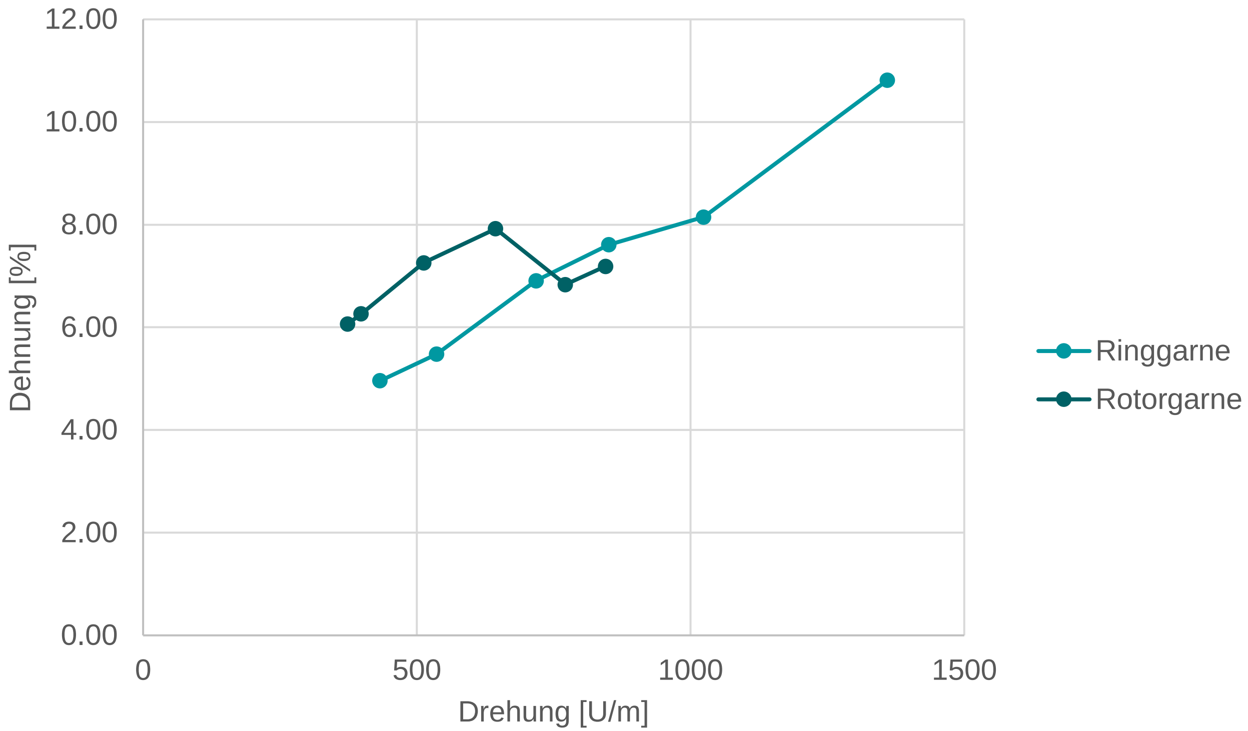
External influences reality





Twisting influences





Spinnability

Data Limits – production data

- Accepted amount of yarn breakages is usualy below 10 per 1000 rh (rotor hours)
- Efficiency should be above 98 %
- In low-wage countries at least 7800 h/a operating hours are required, in high-wage countries 8200 h/a
- Trend for automation and digitalization all over the globe

Produktionsstart:	26.06.2018	Einzugsgeschwindigkeit:	0,61 m/min
	06:30:56	Abzugsgeschwindigkeit:	151,5 m/min
Schichtbeginn:	26.06.2018	Anzahl Fadenbrüche:	5
	06:30:56	Anzahl Rotlichter:	8
Produktionsmenge:	4,8 kg	Anzahl Reinigerschnitte:	1
	241024 m		
Gewechselte Spulen:	19		
Aktueller Nutzeffekt:	25,0 %		
Gemittelter Nutzeffekt:	63,2 %		
Fadenbrüche:	187 1/1000rh		
Rotlichter:	487 1/1000rh		
Reinigerschnitte:	37 1/1000rh		
Anspinnsicherheit:	94,3 %		
Durchsatz:	0,1 kg/h		
Produktionszeit:	2 h 48 min		
Stillstandzeiten:	1 h 40 min		

Justin Kühn, M. Eng.

Institut für Textiltechnik (ITA) der RWTH Aachen University
Otto-Blumenthal-Straße 1, 52074 Aachen

Phone (direct): +49 241 80-23256
Phone: +49 241 80-23401
Fax: +49 241 80-22422
E-Mail: Justin.kuehn@ita.rwth-aachen.de
www: www.ita.rwth-aachen.de

Current events: www.ita.rwth-aachen.de/events
Visit us online:

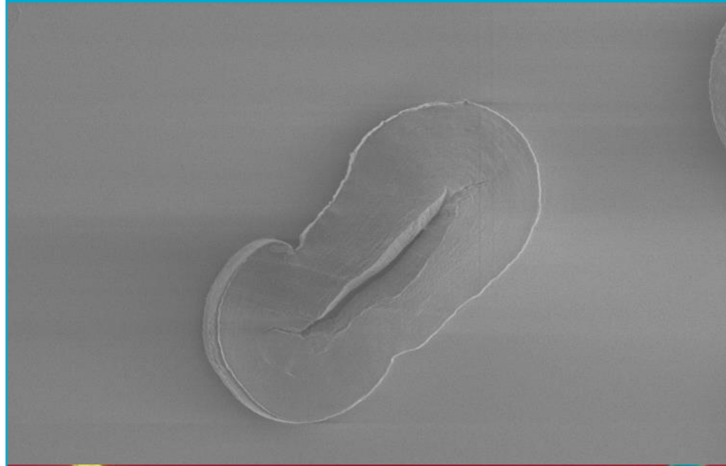
Textile Innovations
Sustainable.Digital.Individual.

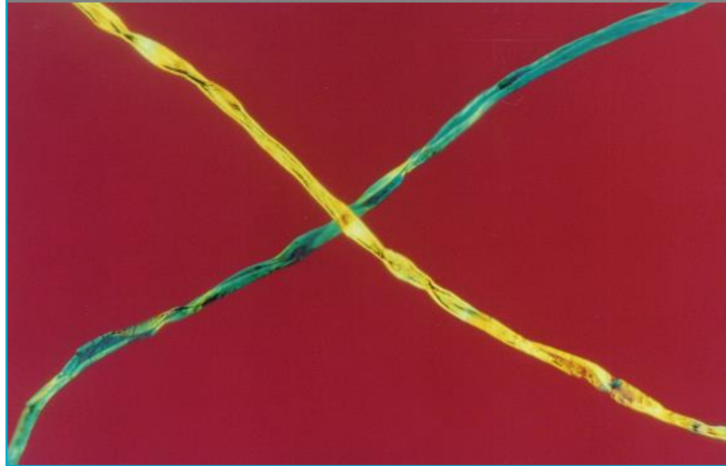
Thank you for your attention!

ICCTM Fineness and Maturity Task Force Report

Stuart Gordon | September 2022

Australia's National Science Agency





ASTM Standards (still) in play…

- D1442-06 (2019), Standard Test Method for Maturity of Cotton Fibers (Sodium Hydroxide Swelling and Polarized Light Procedures).
- D1464-12 (2019), Standard Practice for Differential Dyeing Behaviour of Cotton.
- D1577-07 (2018), Standard Test Methods for Linear Density of Textile Fibers.
- **D8394-21 (2021), Standard Test Method for Automated Measurement of Maturity, Fineness, Ribbon Width, and Micronaire of Cotton Fibers.**

GB Standards (still) in play…

- GB/T 6100-2007 (first drafted 1985) - Test method for linear density of cotton fibres. *(Cut and weigh method)*
- GB/T 6099-2008 - Test method for maturity coefficient of cotton fibres. (*Replaces GB/T 6099.1-1985 - Test method for maturity of cotton fiber cell wall in the cavity contrast method and GB/T 6099.2 - 1992 Test method for maturity of cotton fiber polarization meter method)*
- GB/T 13777-2006 - Test method for maturity of cotton fibres - Microscopic method *(NaOH method)*

ISO (BS EN CSN) Standards (still) in play…

- BS ISO 2403:2021-TC, Determination of micronaire value.
- BS ISO 4912:1981, Evaluation of maturity - microscopic method.
- CSN EN ISO 10306:2014, Evaluation of maturity - airflow method.
- BS 3181-1:1987 Determination of cotton fibre properties by the single compression airflow method.

Withdrawn standards…

- D1448-11 Standard Test Method for Micronaire Reading of Cotton Fibers. (Withdrawn 2020)

RIETER

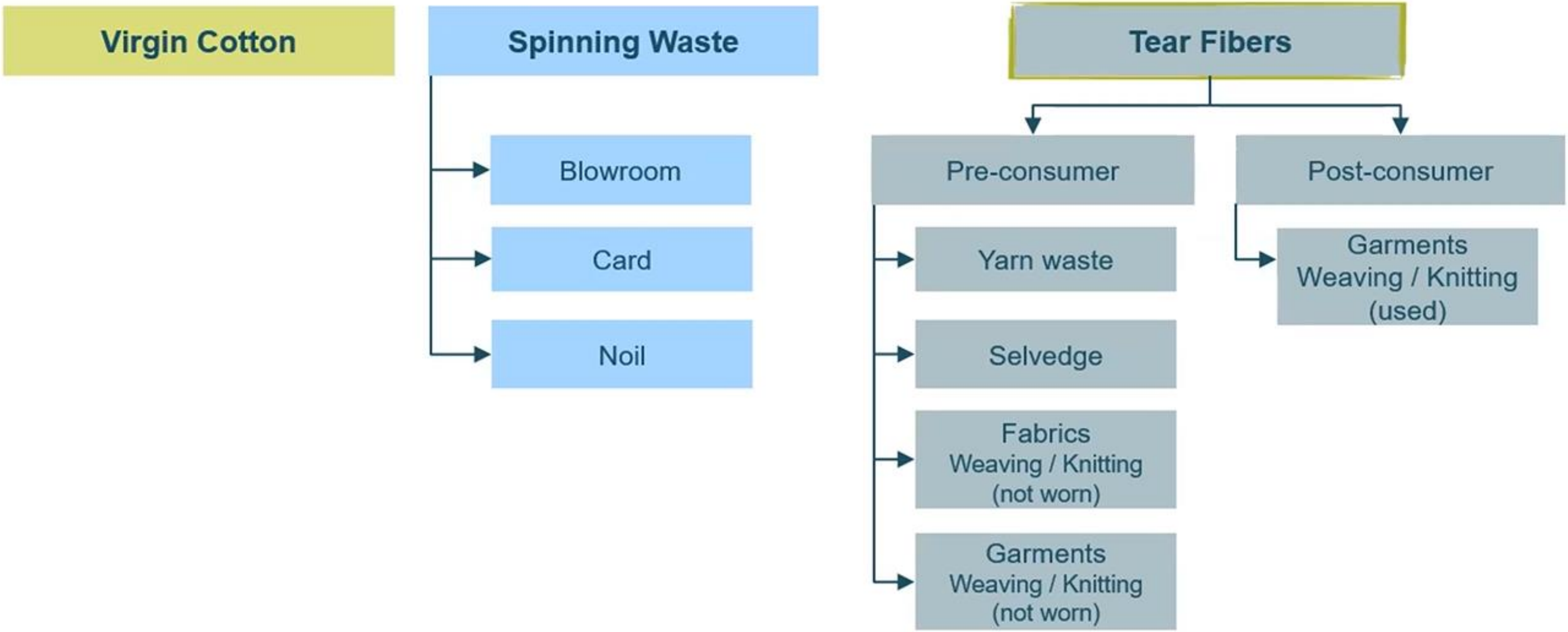
The Rieter Recycling System

ITMF International Committee on Cotton Testing Methods (ICCTM)

Harald Schwippl, 27.09.2022

Pre- And Post-consumer Goods

Rieter recycling system takes into consideration the pre- and post-consumer goods.



Testing of Recycled Fibers

Requirements for Process optimization and machinery development

Issues to be clarified

- handling of fabric and yarn pieces?
- measure the opening degree (amount of fully opened fibers)?
- Handling of colored and/or blended materials?

Required datas

- Fiber length
  → especially SFC
- Fiber neps
- Fiber strength
- Opening degree
- Composition of fiber mix

Current testing process @ Rieter

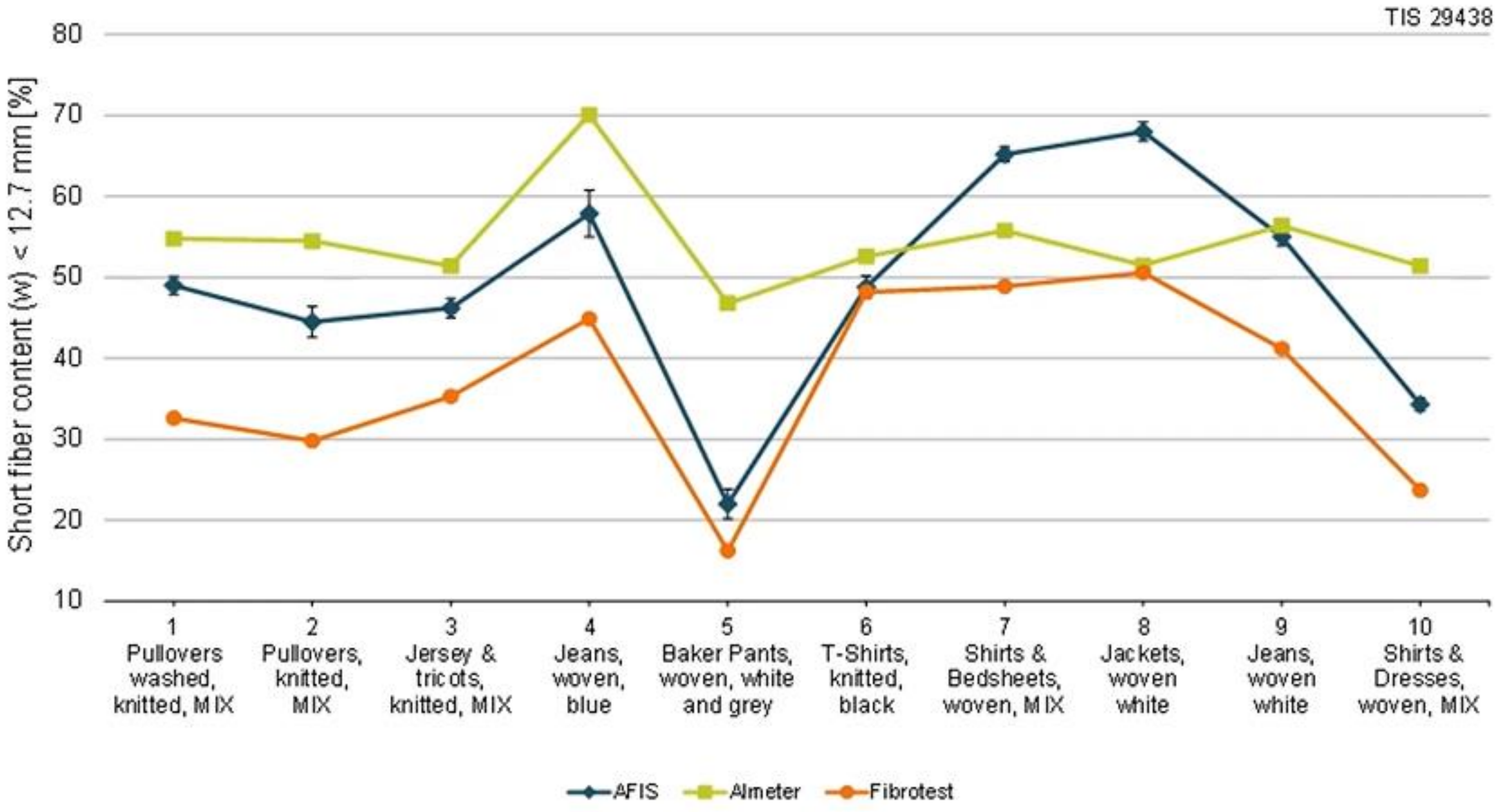
- Remove yarn and fabric pieces on Shirley or MTDA
  → Determination of opening degree
- Length testing with AFIS **and** Almeter **and** Fibrotest

Testing of Recycled Fibers

We need standards / norms to have everyone on the same page

Short fiber content

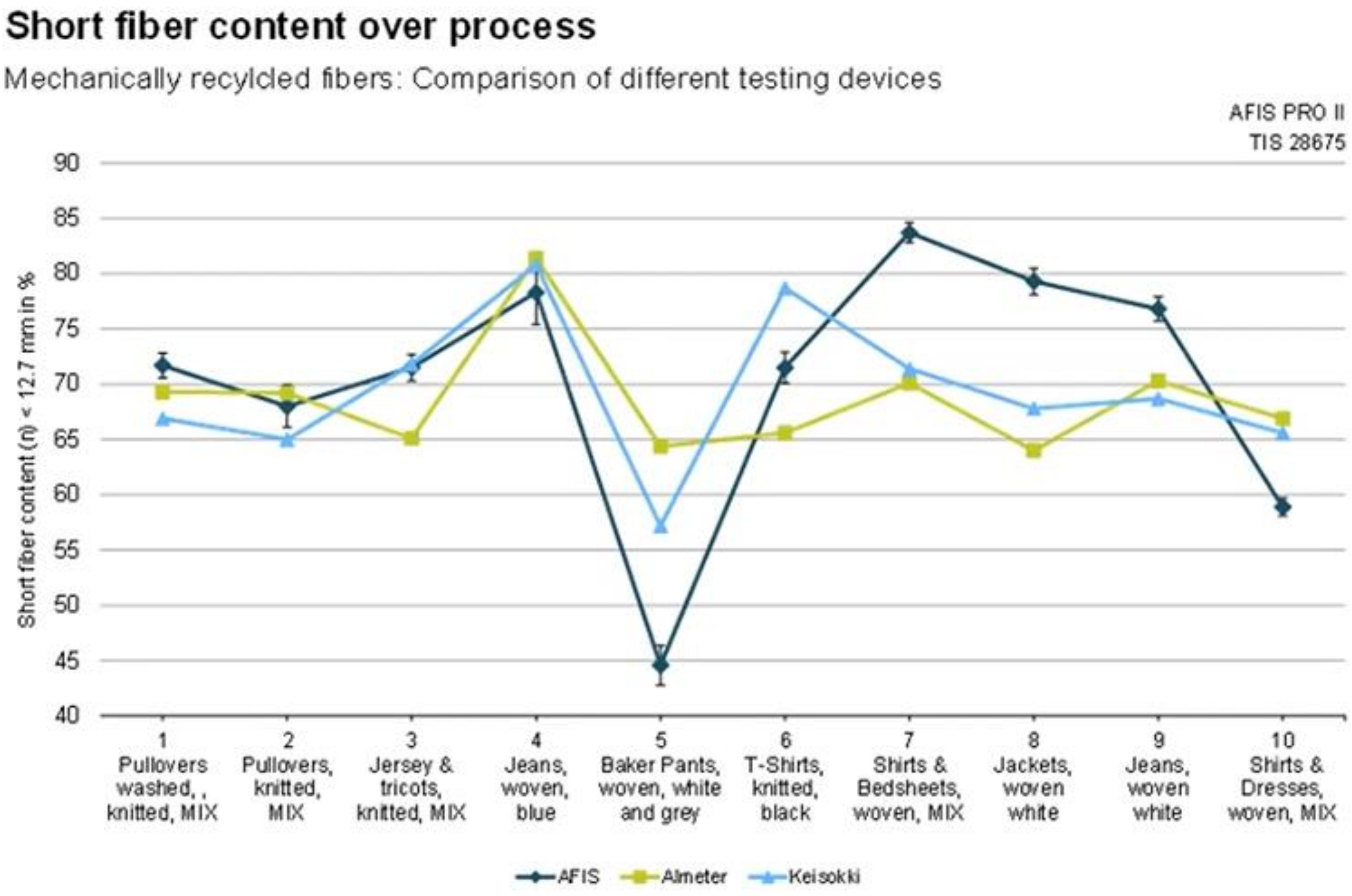
Mechanically recylcled fibers: Comparison of different testing devices



- Different testing devices provide different results
- Currently no testing device alone is sufficient to fully describe recycled materials.
- Without an internationally recognized testing standard, classification / trading of recycled fibers is very difficult

Testing of Recycled Fibers

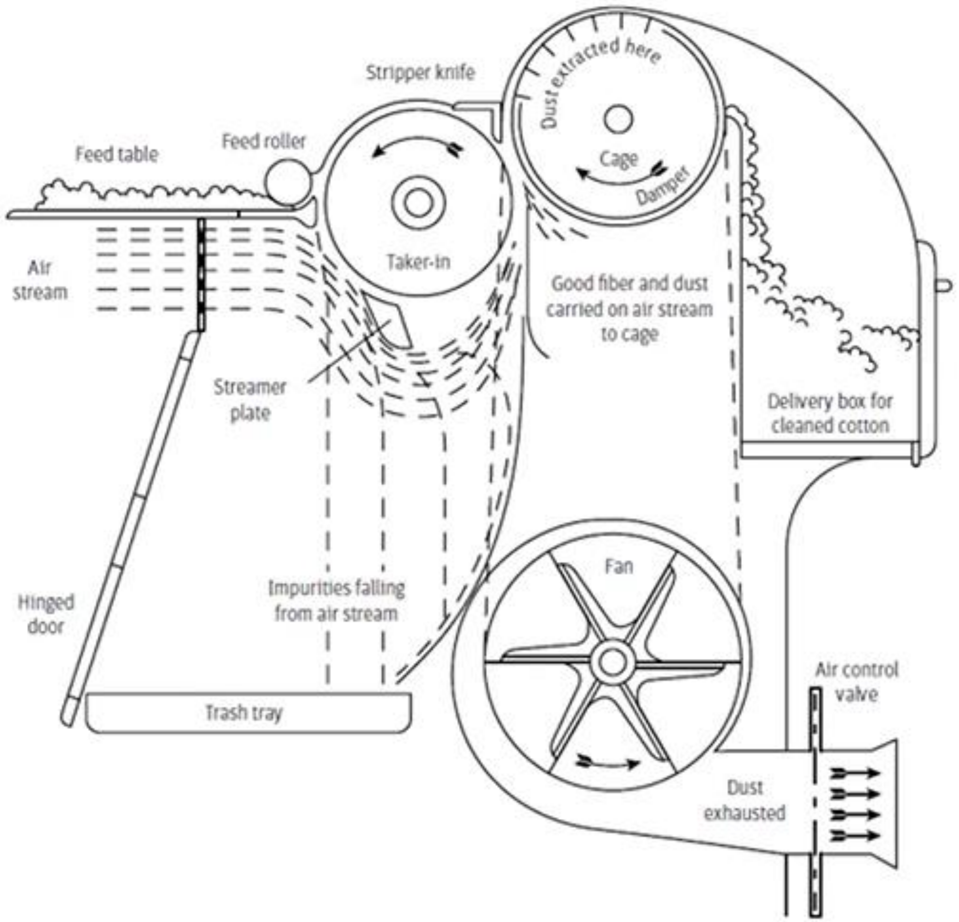
We need standards / norms to have everyone on the same page



Testing of Recycled Fibers

RIETER

Evaluation of efficiency of fiber opening with Shirley



$$\text{Degree fabric opening DFO [\%]} = \frac{\text{fabric input} - \text{fabric output}}{\text{fabric input}} \times 100$$

$$\text{Efficency of fiber opening EFO [\%]} = \frac{\text{raw material} - \text{non-opened fibers} - \text{fiber fragments}}{\text{raw material}} \times 100$$

Rieter Recycling Classification

The Rieter recycling classification makes it easier for spinners to estimate what targets can be reached depending on the material

Fiber Key Parameters by number (n)	Short-Fiber Content	Mean Fiber Length	Long Fiber 5%
Cotton short staple (<1 1/8” as reference)	24%	21 mm	34 mm
Very good	45%	17 mm	31 mm
Good	55%	14 mm	29 mm
Medium	60%	13 mm	28 mm
Poor	78%	10 mm	22 mm

Source: Technology and Process Analytics
SFC measured with AFIS PRO II

Find More Information

https://www.rieter.com/products/system-applications/recycling-spinning-system

Special print on recycling including the Rieter classification methodology.

Fiber Classifying System FCS – Tool to characterize recycling fibers

Dr. G.Kugler, Dr. S.Fliescher, Dr. U.Mörschel, M.Sc. F.Liebhold

Textechno textile testing technology

© Textechno Germany

Structure :

RECYCLING of fibers

- *Motivation for recycling fibre manufacturing*
- *Textechno's Tool to characterize recycling fibers: brief description of FCS*

Experiences from recycling fibers testing

- *FIBROTEST*
- *FIBROFLOW*
- *MDTA 4*

Textechno
textile testing technology

© Textechno Germany

Fiber Recycling

Motivation

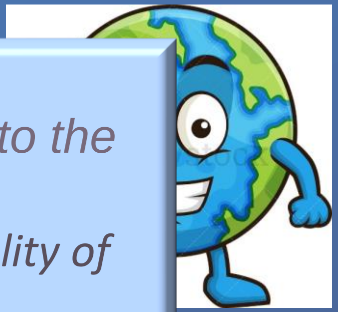
Recycling-Fibers :
(After-use or industrial waste)

recycling

Key words :

* *Sustainability - returning the recycled fibers to the textile production chain*

* *Definition of quality criteries to describe the quality of recycling fibers are necessary*



downcycling

non-wovens

Textechno
textile testing technology

© Textechno Germany

FCS – Tool to characterize reycling-fibers

FIBROTEST:
Fibre length & Fibre-bundle strength (absolute & HVI)

FIBROFLOW:
Micronaire and Maturity (double compression metho)

OPTOTEST:
Trash Analyzis & Colour classification

MDTA 4:
Trash Separation, single fibre length, Openening energy, Sliver creation

Textechno
textile testing technology

© Textechno Germany

FCS – Tool to characterize reycling-fibers

FIBROTEST:

FIBROFLOW:
Micronaire und

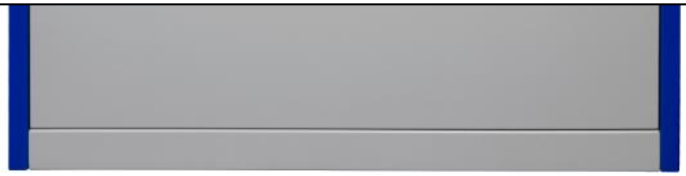
MDTA 4:
Trash Separation,

FCS – Features:

FCS – Features:

FCS – Features:

- *Very flexible : User can specify his own system configuration, stations are working independent each other;*
- *Sample form : Fibers from bales, carding & draw frame slivers and flyer rovings can be tested;*
- *The system is comparable with HVI systems and allows to realize 2 different testing modi:*
  (1) HVI Mode, i.e. the results are cotton HVI test results (calibration with HVI-CC required)
  (2) Direct Mode, i.e. all results are absolute measured results (no HVI-CC required)
-



© Textechno Germany

FCS-Version 5-5:
Example of FCS Installation
in Belgium

Producer of Recycling Fibers
from Industrial waste

- Since 2018 : TEXTECHNO has been contacted by producers / processors of Recycling fibers. From companies world wide we have got fibers to be tested at FCS.
- In 2019 Textechno has sold the first FCS-Systems to producers / processors of Recycling fibers.

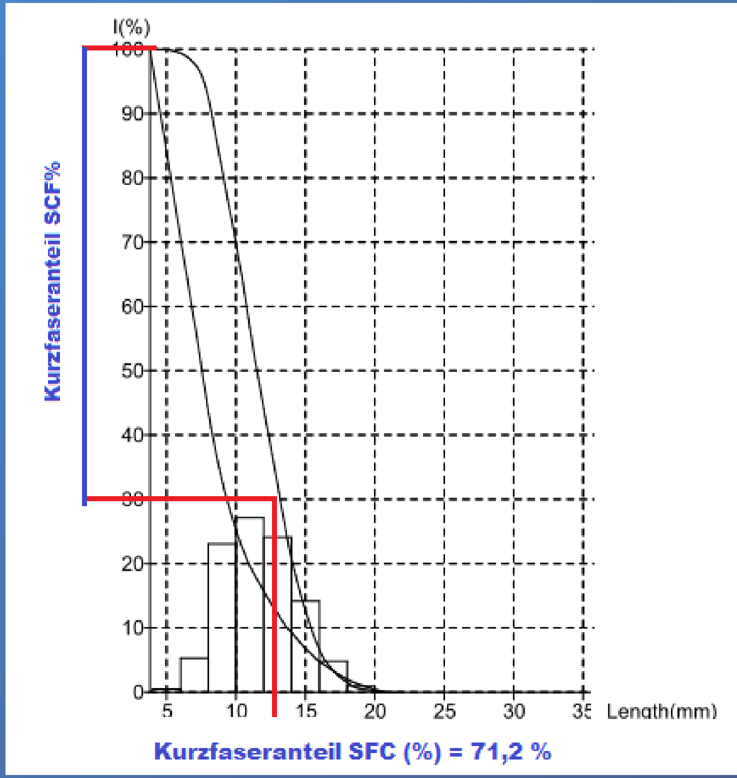
Examples of Recycling fibers, made by different recycling technologies:

(1) Bleached Recycling-Fibers
(2) Recycling-Fibers made from T-Shirts
(3) Denim Recycling-Fibers.

Textechno
textile testing technology

© Textechno Germany

Denim Recycling-Fibers :
Measured Short Fiber content SFC% = 71,2%



Definition of criteria to evaluate the Quality of Recycling Fibers from the perspective of manufacturer / processor - Recommendations :

A) Longest fibers within the Recycling fiber material;
B) Mean Length and variation of the fiber length distribution;
C) Short fiber content within the Recycling fiber material;
D) Fiber bundle strength of the Recycling fibers;
E) Average linear density of the Recycling fiber material;
F) Average colour of the fibers within the Recycling fiber material;
G) Percentage of remnant yarn pieces within the Recycling fiber material.

Material: Cotton — Fibroflow ver. 2.73

Measured Data

5	Micronaire	Maturity	Maturity %	LD (mTex)
1.	5.23	0.82	76.4	205.91
2.	5.04	0.91	82.6	198.43
3.	5.21	0.87	80.3	205.12
4.	5.30	0.85	79.1	208.66
5.	5.12	0.89	81.4	201.57

Statistics

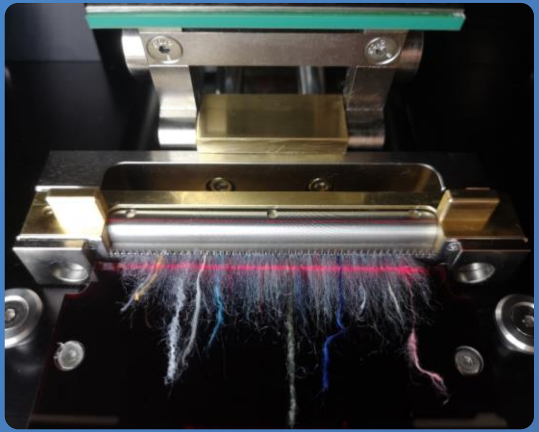
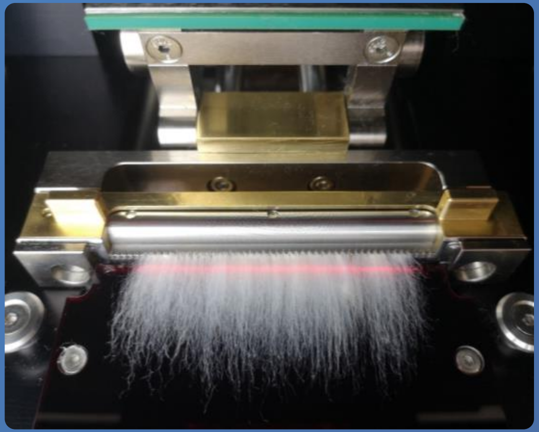
6	Micronaire	Maturity	Maturity %	LD (mTex)
Avg	5.17	0.86	79.95	203.93
S	0.09	0.03	2.12	3.56
CV%	1.740	3.488	2.651	1.745
Min	5.040	0.819	76.400	198.429
Max	5.300	0.909	82.599	208.659
R	0.2	0.0	6.1	10.2

Denim Recycling-Fibers : Fiber sample with yarn pieces & results of FIBROFLOW

Textechno
textile testing technology

© Textechno Germany

FIBROTEST: Comparison Recycled & Virgin Cotton

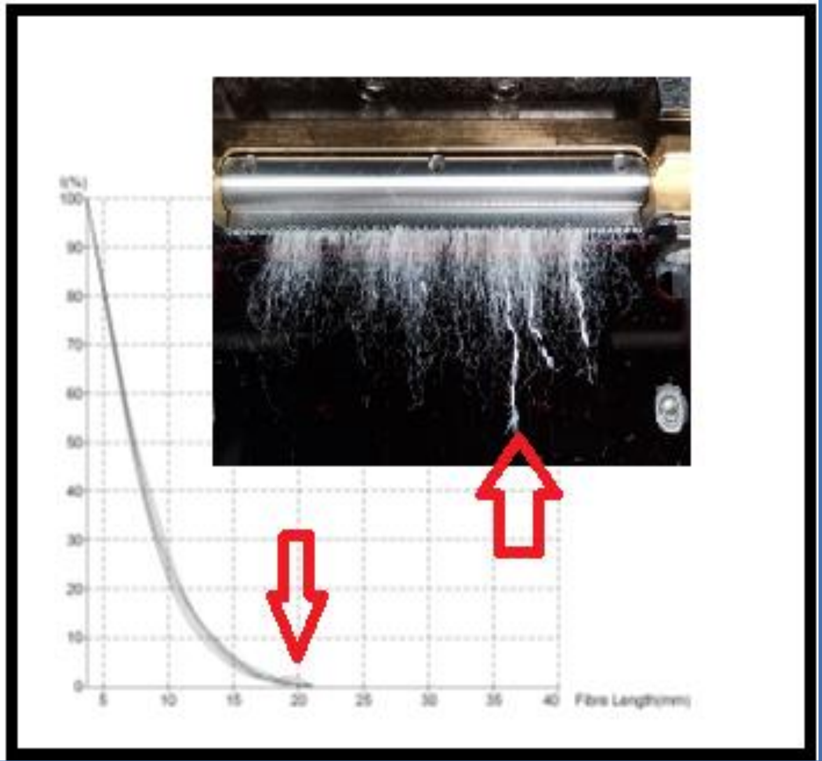
	Bundle in fiber magazine	*Image of Bundle (CCD Line camera)*	*Test results :*
Mechanical recycled Cotton:			▪ UHML: 19.5 mm ▪ UI: 73.3 ▪ SFC: 42.7 % ▪ Rel. Strength: 17.1 g/tex ▪ Abs. Strength: 7.5 g/tex ▪ E_{max}: 4.5 %
Virgin cotton:			▪ UHML: 26.8 mm ▪ UI: 80.7 ▪ SFC: 14.8 % ▪ Rel. Strength: 31.5 g/tex Abs. Strength: 17,5 g/tex ▪ E_{max}: 9.6 %

Textechno
textile testing technology

© Textechno Germany

FIBROTEST: Remnant yarn pieces in bundle

Fiber magazine / Fibrogram



Mechanical recycled Cotton

Test results / Single tests

1. Faserbündel-Test

Nr.	ML mm	UHM mm	UQL mm	SL50 mm	SL25 mm	SL2.5 mm	SFC %	SFI %	UI --	UR --
1	16.4	22.1	23.0	8.65	12.5	21.4	13.0	18.70	74.4	40.4
2	14.2	19.0	19.6	8.10	11.1	18.1	12.6	21.55	74.5	44.7
3	14.2	19.1	19.9	8.13	11.6	18.1	12.6	21.51	74.6	44.9
4	14.6	19.7	20.3	8.06	11.5	18.9	12.7	21.03	73.9	42.7
5	14.3	19.4	20.1	7.96	11.1	18.4	12.7	21.43	73.9	43.1

Nr.	ML mm	UHM mm	UQL mm	UQL(i)-AVE mm
1	16,4	22,1	23,0	2,5
2	14,2	19,0	19,6	-0,9
3	14,2	19,1	19,9	-0,6
4	14,6	19,7	20,0	-0,5
5	14,3	19,4	20,1	-0,4
AVE	14,7	19,9	20,5	

Remaining yarn pieces in the bundle ???

Textechno textile testing technology

© Textechno Germany

FCS-FIBROTEST Station

Viskose Fiber Sample: Fibrograph Method & Almeter Method

Fibrograph Method

1. Fibre Bundle Test

No.	ML mm	UHM mm	UQM mm	SL50 mm	SL25 mm	SL2.5 mm	SFC %
1	34.6	35.7	38.6	20.9	29.3	36.2	4.41
2	36.0	37.6	41.8	20.5	28.8	38.2	3.99
3	33.0	37.2	41.0	16.8	29.5	37.8	4.98
4	35.4	36.9	40.4	20.6	29.0	37.4	4.15
5	31.8	34.0	37.4	18.9	26.4	34.3	5.49

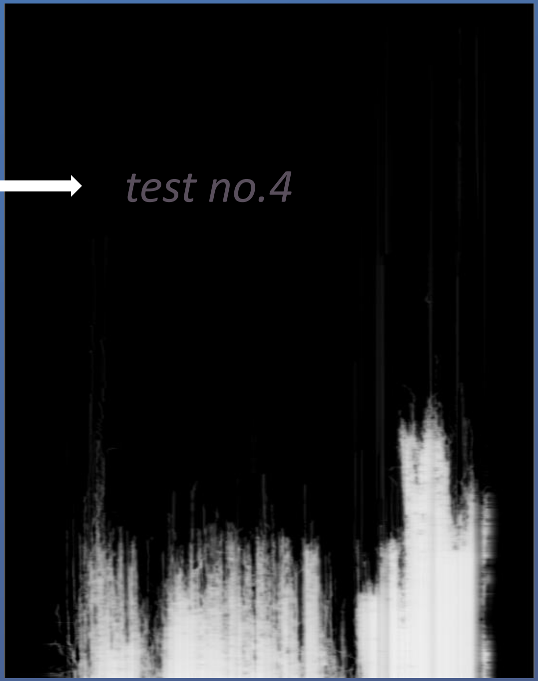
Statistics	-N-	-X-
Mean Length	5	34.15mm
Span Lengh 50%	5	19.52mm
Span Length 25%	5	28.59mm
Span Length 2.5%	5	36.77mm
Upper Half ML	5	36.31mm
Upp. Quart. ML	5	39.84mm
Short Fibre Cont.	5	4.605%
Short Fibre Index	5	-0.98%
Uniformity Ratio	5	53.17
Uniformity Index	5	94.07
Bundle Weight	5	3.44mg
Maximum force	5	148.98N
Strength	5	14.20g/tex
Elongation(Fmax)	5	7.25%

Almeter Method

1. Long Staple Fibre Bundle Test

No.	ML(n) mm	CV(n) %	ML(w) mm	CV(w) %	TL50 mm	TL25 mm	TL2.5 mm	SFC(n) %	SFC(w) %	L5(n) mm	L5(w) mm	L1(n) mm	L1(w) mm
1	37.1	24.4	39.1	23.1	21.4	30.1	41.2	3.23	3.06	44.9	47.3	50.7	53.4
2	25.7	24.3	27.1	23.1	15.9	22.0	30.7	8.23	7.81	32.2	33.9	36.3	38.3
3	32.4	28.2	34.6	26.4	17.7	25.5	39.0	4.41	4.12	42.5	45.5	48.1	51.4
4	38.3	29.2	41.2	27.2	19.9	29.5	45.1	2.83	2.63	49.5	53.2	56.0	60.1
5	29.7	25.9	31.5	24.5	17.3	24.2	35.3	5.61	5.29	37.3	39.5	42.1	44.7

Statistics	-N-	-X-	-S-	-CV-	-Q(95%)-
ML(n)	5	32.65mm	5.216	15.97	6.466
CV(n)	5	26.40%	2.217	8.40	2.748
ML(w)	5	34.70mm	5.684	16.38	7.046
CV(w)	5	24.85%	1.865	7.50	2.312
TL50	5	18.46mm	2.170	11.75	2.690
TL25	5	26.27mm	3.498	13.31	4.336
TL2.5	5	38.27mm	5.532	14.46	6.858
SFC(n)	5	4.861%	2.175	44.74	2.696
SFC(w)	5	4.585%	2.077	45.31	2.575
L5(n)	5	41.28mm	6.738	16.32	8.353
L5(w)	5	43.87mm	7.413	16.90	9.190
L1(n)	5	46.64mm	7.613	16.32	9.438
L1(w)	5	49.57mm	8.377	16.90	10.38
Bundle Weight	5	4.64mg	1.39	29.94	1.72
Maximum force	5	186.46N	49.18	26.37	60.97
Elongation(Fmax)	5	6.59%	0.86	13.01	1.06
Strength	5	13.23g/tex	2.59	19.59	3.21



© Textechno Germany

FCS-FIBROTEST Station

The solution : New defined Method

- *Fibrograph Method* + *Almeter Method* → *NEW – **Combined Method***
- *Containes the most important results for Recycling fiber producers as well for the Spinners*
- *Interesting for Recycling-Fibers, but also for PES, VIF and Aramid fibers, etc.*

1. Long Staple Fibre Bundle Test

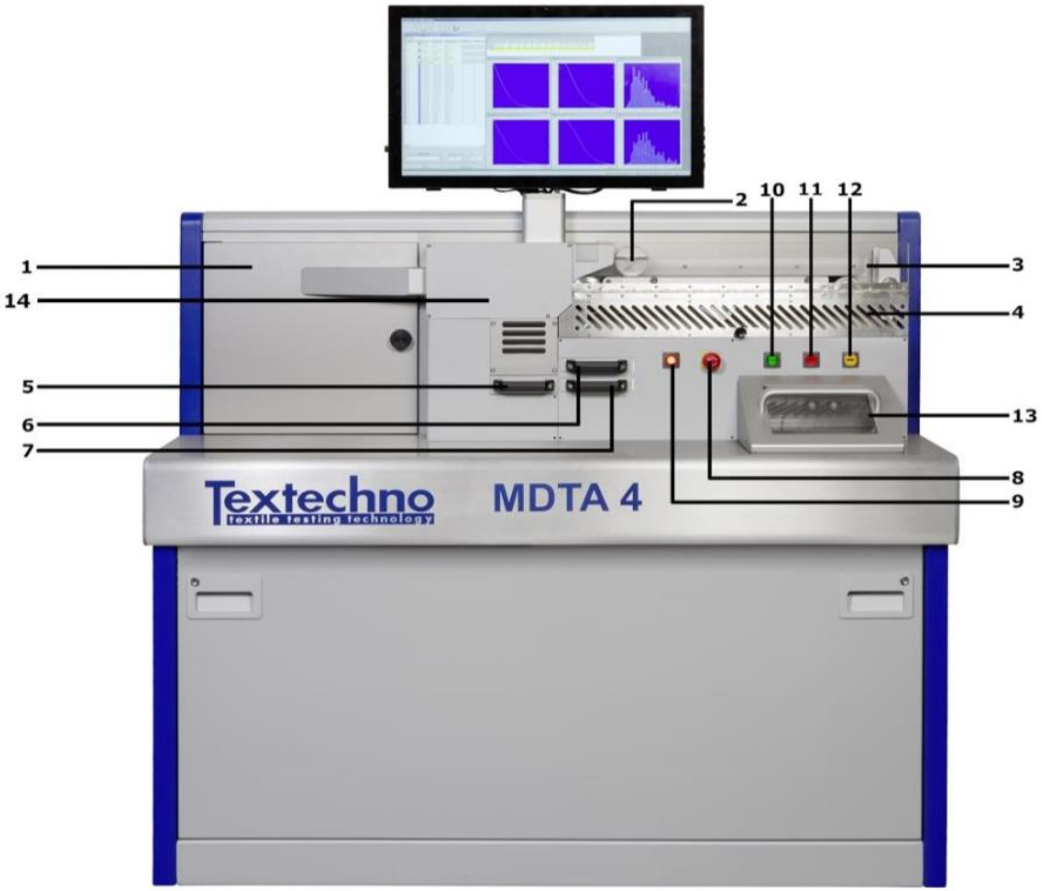
No.	ML(n) mm	ML(w) mm	TL50 mm	TL25 mm	TL2.5 mm	SFC(n) %	SFC(w) %	L1(n) mm	L1(w) mm	UHM mm	UQM mm	UI --	BW mg	Fmax N	EAB %	STR g/tex
1	32.8	34.5	19.8	28.2	36.9	4.46	4.25	43.5	45.6	37.3	41.0	93.9	4.9	484.7	19.8	32.0
2	34.9	36.5	21.1	29.8	38.3	3.84	3.67	45.2	47.4	36.8	40.6	94.5	4.0	455.1	21.0	37.1
3	33.7	35.4	20.2	28.5	37.8	4.16	3.96	46.1	48.5	37.5	40.9	95.5	4.7	443.4	20.6	30.8
4	33.2	34.9	20.1	28.9	37.2	4.32	4.12	43.5	45.6	36.6	40.1	95.7	4.0	407.7	20.5	33.3
5	31.2	33.0	18.3	26.2	36.4	4.98	4.71	46.2	48.8	36[illegible]	40.3	94.4	2.0	243.5	20.4	40.2

BundleLong **Bundle** **Bundle Strength**

© Textechno Germany

FCS-MDTA 4 Station

Micro-Dust, Trash, Fiber length and Opening work



1 – Rotor/ Collection chamber	
2 – Transportation roller	
3 – Feeding belt	
4 – Hinged vertical cover	
5 – Trash tray	
6 – Fragment Tray	
7 – Dust Tray	
8 – Emergency button	
9 – Power-on button	
10 – Start button	
11 – Stop button	
12 – Reverse button	
13 – Collection chamber	
14 – Covered feeding and opening roller	

Textechno
textile testing technology

www.textechno.com
© Textechno Germany

FCS-MDTA 4 Station

Testing task : Finding the optimized settings at MDTA 4 to measure the remaining yarn pieces in the sample

Ideale Separation:

MDTA 4

Recycled Fiber material
*(**Fibers** & **Yarn pieces**)*

Sliver: 100% Fibers

*Trash box: 100% **yarn pieces***

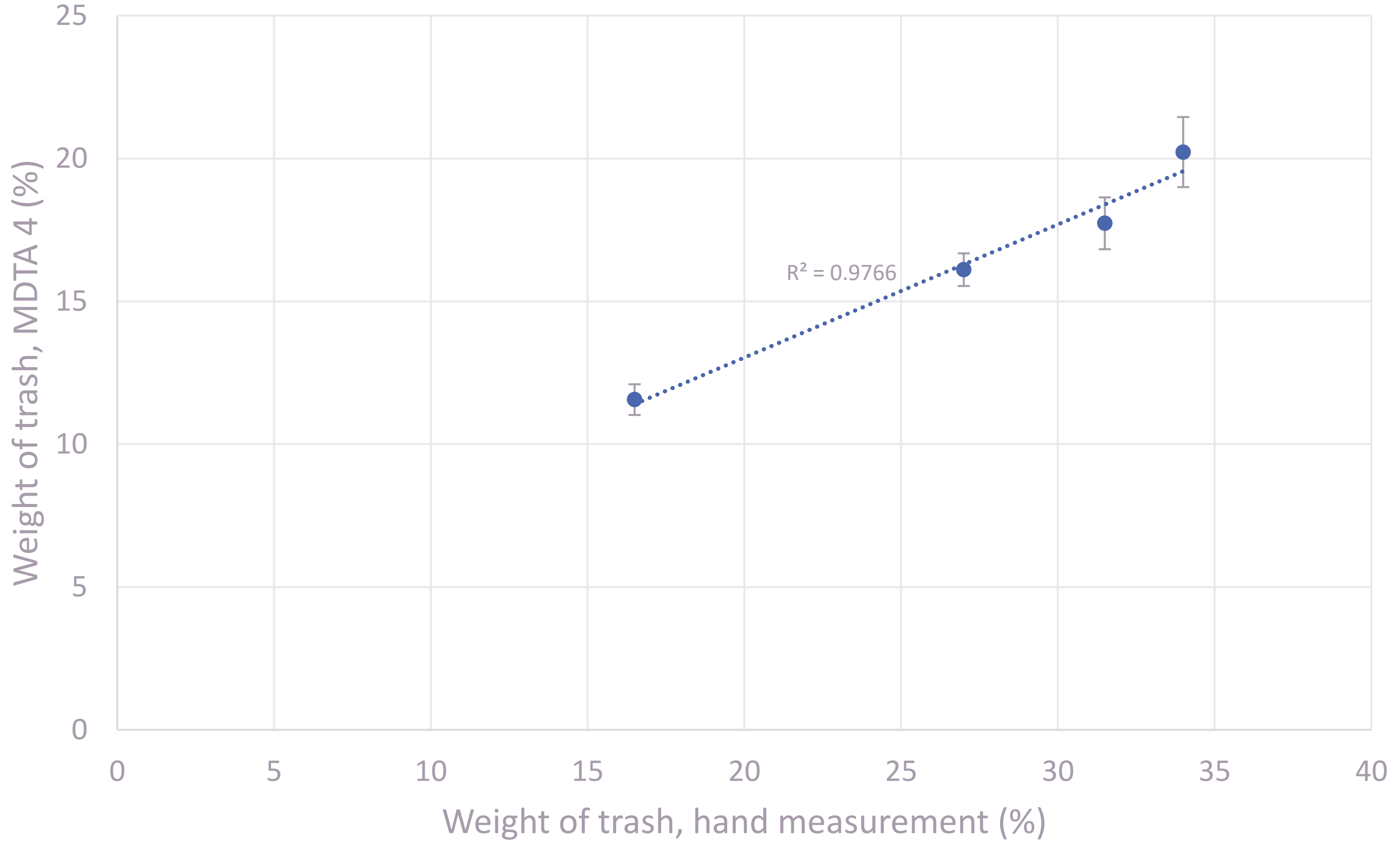
www.textechno.com
© Textechno Germany

FCS-MDTA 4 Station

Correlation between MDTA 4 Trash weight & hand measured weight

Hand measured results:

- *A: 16,5%*
- *B: 27,0%*
- *C: 31,5%*
- *D: 34,0%*



www.textechno.com
© Textechno Germany

Thanks for your attention !

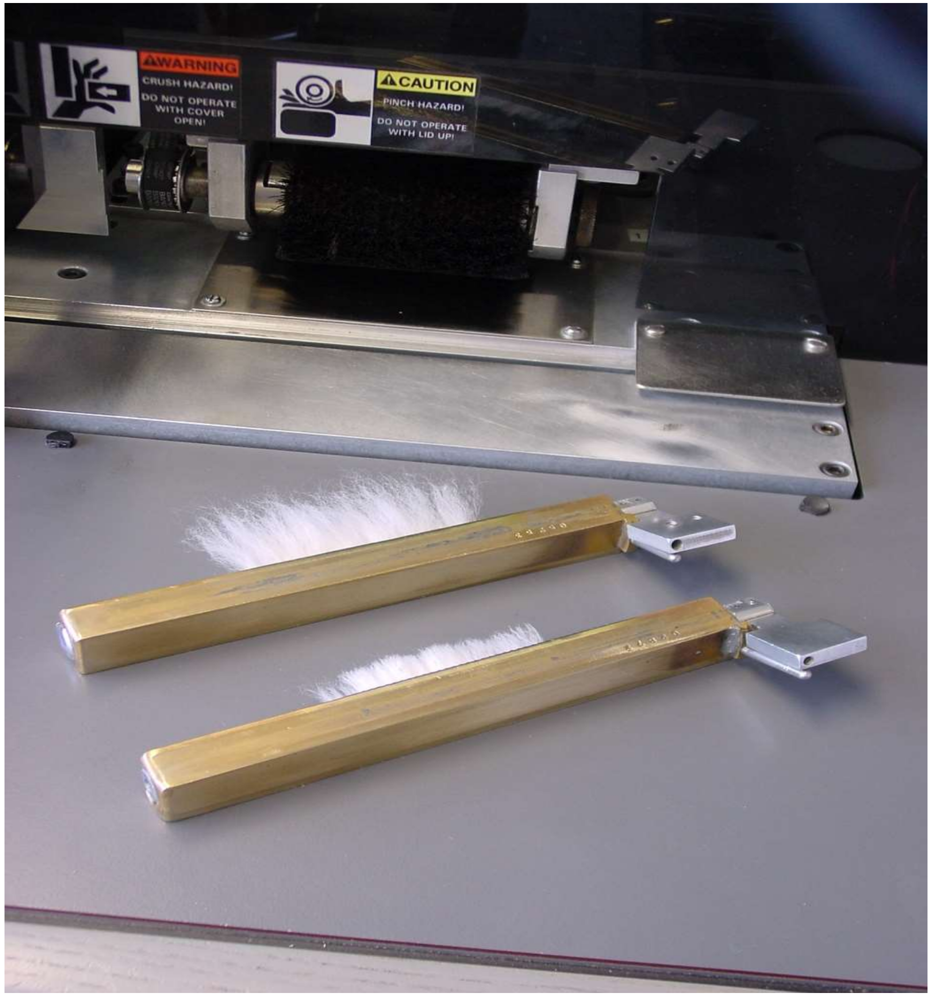
made in Germany

www.textechno.com

Textechno textile testing technology

© Textechno Germany

Analysis of ICA Bremen Round Trial Results: Correlation between Length Test Methods



Axel Drieling, Faserinstitut Bremen e.V.

Marinus van der Sluijs, Textile Technical Services, Australia

Presented at the ITMF International Committee on Cotton Testing Methods Meeting

Bremen, September 27, 2022

ICA Bremen Cotton Round Tests

- Started in 1956
- Service currently free of charge for participants
  - funded by ICA Bremen / Bremen Cotton Exchange
- Executed by Fibre Institute Bremen
- Currently 160 registered participants
  - (participation stops with not participating for one year)
- Participants from 39 countries
- Wide choice of cotton origins
- Most kinds of cotton testing instruments and properties included
  - Not including stickiness (extra Round Tests since 2017)
  - Including trash gravimetric methods since 2022

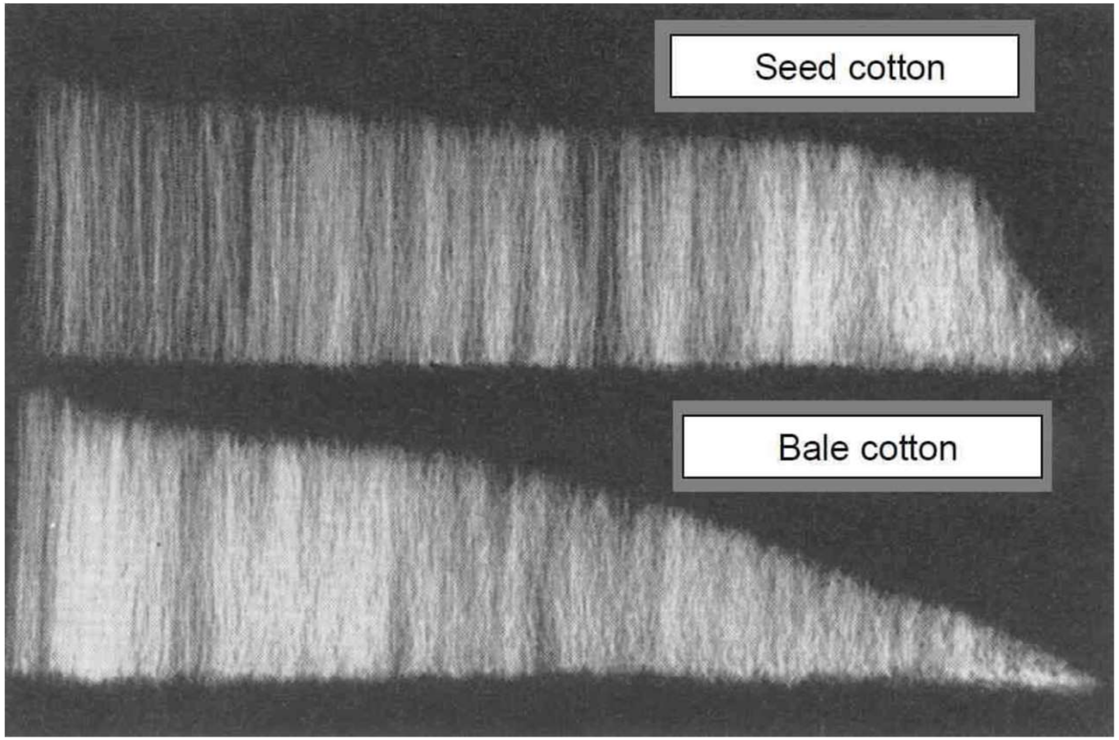
Length Test Methods

Universität Bremen

FASERINSTITUT FIBRE BREMEN

Length methods included in the Round Tests

- High Volume Instruments
  - HVICCS Calibration
  - ICCS Calibration
- Fibrograph
- Comb Sorter
- Almeter
- AFIS
- aQura



Wakeham, H., Cotton fiber length distribution – An important quality factor. Textile Research Journal, 25(5), 422-429, 1955.

Data Used for the Analysis

Parameters

- Staple length, average length, uniformity and short fibre data for each method
- In sum 40 parameters

Statistics

- For each RT
  - Average after excluding outliers (Grubbs)
  - Standard deviation between laboratories
  - Number of results

Database

- Round Trial data from 1997 to 2020
  - Could be widened to 1990 and before

→ Best available data for correlation, as it is based on a very high number of instruments

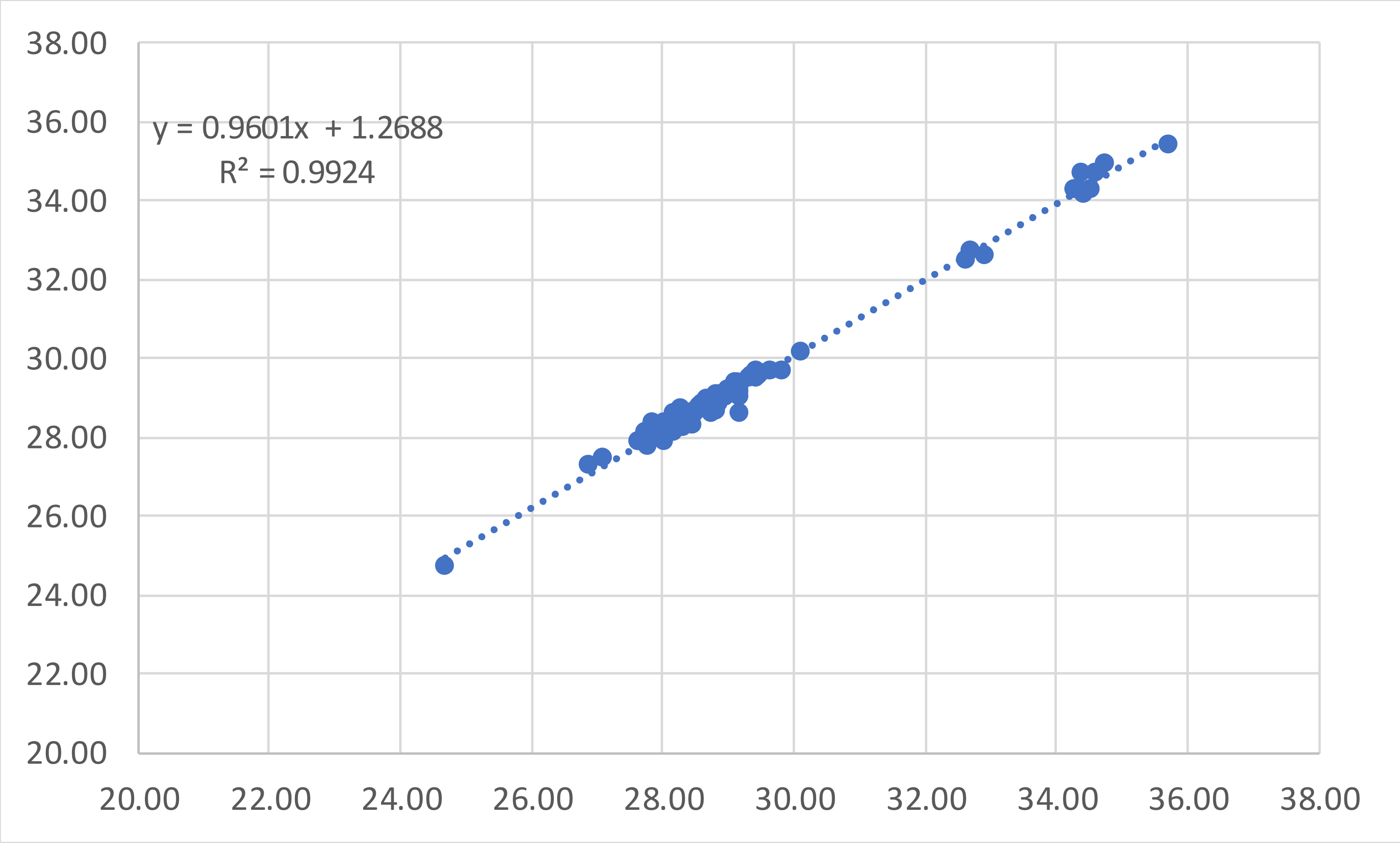
Explanations

- Reliablity of the statistics is influenced by
  - Number of RTs/samples for the correlation (datapoints)
  - Number of instruments for each datapoint
    - Changing with the years
    - For several „older“ methods, the number of instruments is getting very low (e.g. Almeter, Comb Sorter)
  - Standard deviation / confidence limits of the data points
  - Changes of the correlation over time
    - Due to the calibration with natural fibres standards not based on reference methods the correlations can change with the years
    - Correlations for limited time periods

Correlations to UHML

- X-axis:
  - HVI – ICCS calibration
  - 2.5% SL
  - mm

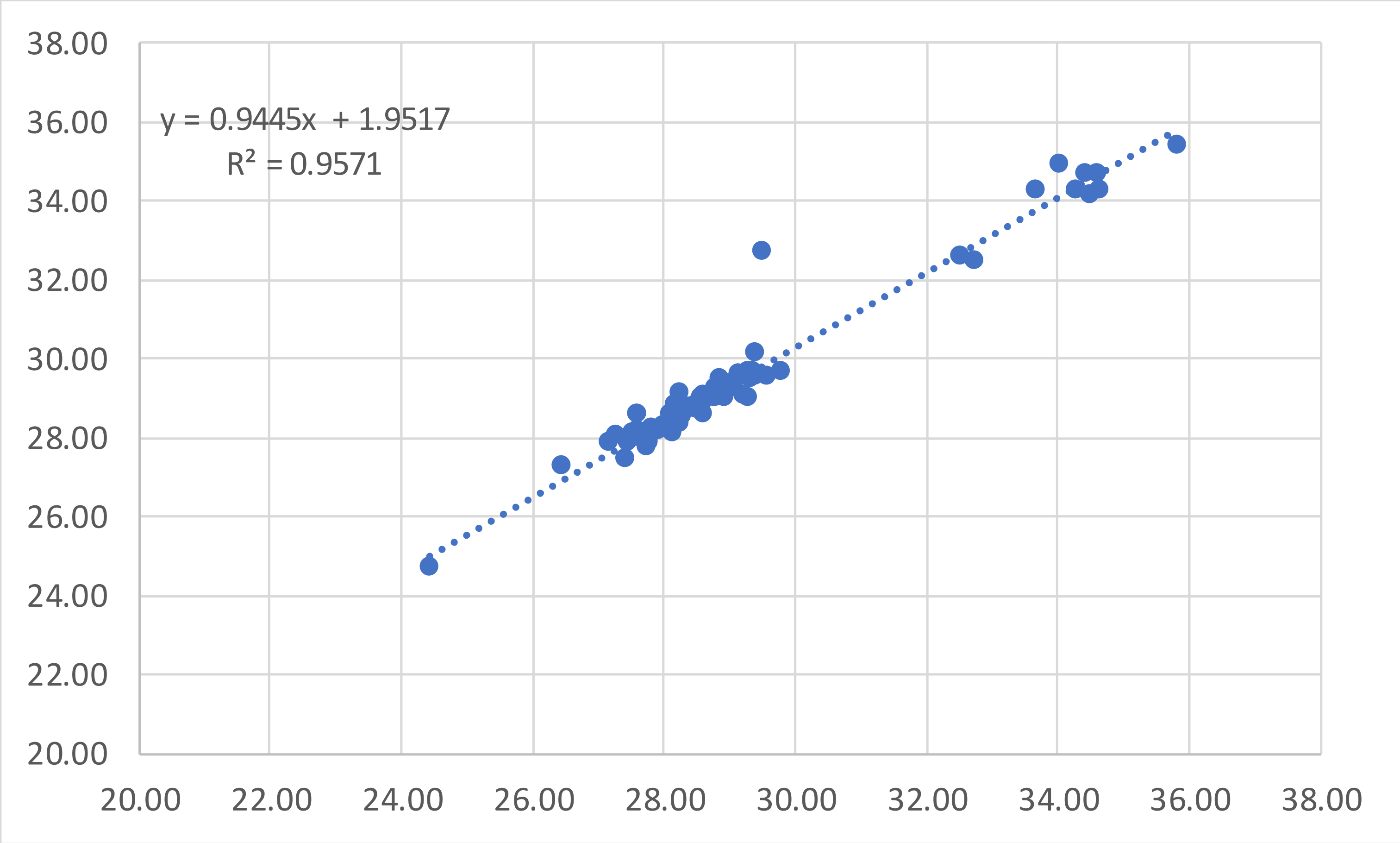
- Y-axis:
  - HVI – HVICCS calibration
  - UHML
  - mm



Correlations to UHML

- X-axis:
  - Fibrograph
  - 2.5% SL
  - mm

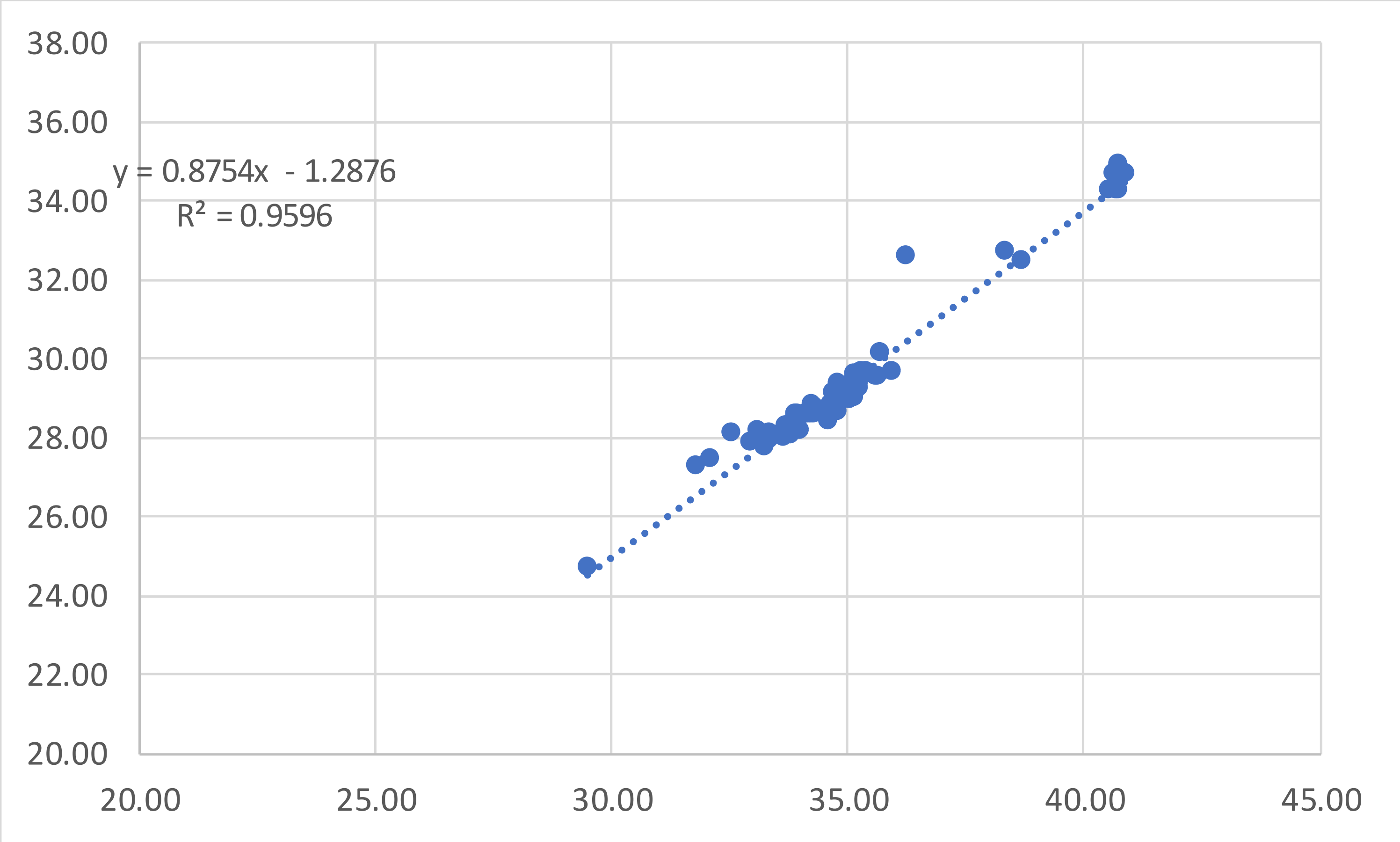
- Y-axis:
  - HVI – HVICCS calibration
  - UHML
  - mm



Correlations to UHML

- X-axis:
  - AFIS
  - 5% Length by Number
  - mm

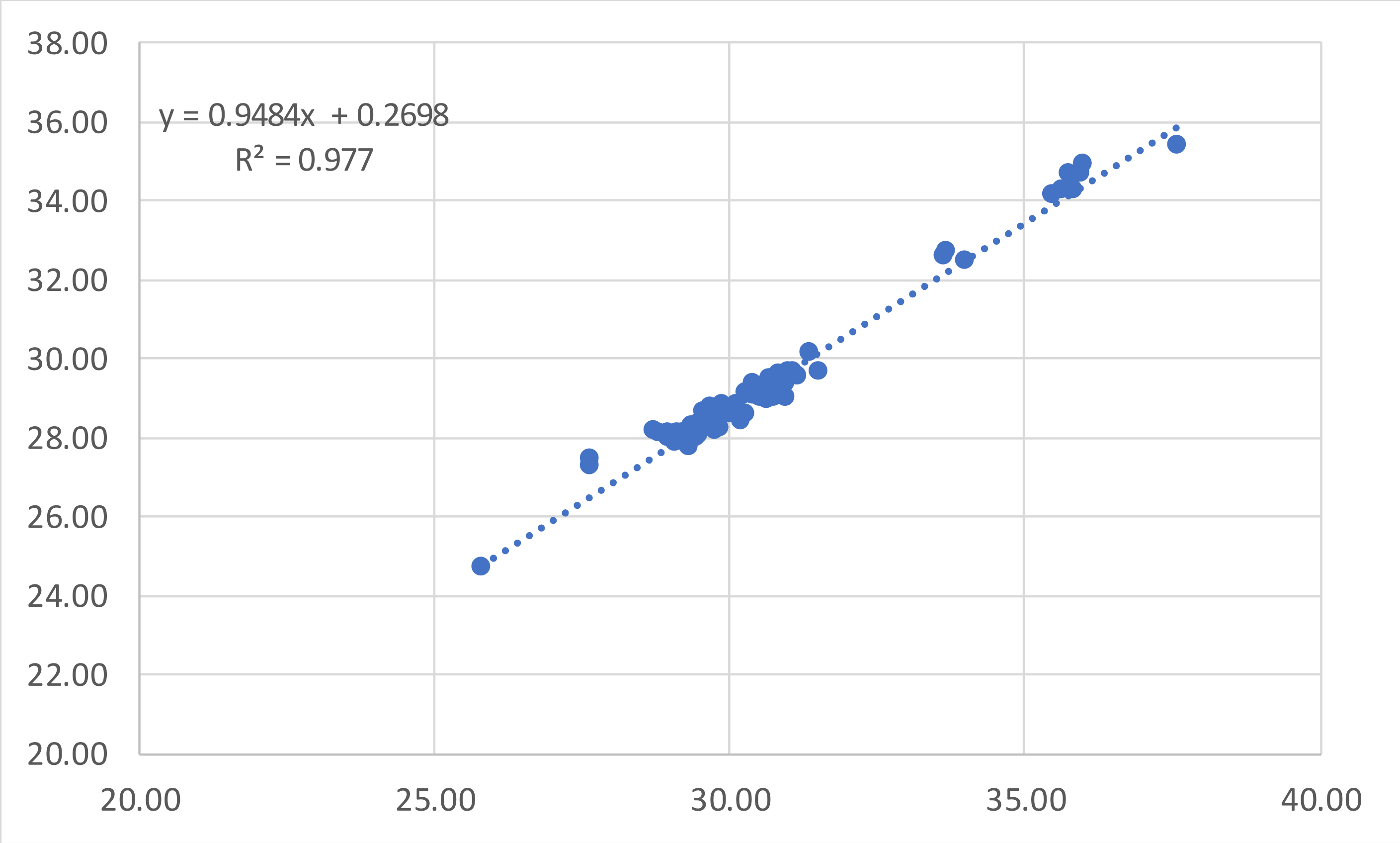
- Y-axis:
  - HVI – HVICCS calibration
  - UHML
  - mm



Correlations to UHML

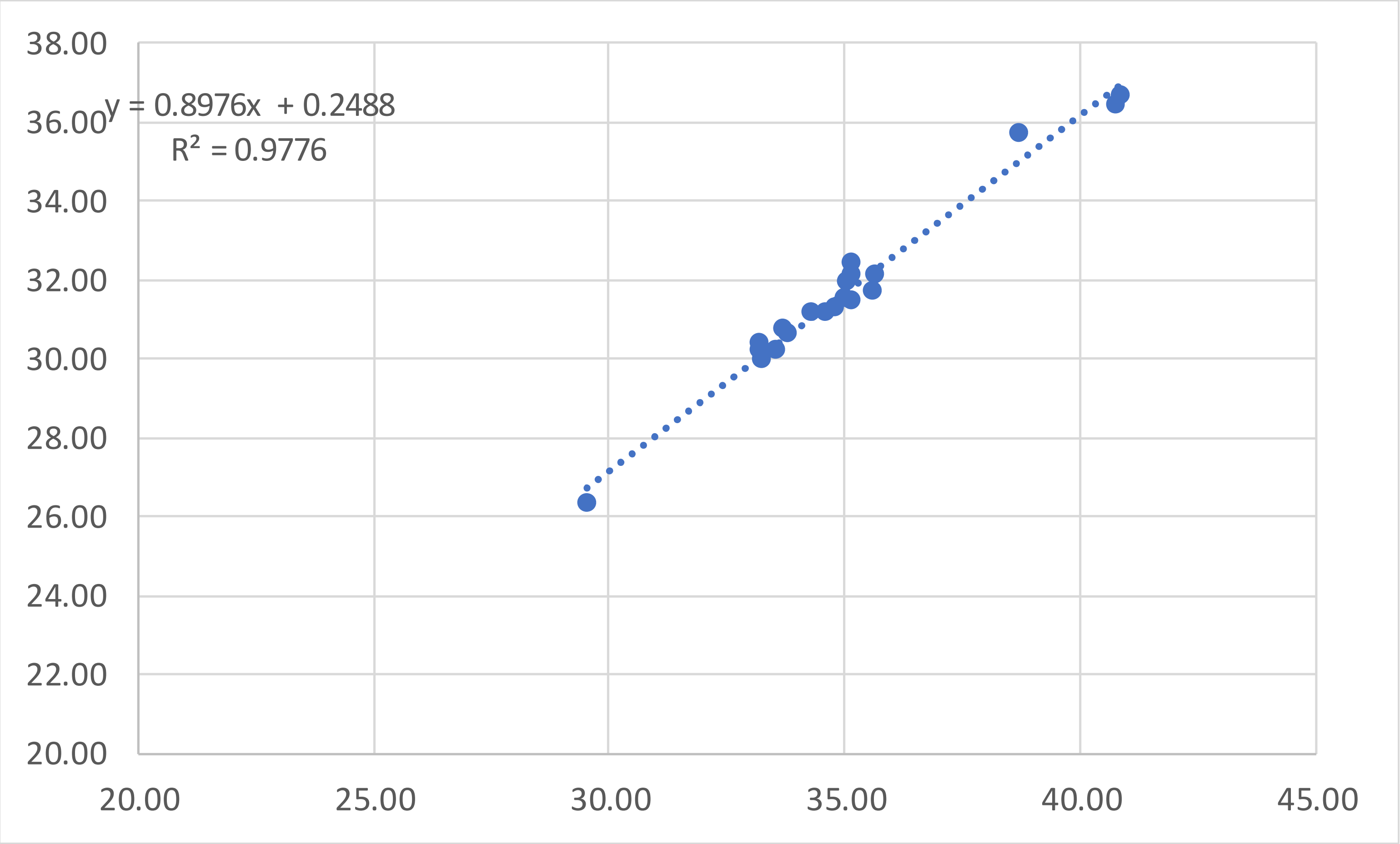
- X-axis:
  - AFIS
  - UQL (W)
  - mm

- Y-axis:
  - HVI – HVICCS calibration
  - UHML
  - mm



Correlations to UHML / related

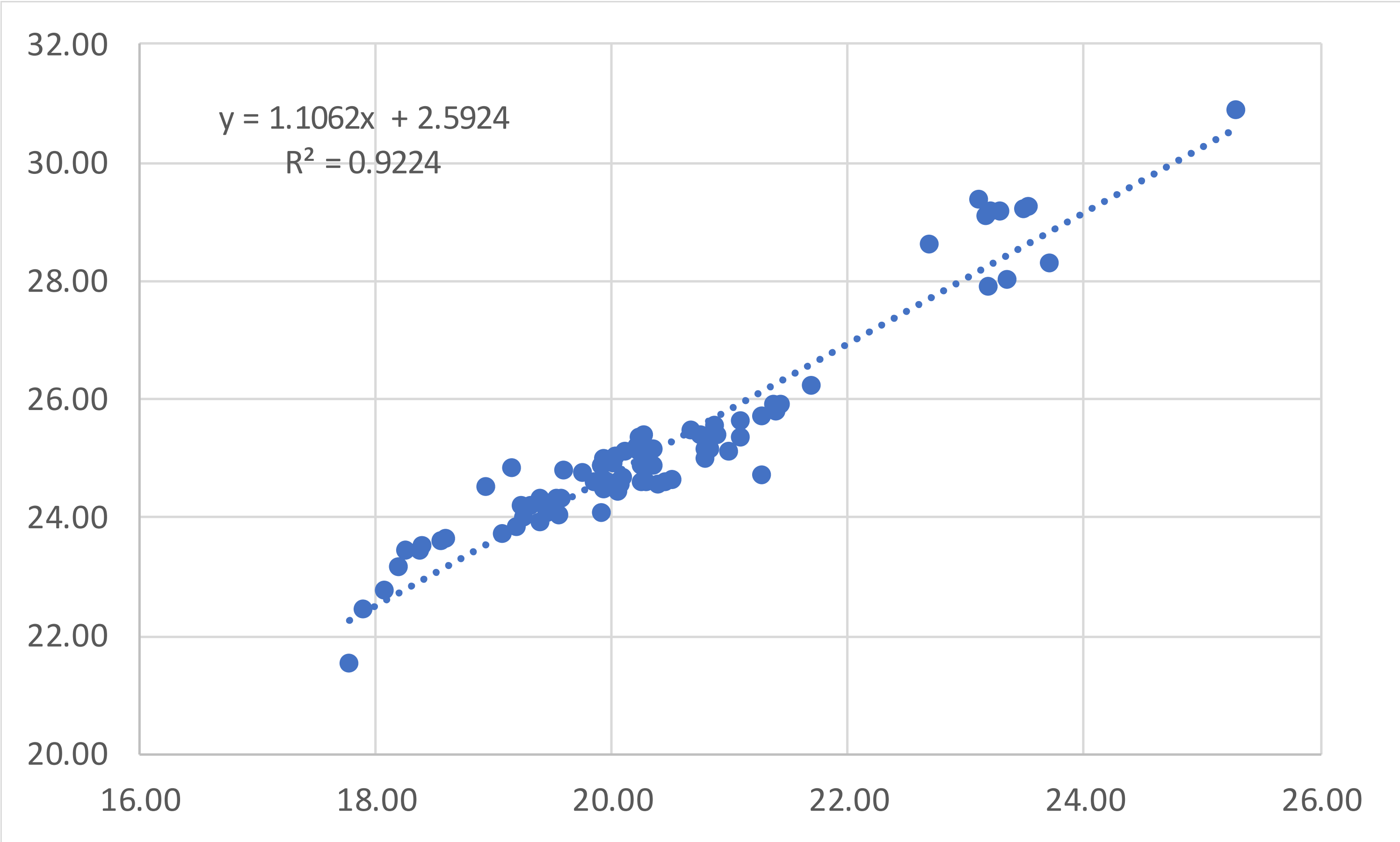
- X-axis:
  - AFIS
  - 5% Length by number
  - mm
- Y-axis:
  - aQura
  - 5% Length by number
  - mm



Correlations Mean Length

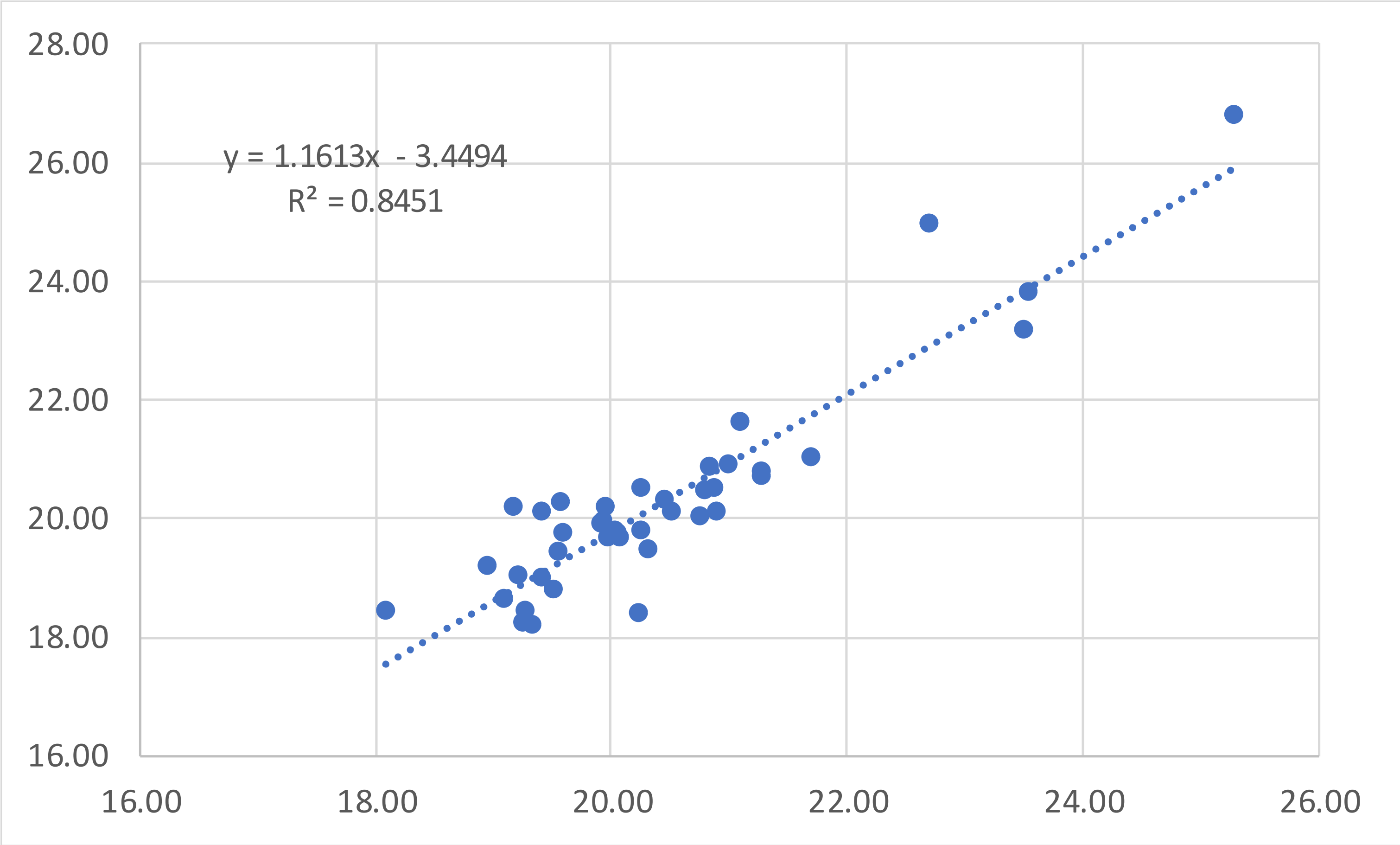
- X-axis:
  - AFIS
  - ML (N)
  - mm

- Y-axis:
  - AFIS
  - ML (W)



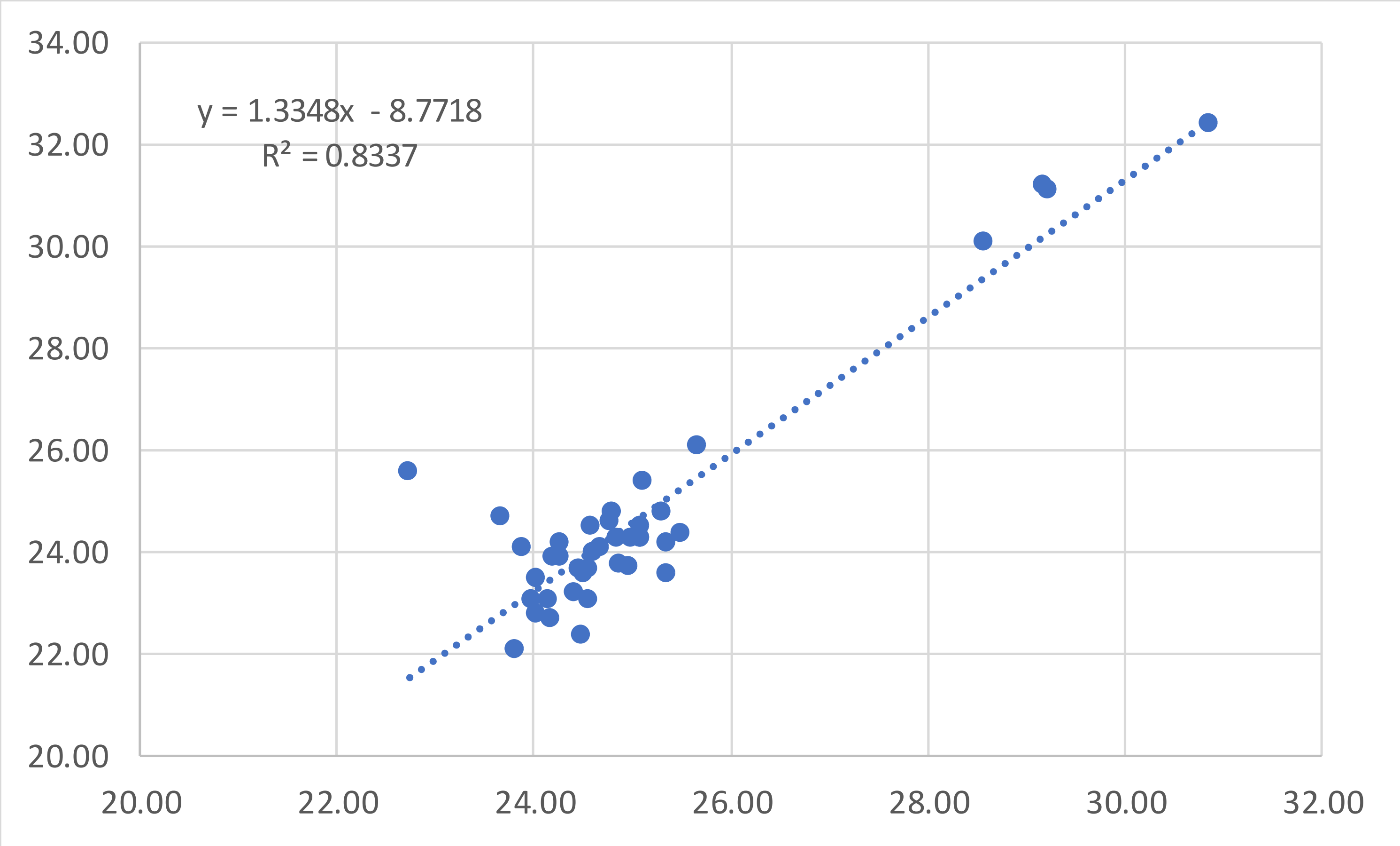
Correlations Mean Length

- X-axis:
  - AFIS
  - ML by number
  - mm
- Y-axis:
  - Almeter
  - ML by number
  - mm
  - (5 to 15 participants)



Correlations Mean Length

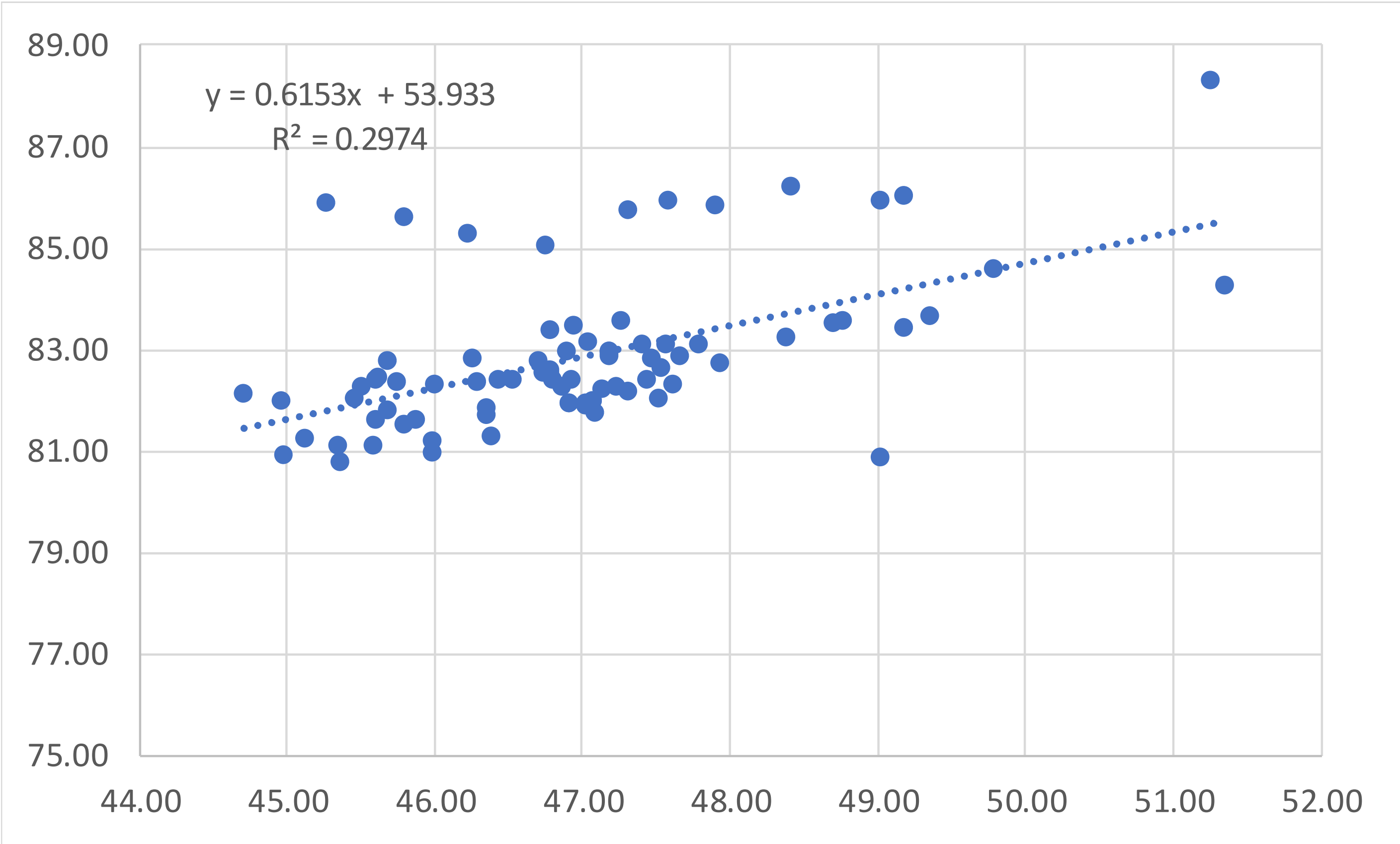
- X-axis:
  - AFIS
  - ML (W)
  - mm
- Y-axis:
  - Comb Sorter
  - (Reference method)
  - ML (W)
  - mm
  - (1 to 6 participants)



Correlations Uniformity

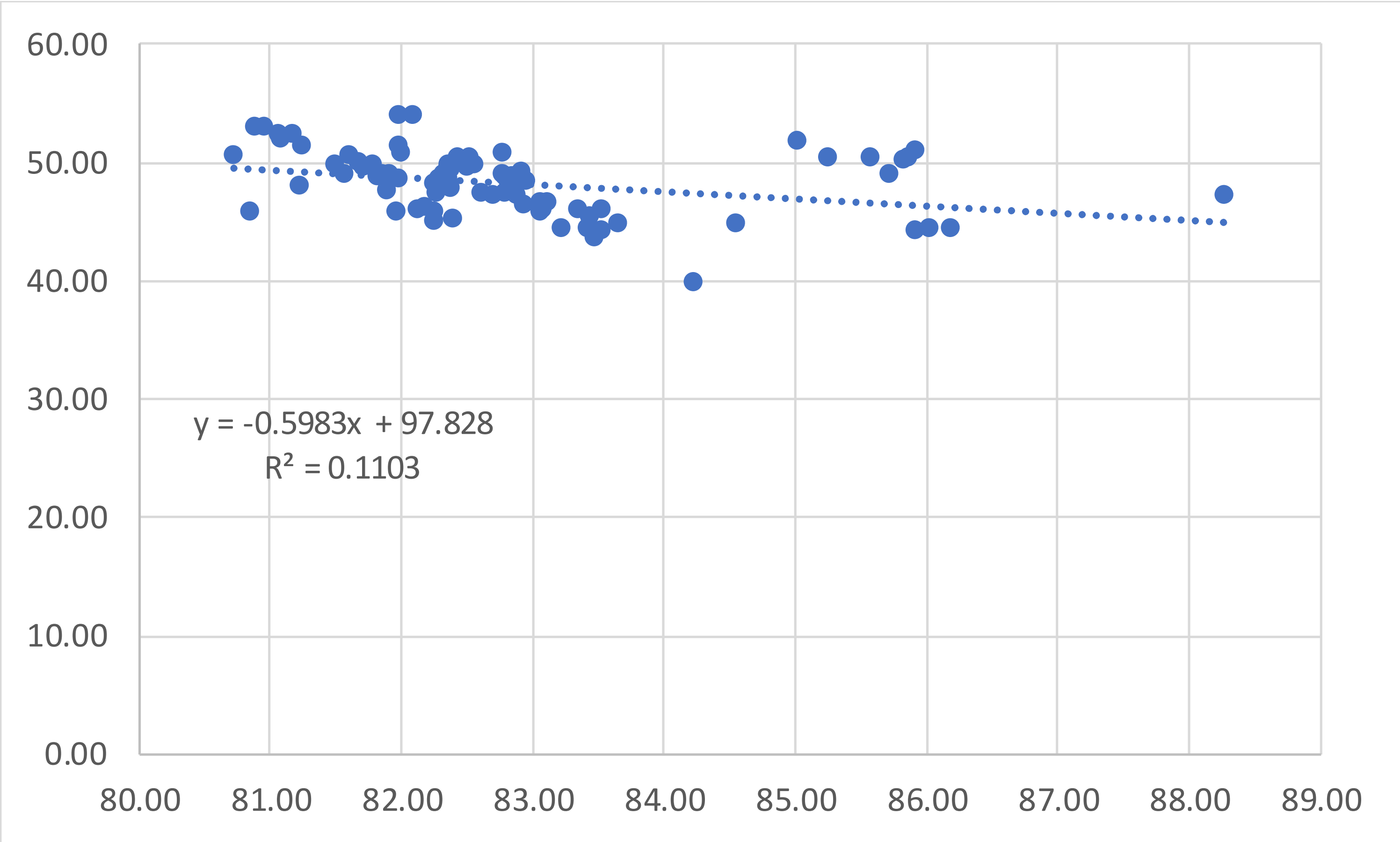
- X-axis:
  - HVI – ICCS calibration
  - UR

- Y-axis:
  - HVI – HVICCS calibration
  - UI



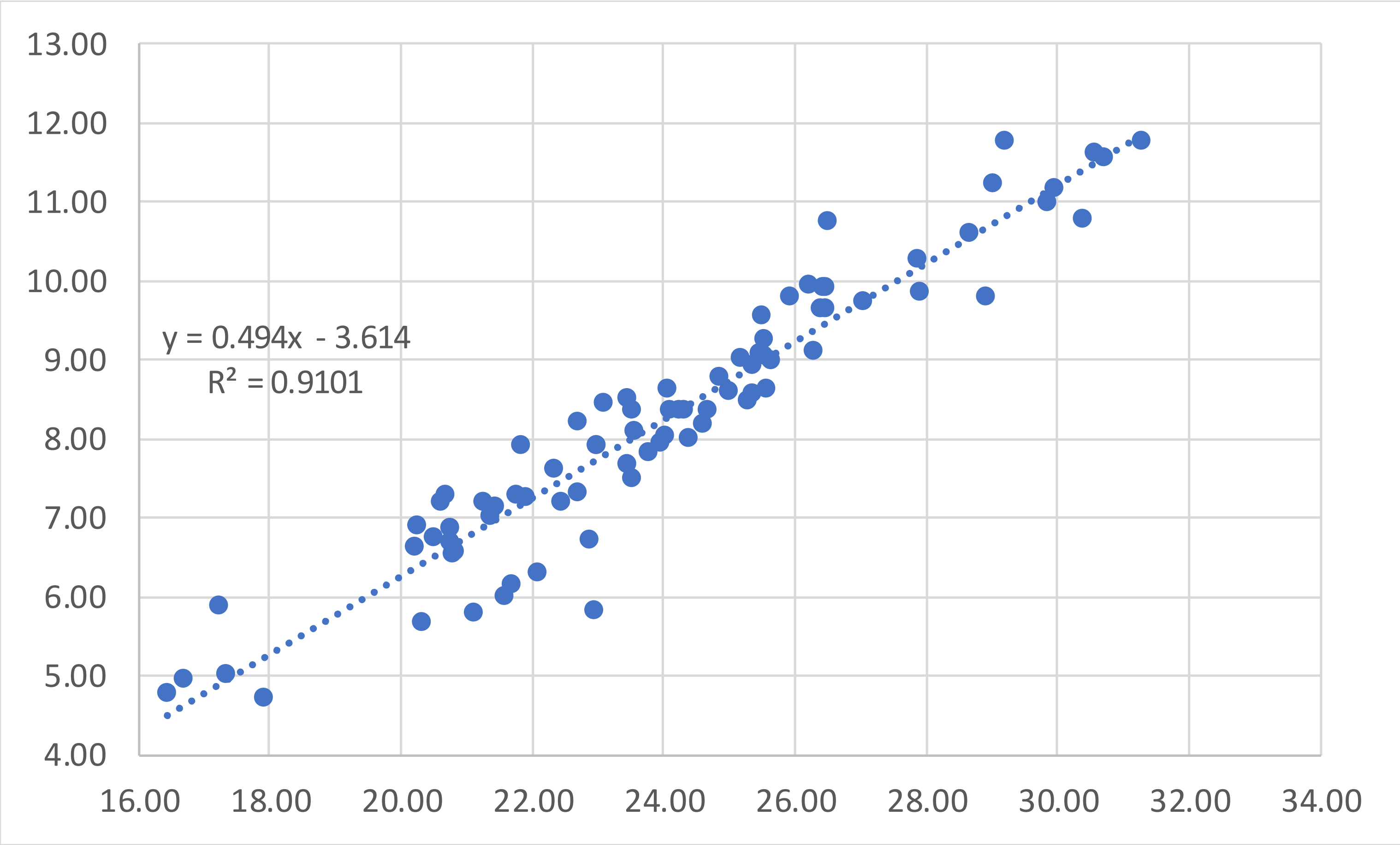
Correlations Uniformity

- X-axis:
  - HVI – HVICCS calibration
  - UI
- Y-axis:
  - AFIS
  - CV% by number



Correlations between Short Fibre Contents

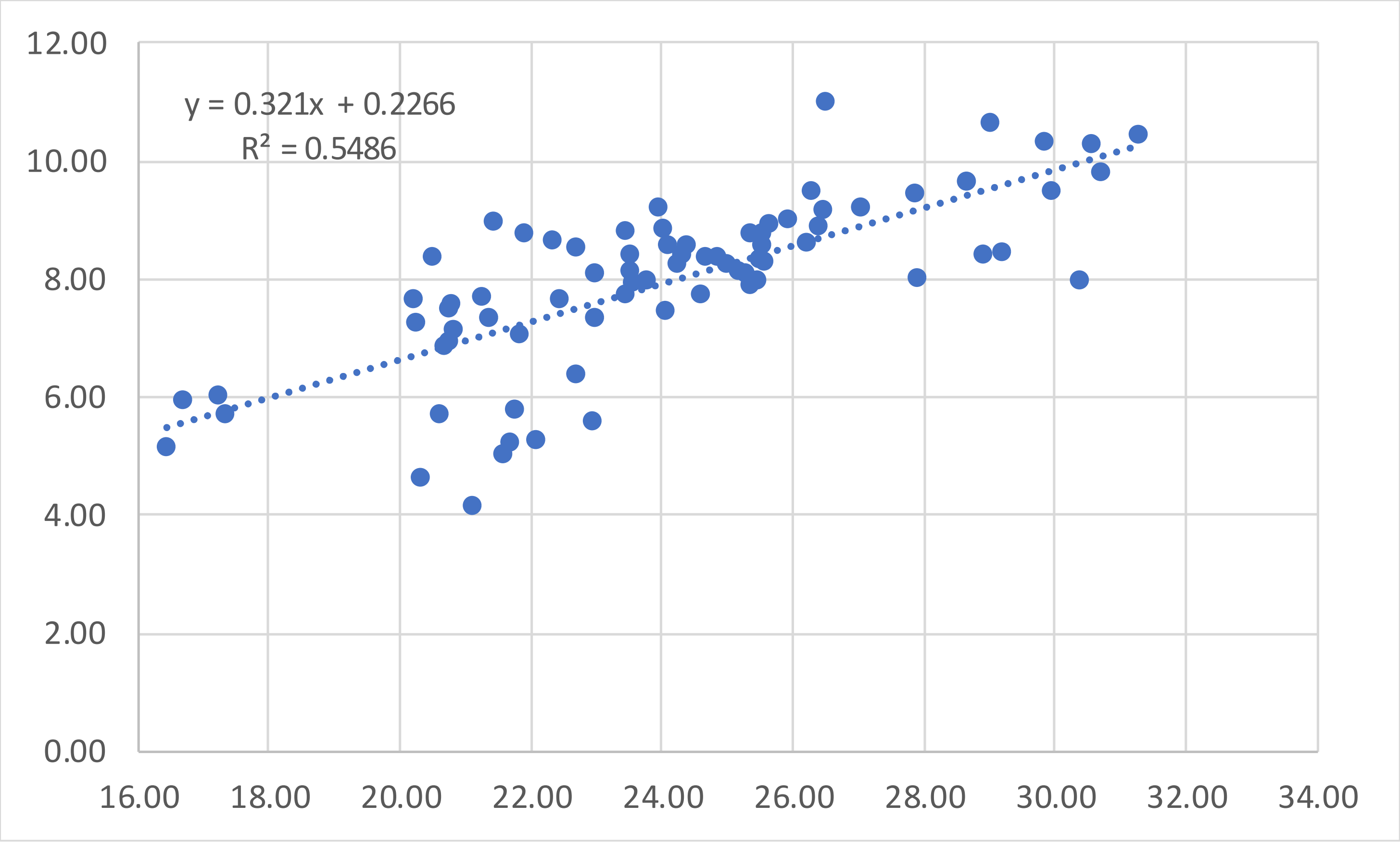
- X-axis:
  - AFIS
  - SFC (N)
  - %
- Y-axis:
  - AFIS
  - SFC (W)
  - %



Correlations between Short Fibre Contents

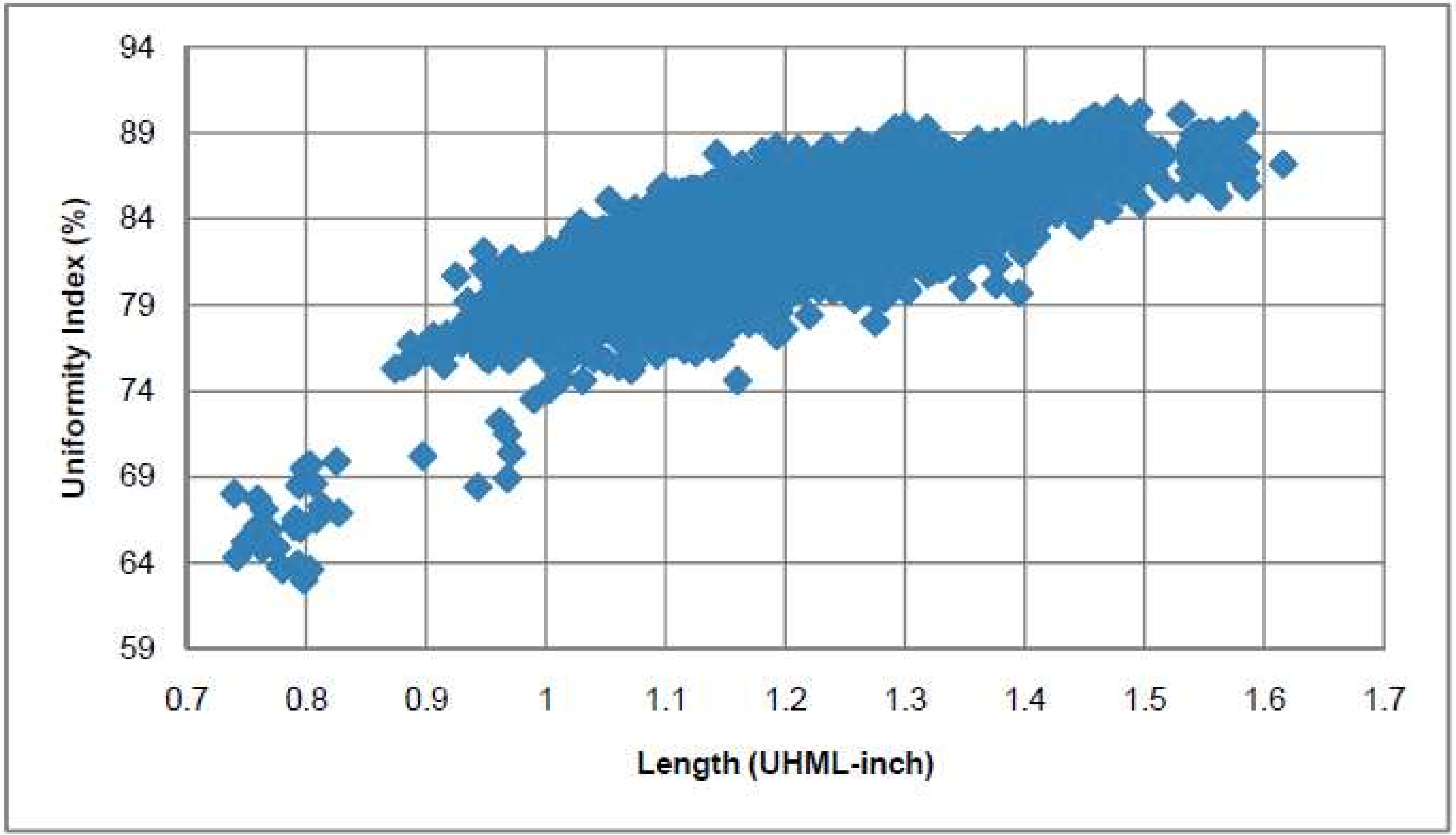
- X-axis:
  - AFIS
  - SFC (N)
  - %

- Y-axis:
  - HVI
  - HVICCS Calibration
  - SFI



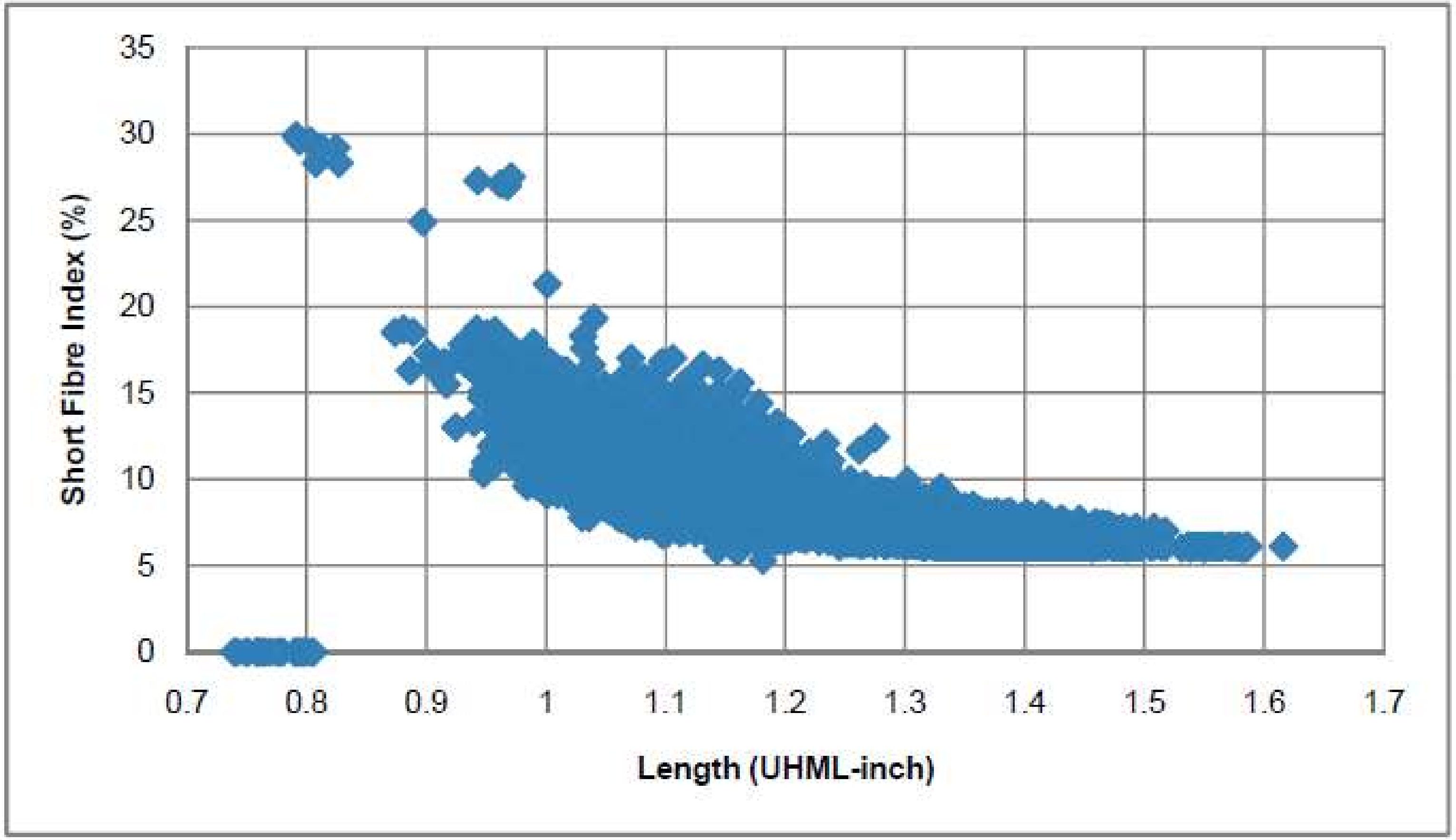
Correlations UHML to UI

- No suitable analysis for RTs, as only limited number of samples (80 from approx 20 origins)
- Instead: Data from > 16 000 samples



Correlations UHML to UI

- No suitable analysis for RTs, as only limited number of samples (80)
- Instead: Data from > 16 000 samples



Summary / Outlook

- Best available data for correlations, based on a high number of instruments
- With the very good correlation, formula (with or without offset) can be used for translating from one parameter to a comparable parameter on another instrument

- Continuation of the length data analyses
  - Including more intense statistical analysis (?)
  - Analysis of influences on the correlation (?)
  - Analysis of changes in correlation over time (?)
  - Publication
- Analysis for additional properties
  - Strength/Tenacity
  - Which other properties should be considered
- Analyses by others?
  - All reports are available

Introduction of the 2022 ITMF-ICCTM Task Force Session

Jean-Paul GOURLOT

cirad

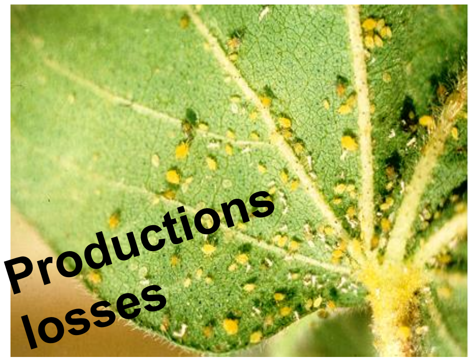
UNIVERSITÄT BREMEN FASERINSTITUT FIBRE BREMEN

ICA Bremen
The Global Centre for Cotton Testing and Research

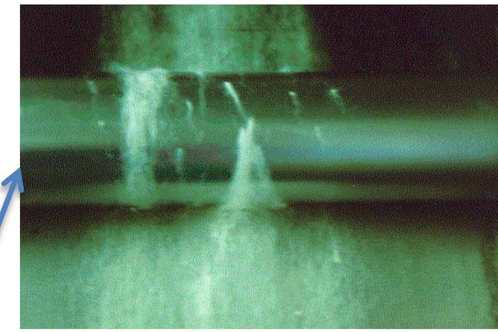
Stickiness in spinning mill due to entomological sugars

These sugars or honeydew are mainly produced by *Aphis* and *Bemisia, …* but new insects are coming (mealybug, …, due to resistance, GMO…)

Aphis gossipii



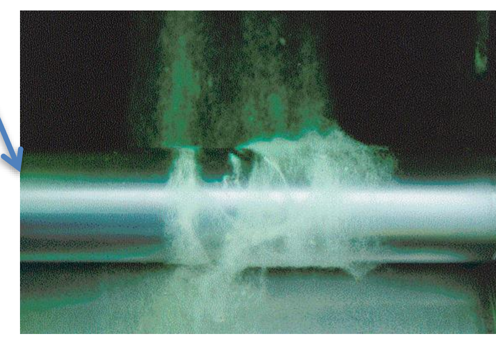
Honeydew on open boll



Problems **Productivity, quality** ↘

Bemisia tabaci

Honeydew in fibers



=> Need for reliable characterization (method, <u>reference material</u>, predictive of problems in spinning…)

Mandates

Reminder

Two of the mandates of the ICCTM are:

[…/…] **“**to harmonize cotton testing results by means of:

- a. proposition and support for the international standardization of test methods
- b. development of guidelines for testing
- **c. technical evaluations using world-wide round tests.**

and to discuss the problems related to testing of cotton fiber properties and their relations to cotton processing**.”** […/…]

Objectives of ICCTM: past and current results

Reminder

- To check the ability of each measuring technique to reproduce itself within a same single laboratory
- To check the ability of each measuring technique to reproduce itself between several laboratories
- To give some indications about the ability of various measuring techniques to correlate to each others

One RT conducted in 2013-2014

=>report 2014 and 2016 (instruments vs micro-spinning)

➔need harmonization

➔need creation of reference materials

➔proposed project … limited to a periodical round-test running since 2017…

Eleven RTs conducted since 2017

Just a point about participation in RTStick

	Nb of LabIDs										
Methods	**2017-1**	**2017-2**	**2018-1**	**2018-2**	**2019-1**	**2019-2**	**2020-1**	**2020-2**	**2021-1**	**2021-2**	**2022-1**
Benedict	1	-	-	-	-	-	-	-	-	-	-
Caramelization	4	4	5	4	5	4	3	3	4	3	2
Clinitest	1	1	1	1	1	1	-	-	-	-	-
Contest-S	**4**	**5**	***6***	***10***	***7***	***6***	***7***	***7***	***8***	***8***	***8***
GB/T13785-1992	1	1	1	1	-	-	-	-	-	-	-
H2SD	**5**	**5**	***9***	***8***	***9***	***7***	***7***	***8***	***8***	***8***	***8***
HSI-NIR	-	1	1	1	1	1	1	1	-	-	-
KOTITI	1	1	1	1	1	1	1	1	1	1	1
Minicard	4	4	3	3	3	3	1	1	1	1	1
MinicardC	-	-	-	-	-	-	-	-	-	1	1
Qualitative meth.	-	-	1	1	1	1	1	1	-	1	1
Quantitative meth.	1	1	2	1	1	1	2	1	1	2	-
Reactive spray/heat	1	1	-	1	1	1	-	-	-	-	-
SCT	**13**	**11**	***16***	***15***	***14***	***15***	***11***	***10***	***10***	***10***	***10***
TDM-A	-	-	1	1	-	-	-	-	-	-	-
Variab. SITC	-	-	-	-	5	20	20	20	20	20	20
nb Method/RT(*)	**11**	**11**	**12**	**13**	**11**	**11**	**9**	**9**	**7**	**9**	**8**
Nb LabID (*) in Official reports	**34**	**33**	**36**	**33**	**31**	**29**	**22**	**21**	**32**	**35**	**32**

All reports on:
https://www.itmf.org/committees/international-committee-on-cotton-testing-methods
Button: ICCTM Round Trials Stickiness

(*) Official participations included in Official reports

Summarizing Lab & Method performances in simple indicators Step to come in RTStick*?

Jean-Paul GOURLOT
Michel GINER
Serge LASSUS

*ITMF-ICCTM Round-test on stickiness measuring methods

cirad

UNIVERSITÄT BREMEN FASERINSTITUT FIBRE BREMEN

ICA Bremen The Global Centre for Cotton Testing and Research

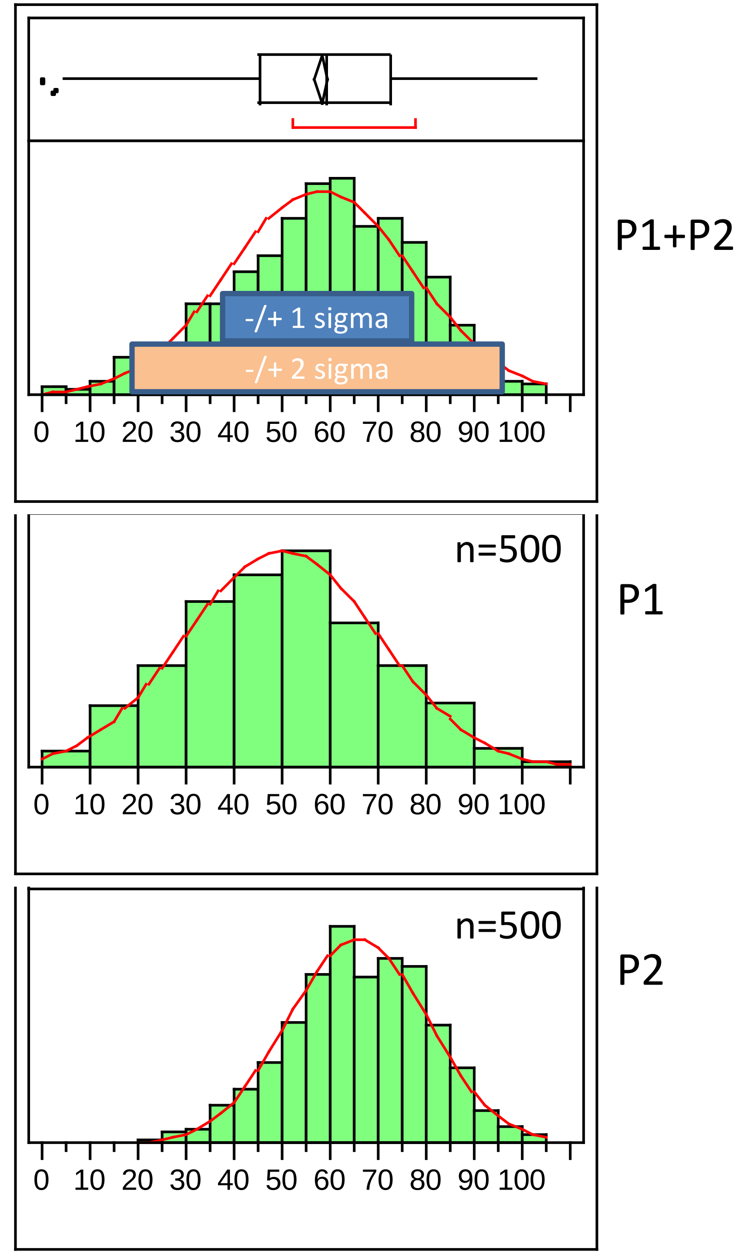
About distributions

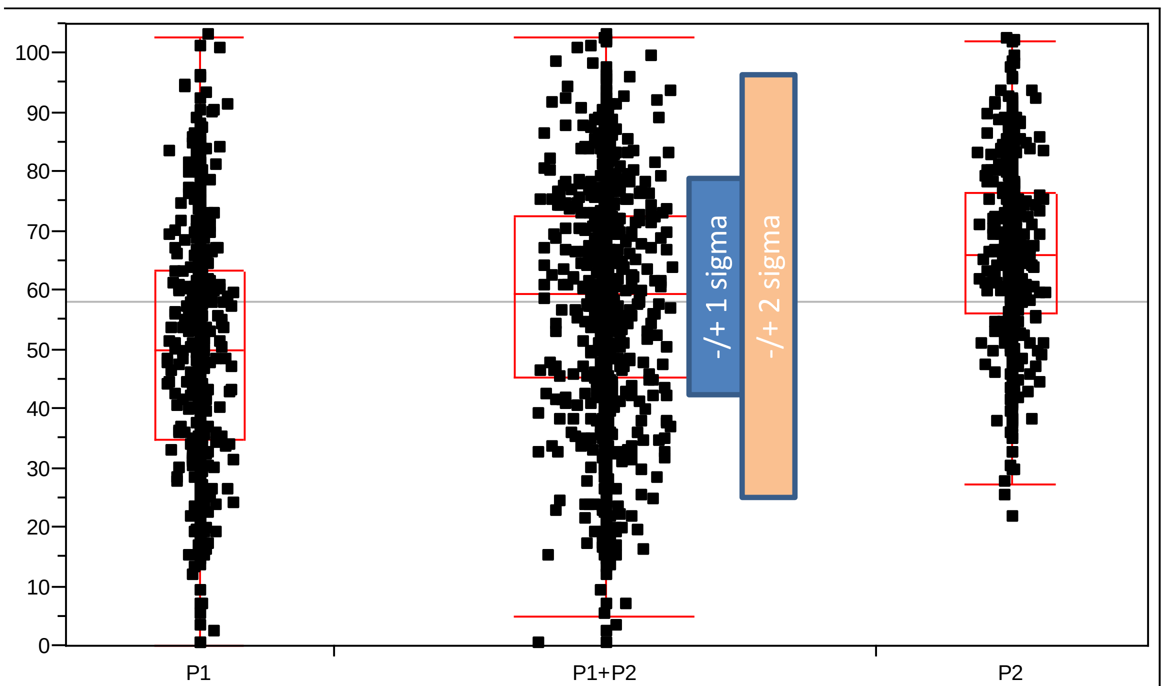
Population	Mean	Sigma
P1	50	20
P2	65	15
P1+P2	58	19

- Assume two (Normal) distributions and their sum
- Example
  - P1 and P2: results from two labs or two methods
  - P1+P2: results seen as from a RT organizer
- Organizers want to support labs to improve their performance
- What about Z-Scores?

About distributions

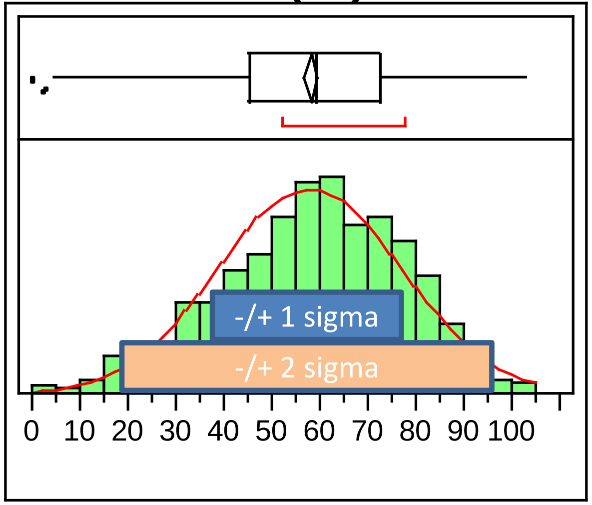
Population	Mean	Sigma
P1	50	20
P2	65	15
P1+P2	58	19



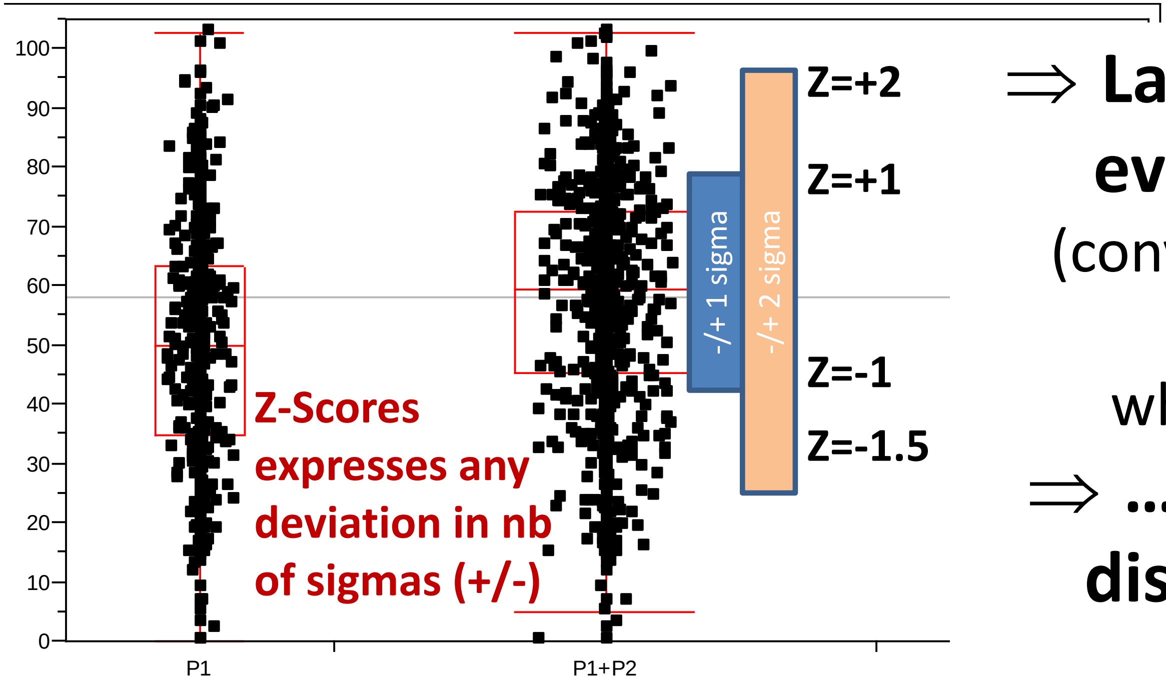


About distributions and Z-Scores (Z)

Population	Mean	Sigma
P1	50	20
P2	65	15
P1+P2	58	19



P1+P2



⇒ **Lab performance can be evaluated using Z-Scores**

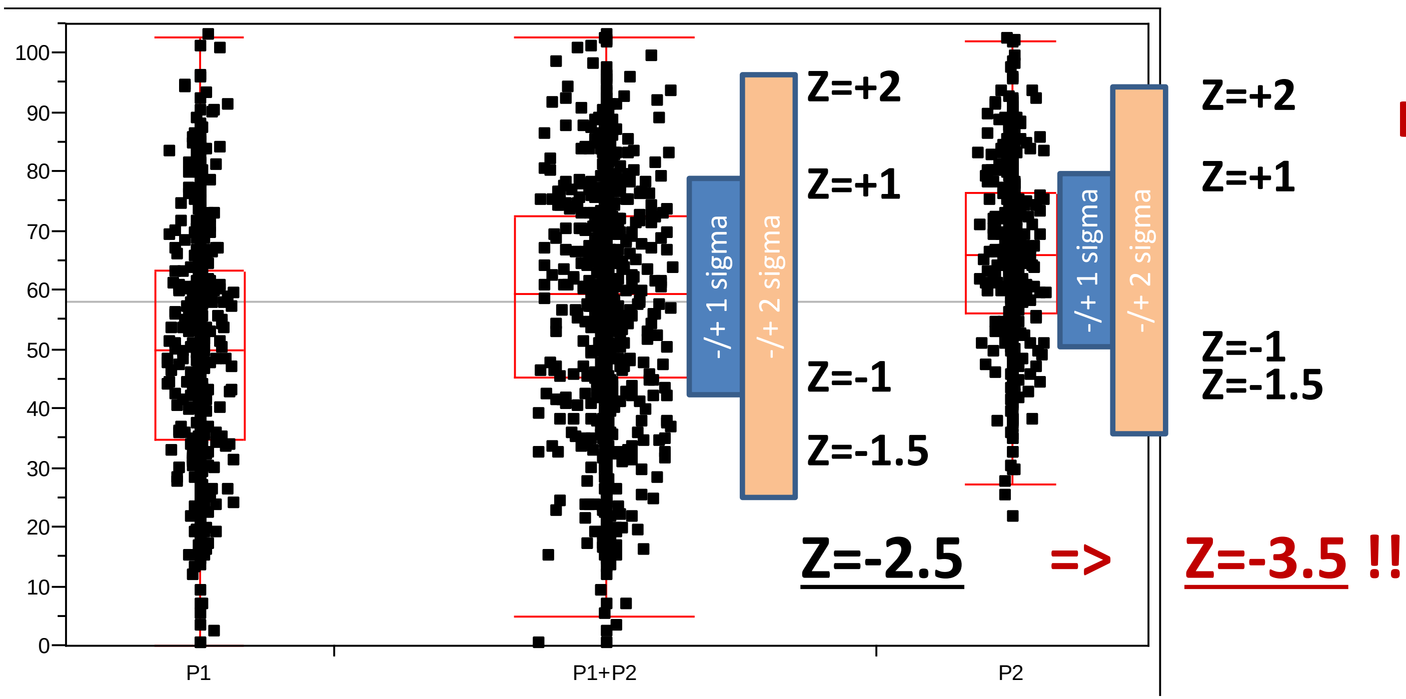
(converting a measurement data into a normalized value, whatever the Method used)

⇒ **… based on a (Normal) distribution of reference!**

Z-Score=(data-mean)/sd **|Z|>2 or 3: alert!**

About distributions and Z-Scores (Z)

Population	Mean	Sigma
P1	50	20
P2	65	15
P1+P2	58	19

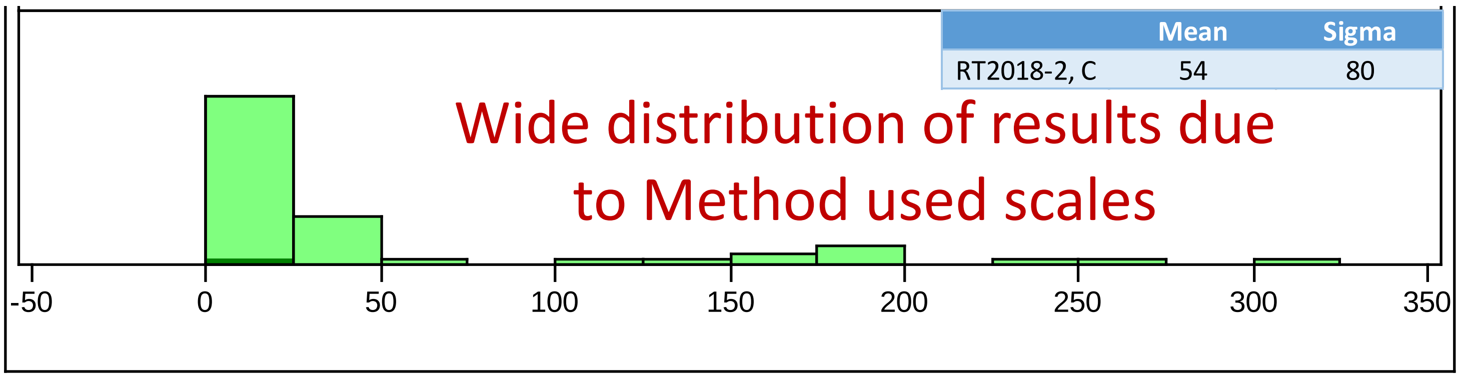


Choosing the distribution of reference is of real importance to evaluate laboratory performances

Z-Scores (Z) for RT data

- RT 2018-2
- Cotton C, 46 mean results from 14 Methods

Raw results:



	Mean	Sigma
RT2018-2, C	54	80

⇒ Z-Scores non-pertinent in this case (Method scales!)

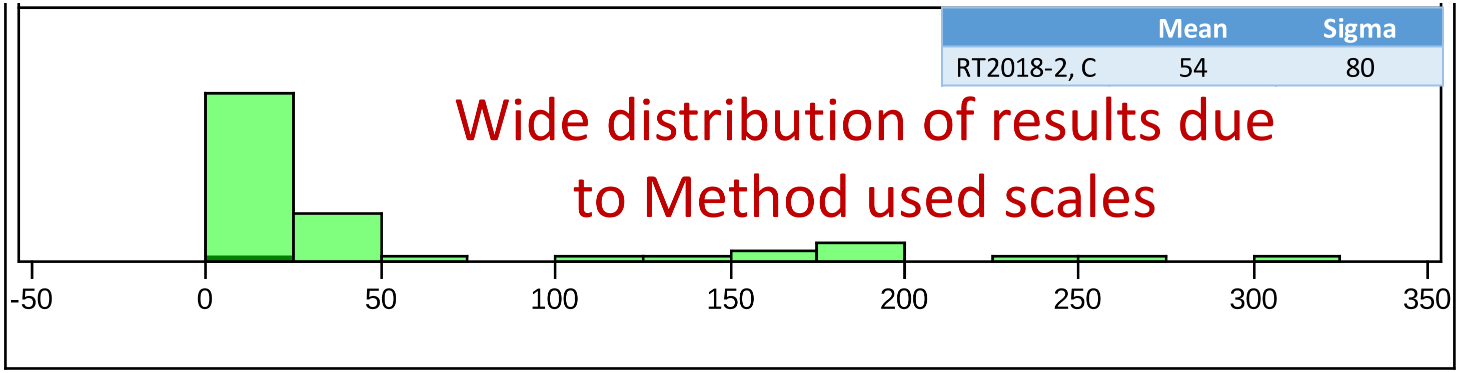
⇒ In addition to choosing a distribution of reference, it is important to use a proper scale

⇒ Solution(s)?

Z-Scores (Z) for RT data

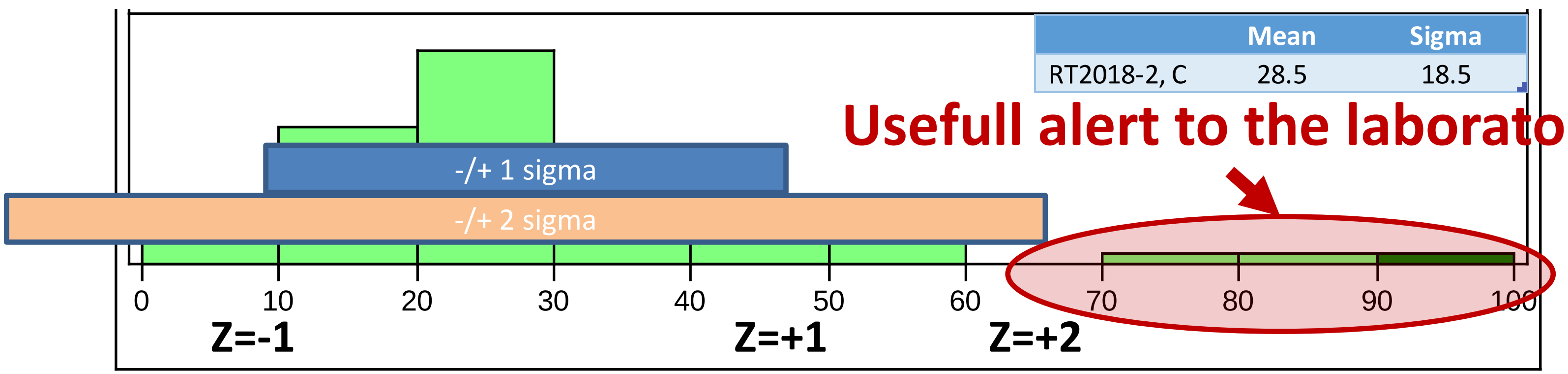
- RT 2018-2
- Cotton C, 46 mean results from 14 Methods

Raw results:



	Mean	Sigma
RT2018-2, C	54	80

Corresponding 'CommonScale'* results:



	Mean	Sigma
RT2018-2, C	28.5	18.5

$$*CommonScale = \frac{LabID\ reading * 100}{MaxEver\ for\ this\ method}$$

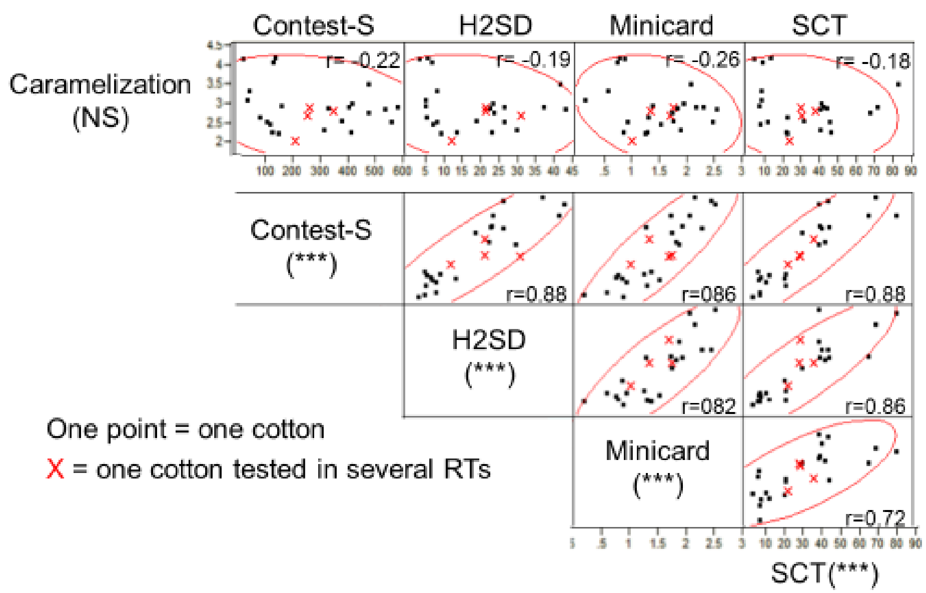
Application of Z-Scores to RT 2022-1 data

Reminder

- Choice of distribution primarly based on the correlation to incidences of stickiness during spinning

Observations on variations in round-tests

8. Correlations between methods



Good correlations between thermo-mechanical methods, Minicard.
Good correlation to SIP.

→ Methods kept for further harmonization
- Contest-S
- H2SD
- SCT
- Minicard

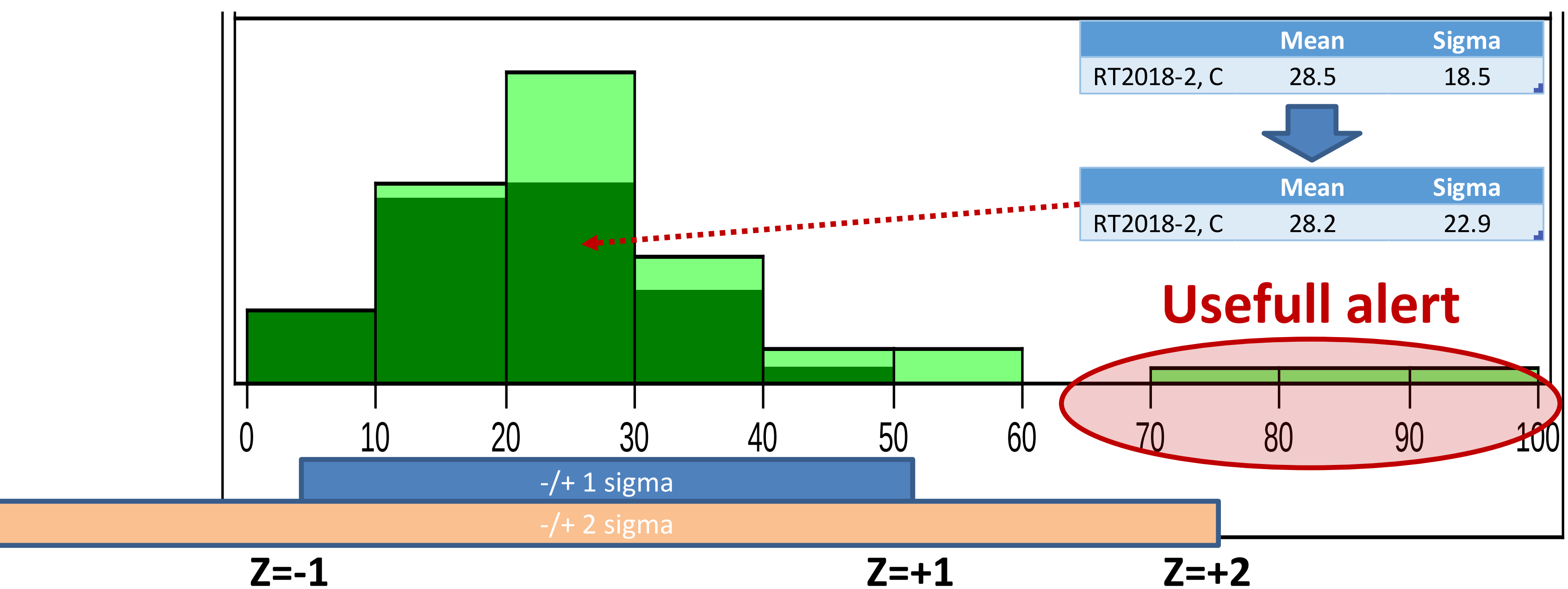
37

Z-Scores (Z) for RT data

- RT 2018-2, CommonScale results
- Cotton C, 46 mean results from 14 Methods
- **Finally, in 2021, choice of thermo-mechanical Methods to start harmonization process**
- **Z-Scores to be included in RT reports?**

Reminder

Corresponding 'CommonScale' results:



Z-Scores (Z) for RT data

- [RT 2018-1 : 2022-1], **Alert if |Z|>2**

Method	Alert	No alert	Nb available results*	Percent of Labs to be alerted
Caramelization	55	110	165	33
Clinitest	9	11	20	45
Contest-S	15	315	330	5
GB/T13785-1992	7	3	10	70
H2SD	16	344	360	4
HSI-NIR	5	20	25	20
KOTITI	41	4	45	91
Minicard	34	46	80	43
MinicardC	22	18	40	55
Qualitative method	11	24	35	31
Quantitative method	20	35	55	36
Reactive Spray	4	11	15	27
SCT	25	505	530	5
TDM-A	7	3	10	70
Overall	271	1449	1720	16

* Nb RTs x Nb LabID x Nb cottons, CommonScale results

Z-Scores (Z) for RT data

- RT 2022-1, **Alert if |Z|>2**

Method	Alert	No alert	Nb available results*	Percent of Labs to be alerted
Caramelization	0	10	10	0
Contest-S	3	37	40	8
H2SD	2	38	40	5
KOTITI	5		5	100
Minicard	3	2	5	60
MinicardC	4	1	5	80
Quantitative method	1	4	5	20
SCT	2	43	45	4
Overall	20	135	155	13

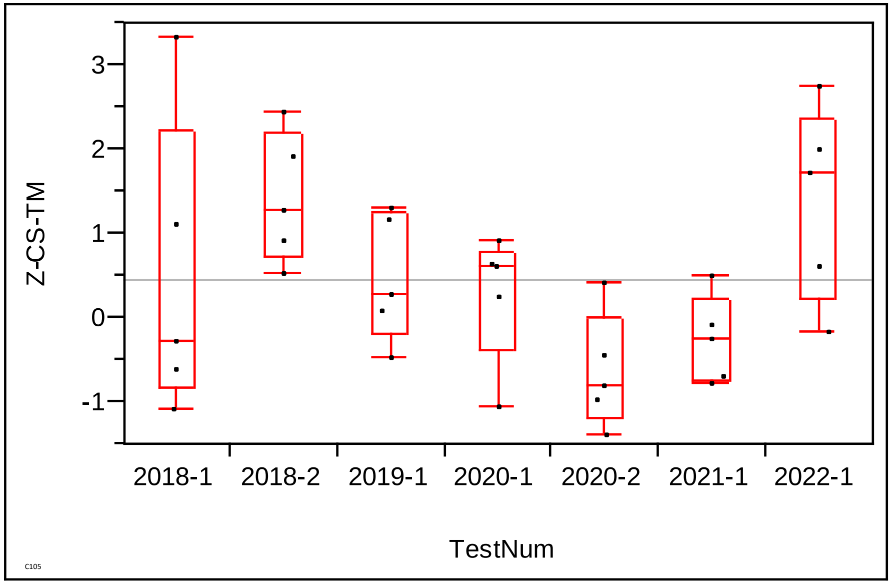
* Nb LabID x Nb cottons, CommonScale results

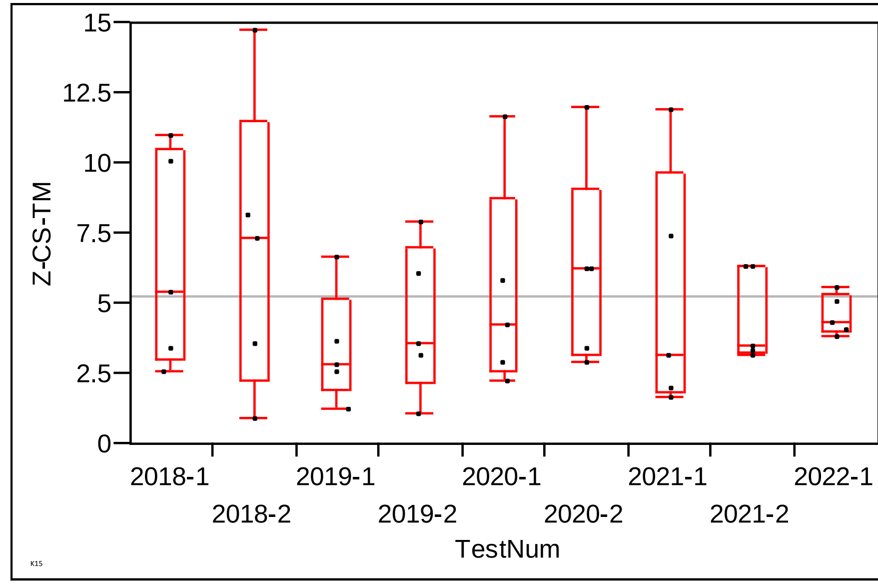
Z-Scores: Example of annex of future RT reports

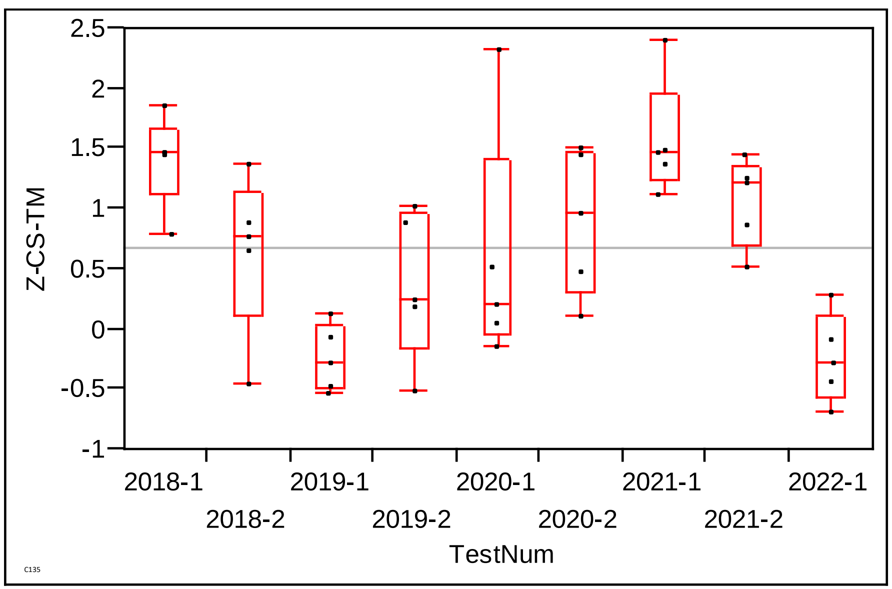
Meth	LabID	A	B	C	D	E
Caramelization	95	-0.92	1.73	0.24	0.52	-0.73
Caramelization	120	0.20	1.89	0.73	0.94	0.15
Contest-S	5	-0.06	**2.50**	0.16	1.83	-0.85
Contest-S	40	-0.07	-0.68	-0.27	-0.43	0.30
Contest-S	50	0.62	-0.15	**2.00**	1.75	**2.77**
Contest-S	60	0.43	-0.50	0.24	-0.17	1.02
Contest-S	70	0.54	-0.81	-1.20	-0.50	1.49
Contest-S	105	0.45	0.00	0.69	0.80	0.54
Contest-S	110	0.07	-0.05	0.88	0.89	0.89
Contest-S	135	0.05	-0.53	0.42	0.29	0.53
H2SD	25	-0.07	-0.34	0.29	-0.21	-0.05
H2SD	65	-0.33	-0.91	0.08	-0.83	-1.05
H2SD	80	**2.08**	1.76	1.81	0.75	0.17
H2SD	85	1.32	1.89	0.22	-0.68	0.68
H2SD	100	0.54	0.88	1.24	1.53	0.03
H2SD	115	0.15	1.03	0.77	1.65	0.23
H2SD	140	0.53	1.45	0.17	0.59	0.23
H2SD	150	**2.02**	-0.11	-0.46	-1.27	-1.17
KOTITI	30	**4.16**	**4.37**	**5.63**	**5.12**	**3.91**
Minicard	75	**3.47**	0.73	**2.57**	**2.09**	1.61
MinicardC	155	**3.11**	1.95	**3.11**	**2.83**	**2.06**
Quantitative method	55	-1.57	0.39	-1.35	-0.86	**-2.57**
SCT	10	-0.91	-0.14	-0.97	-0.37	-1.19
SCT	15	-0.29	0.10	-0.91	0.22	-0.28
SCT	20	**-2.12**	-1.08	**-2.14**	-1.67	-1.18
SCT	35	-0.04	-0.65	-0.87	-0.50	-0.05
SCT	45	-1.28	-0.67	0.17	-0.50	-0.94
SCT	90	-0.38	-1.03	0.46	-0.05	0.89
SCT	125	-1.44	-0.42	-1.20	-1.09	-1.21
SCT	130	-0.11	-0.84	-0.05	-0.92	-0.64
SCT	145	-1.68	-0.69	-1.54	-1.12	-1.16

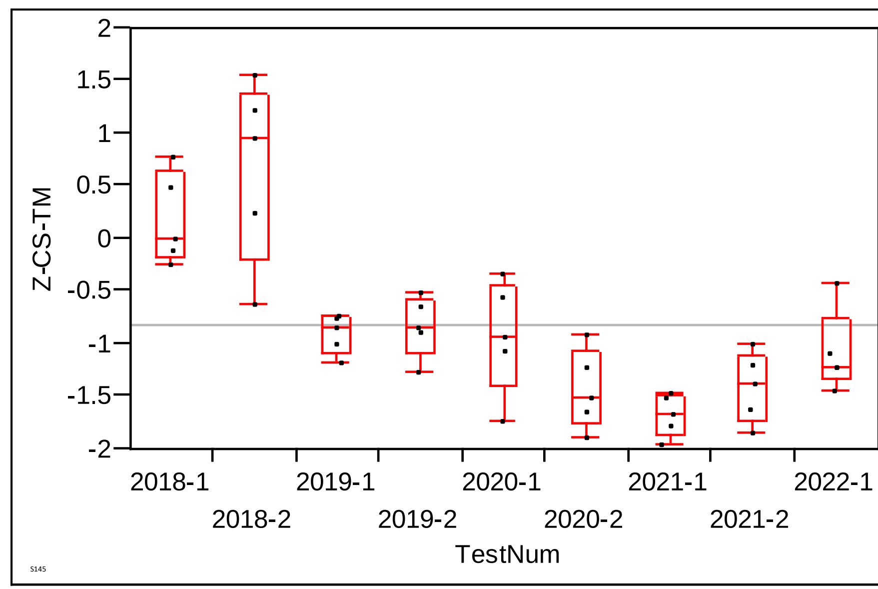
RT2022-1 data, CommonScale results

Evolution of Z-Scores vs RTs / LabName









One point = Z-Score for one cotton

Objectives of this Annex to RTs reports

- Z-Scores = Simple indicators to inform participating laboratories about their performance, RT after RT, Cotton by Cotton
- Remind the existence of reference documents per Method
- **<u>Harmonize</u>** readings and results between instruments within Methods (particularly visual appreciations)
- Alerted Labs should then explore their own data looking after any sort of variation or deviation, with the support of Method manufacturers

Cordeiro F, Emons H, Robouch · Piotr. Is the z score sufficient to assess participants' performance in proficiency testing? The hidden corrective action. *Accredit Qual Assur* 2022; 27: 145–153.

Thanks for your kind attention

Comments? Questions?

Jean-Paul GOURLOT
Michel GINER
Serge LASSUS

Announcements

Cirad

- Produces a small quantity of reference materials for calibrating SCT and H2SD
- Can check SCT instruments using a 30 years old ‘standard’ routine

Email: technologie.coton@cirad.fr
coton@cirad.fr

Thanks for your kind attention

Jean-Paul GOURLOT

cirad

UNIVERSITÄT BREMEN FASERINSTITUT FIBRE BREMEN

ICA Bremen
The Global Centre for Cotton Testing and Research

Agroisolab GmbH

Stable-Isotope-Analysis

The analytical verification of authenticity

agroisolab

Agroisolab.
Our history

2021 More than 150 different databases to check the origin
- Agricultural, chemical products, commodities
- 12 Isotopic mass spectrometer (biggest in EU)
- ICP-MS, DART-TOF Profiling

2008 Winner of the innovation award (region Aache):
„Aktive Markierung von Lebensmitteln und Bedarfsgegenständ

2006 Accredition of the laboratory

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-14370-01-00

2003 Best Practice Award, NRW

2002 Technology Award of the Research Centre Juelich

2002 Collaboration Award of NRW

2002 Founding of Agroisolab GmbH (spin off from the Research Centre Juelich)

REUTERS

UK HELPING ENSURE STOLEN UKRAINIAN GRAIN DOES NOT MAKE IT TO MARKET – MINISTER

6/27/2022

Listen to article 2 minutes

LONDON, June 27 (Reuters) - Britain is providing technology to ensure that any wheat stolen from Ukraine by Russia does not make it to the global market, Britain's environment minister George Eustice said on Monday.

Russia's Feb. 24 invasion of Ukraine and blockade of its Black Sea ports has prevented the country, traditionally one of the world's top food producers, from exporting much of the more than 20 million tonnes of grain stored in its silos.

Last week Turkey said it was investigating claims that Ukrainian grain had been stolen by Russia and shipped to countries including Turkey, but added the probes had not found any stolen shipments so far.

Russia has previously denied allegations that it has stolen Ukrainian grain.

Typical customers:

- Retailer, Traders
- Producers
- Internat. laboratories (e.g. Eurofins)
- Certification bodies (e.g. KAT)
- Associations (e.g. BPEX)
- Authorities / Ministry

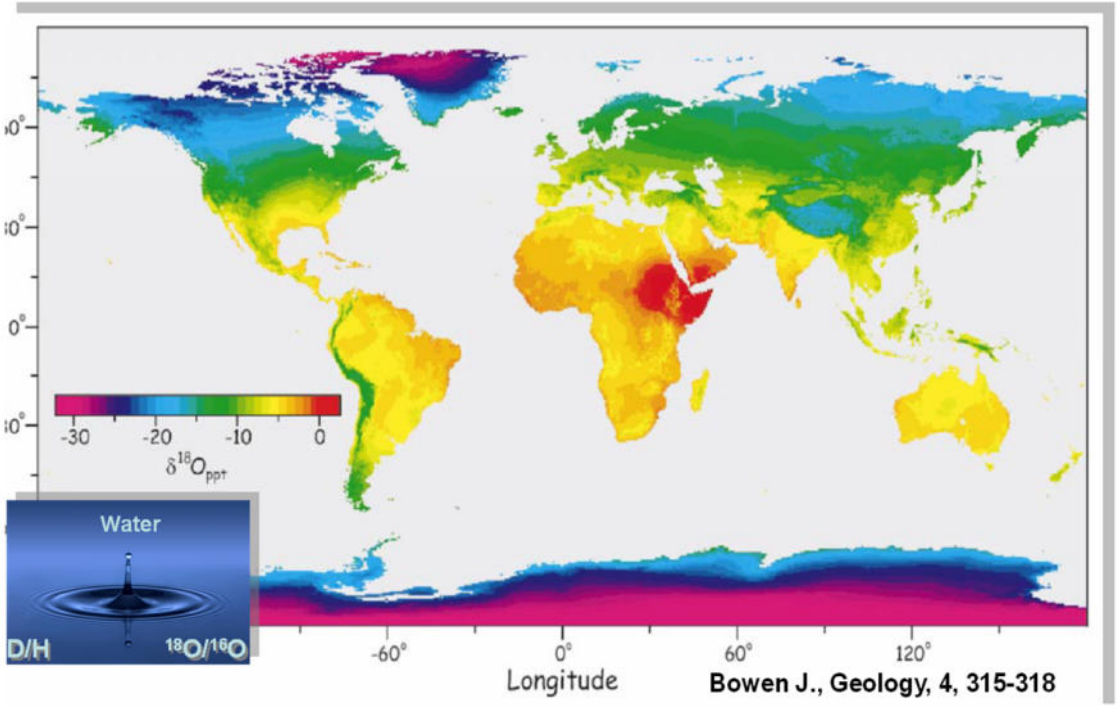
Agroisolab is authorised as an official laboratory for sample testing in the organic market (EU Regulation 2018/848)

olab

Agroisolab.
Our analytic tools.

Stable isotopes in Elements

- **Heavy variants of the elements**
- **Not radioactive**
- Found in all nature, but very little
- Different distribution and pattern
- -> Perfect physical tracking tool



Agroisolab.
Stable isotopic databases in Europe

Official laboratories are using stable **isotopes** to check the origin of food.

Example of isotopic databases:

- **European wine database Commission Regulation No. 822/97**
- **German asparagus database (AIL)**
- **English pork database (BPEX, AIL)**
- **English beef database (FERA)**
- **European egg database (KAT, AIL)**
- **vinegar database (DIN 16466)**
- **Ivory database (BFN, AIL)**
- **SGF (fruit) database**

Trends in Food Science & Technology 61 (2017) 176–187

Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: http://www.journals.elsevier.com/trends-in-food-science-and-technology

Review

Stable isotope techniques for verifying the declared geographical origin of food in legal cases

Federica Camin [a,*], Markus Boner [b], Luana Bontempo [a], Carsten Fauhl-Hassek [c], Simon D. Kelly [d], Janet Riedl [c], Andreas Rossmann [e]

[a] Department of Food Quality and Nutrition, Research and Innovation Centre, Fondazione Edmund Mach (FEM), via E. Mach 1, 38010, San Michele all'Adige, Italy
[b] Agroisolab GmbH, Prof. Rehm Str. 6, D-52428, Jülich, Germany
[c] Department Safety in the Food Chain, BfR – Federal Institute for Risk Assessment, Max-Dohrn-Straße 8-10, D-10589, Berlin, Germany
[d] Food and Environmental Protection Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Vienna International Centre, PO Box 100, 1400, Vienna, Austria
[e] Isolab GmbH, Laboratorium für Stabile Isotope, Woelkestrasse 9/I, 85301, Schweitenkirchen, Germany

ARTICLE INFO

Article history:
Received 30 June 2016
Received in revised form 5 December 2016
Accepted 21 December 2016
Available online 5 January 2017

Keywords:
H, C, N, O, S and Sr
Food authenticity
PDO
PGI
Legal cases
Fraud
Mislabeling

ABSTRACT

Background: Consumers are increasingly interested in the provenance of the foods and European laws require protection against the mislabelling of premium foods. Methods for testing authenticity require robust analytical techniques that can be utilised by the various regulatory authorities. Of the many techniques, the most widely-used method is stable isotope ratio analysis.
Scope and approach: Focus is on the use of stable isotope ratios of H, C, N, O, S and Sr for verifying the geographical origin of food, cross-referencing it with examples of legal cases. State of the art including rules for building an authentic sample reference database (commonly called databank) and for interpreting the results obtained in actual cases is described. The overall objective is to provide stakeholders and competent authorities dealing with fraud, with a best-practice guide for its use.
Key findings and conclusions: Stable isotope ratios can differentiate foods on the basis of their geographical origin and, especially for light elements, can be measured reliably in routine work in different matrices and compared successfully between different laboratories. Examples of legal applications are grape products, orange juices, olive oil, cheese, butter, caviar. Sometimes, the cases are not brought directly to the court, but before further verifications (e.g. paper traceability, forensic accounting) are conducted. The system can satisfy the court when a robust databank of authentic samples exists, the methods used are officially recognized, validated and accredited, and the expert demonstrates that the conclusions are sufficiently robust and reliable to stand up to the required level of proof.
© 2017 Elsevier Ltd. All rights reserved.

EUROPEAN COMMISSION

Brussels, 12.2.2016
C(2016) 755 final

COMMISSION NOTICE

of 12.2.2016

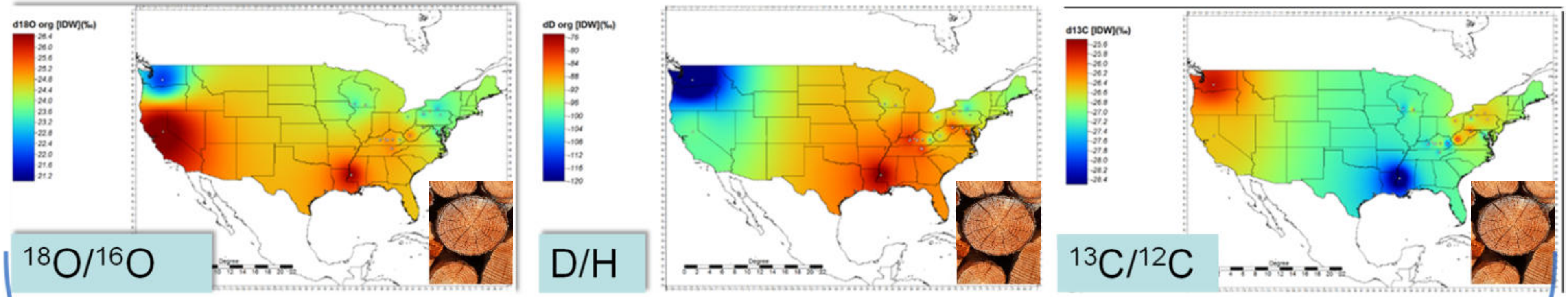
GUIDANCE DOCUMENT

FOR THE EU TIMBER REGULATION

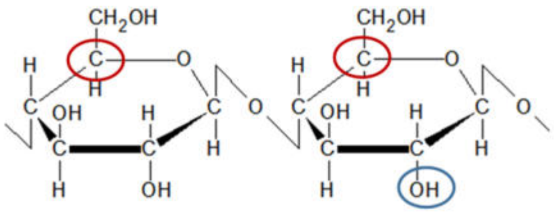
The higher the risk of corruption in a specific case, the more it is necessary to get additional evidence to mitigate the risk of illegal timber entering the EU market. Examples of such additional evidence may include third-party-verified schemes (see section 6 of this guidance document), independent or self-conducted audits, or timber tracking technologies (e.g. with genetic markers or stable isotopes).

Agroisolab.

Main principle; stable isotopes signatures in cellulose



Carbohydrates = hydrated coal,
e.g. **cellulose**



Memory of the water and climate

Main component of cotton

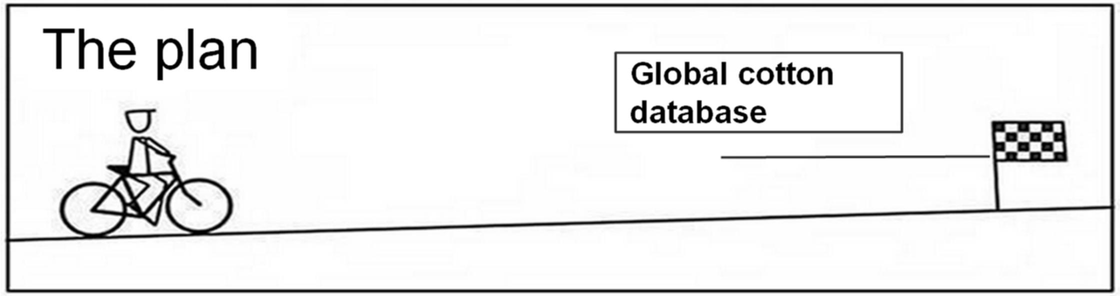
agroisolab

Agroisolab

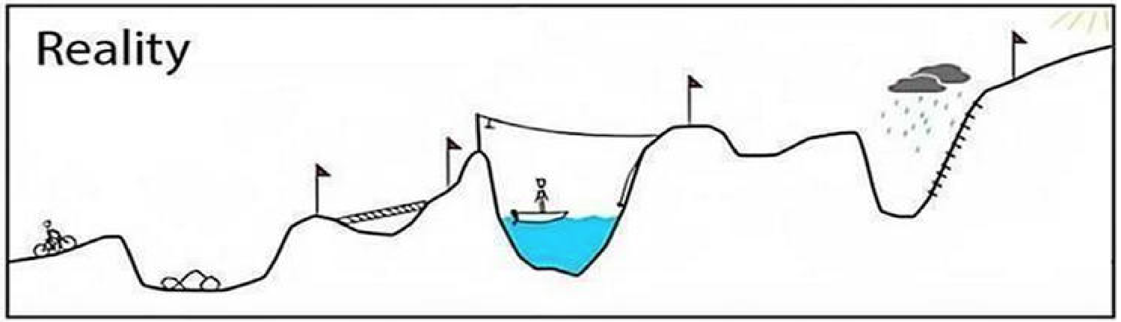
The final aim….the global database (https://worldforestid.org)

Further step:

Creation of an international open database to analyse the origin of **cotton** and **textiles**.



More than 10 years to get:



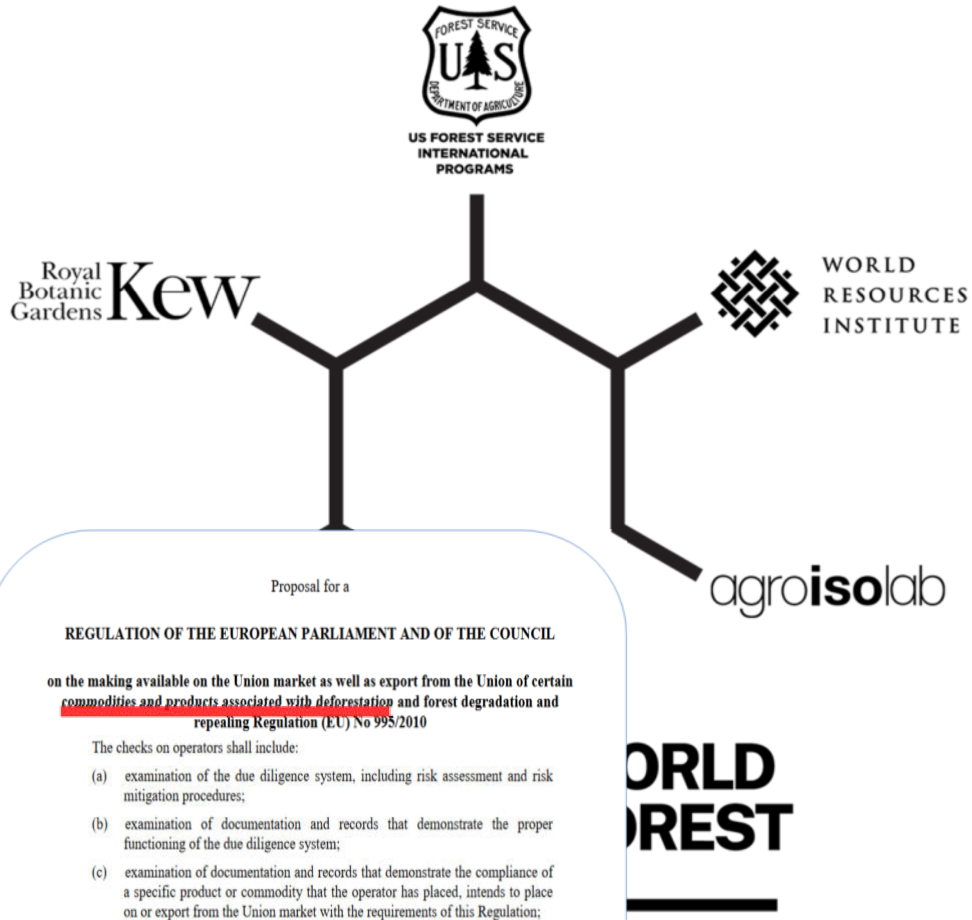
WORLD FOREST ID

Using science to take deforestation off the shopping list

agroisolab

Agroisolab.

WFID consortium: A short overview



The Aim

- Worldwide sampling
- Archive of reference samples
- Development of international analytical databases, e.g. stable isotopes

SAMPLES COLLECTED	SAMPLE TARGET
2163	500,000

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on the making available on the Union market as well as export from the Union of certain *commodities and products associated with deforestation* and forest degradation and repealing Regulation (EU) No 995/2010

The checks on operators shall include:

(a) examination of the due diligence system, including risk assessment and risk mitigation procedures;

(b) examination of documentation and records that demonstrate the proper functioning of the due diligence system;

(c) examination of documentation and records that demonstrate the compliance of a specific product or commodity that the operator has placed, intends to place on or export from the Union market with the requirements of this Regulation;

(d) examination of due diligence statements;

and, where appropriate,

(e) on the ground examination of relevant commodities and products with a view to ascertaining their conformity to the documentation used for exercising due diligence;

(f) any technical and scientific means adequate to determine the exact place where the relevant commodity or product was produced, including isotope testing;

South American sampling

Roundtable on Responsible Soy
- Argentina
- Paraguay

Global Canopy Programme:
- Bolivia

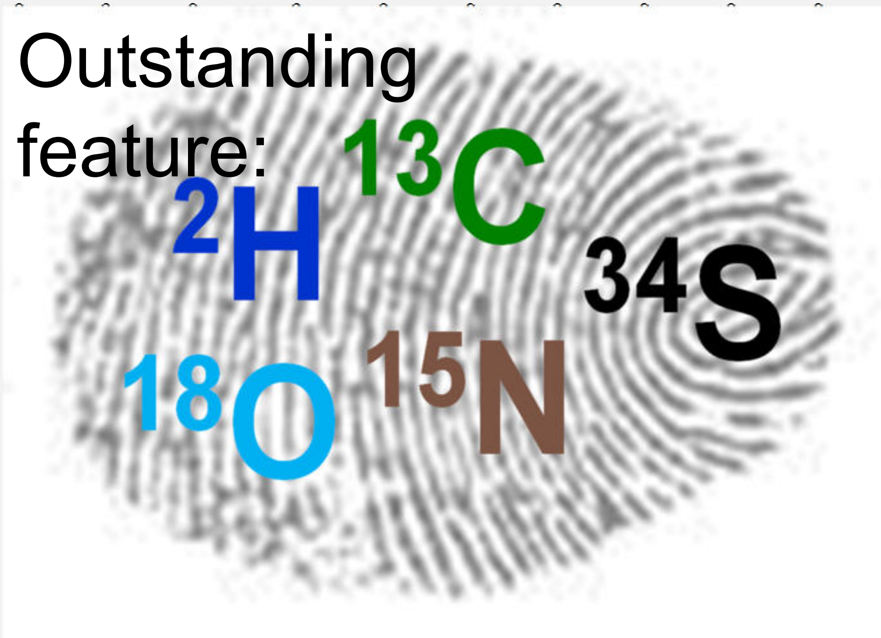
- US Forest Service:
- Brazil

National Wildlife Federation:
- Brazil: Matto Grosso & Pará

Agroisolab.

Current status: (DA) of reference samples of various origins

from \ to	Australia	Brasil	China-Shangdong	China-Xinjang	Egypt	Greece	India	Kasachstan	Kyrgyzstan	Mali	Peru	Sudan	Tansania	Tschad	Turkey	USA	Uganda	Uzbekistan	Total	% correct
Australia	3	0	0	0											0	0	0	0	3	100%
Brasil	0	6	0	0											0	0	0	0	6	100%
China-Shangdo	0	0	4	0											0	0	0	0	4	100%
China-Xinjang	0	0	0	6											0	0	0	0	7	86%
Egypt	0	0	0	0											0	0	0	0	5	100%
Greece	0	0	0	0											0	0	0	0	4	100%
India	0	0	0	0											0	0	0	0	7	86%
Kasachstan	0	0	0	0											0	0	0	0	4	100%
Kyrgyzstan	0	0	0	0											0	0	0	0	5	80%
Mali	0	0	0	0											0	0	0	0	2	100%
Peru	0	0	0	0											0	0	0	0	1	100%
Sudan	0	0	0	0											0	0	0	0	1	100%
Tansania	0	0	0	0											0	0	1	0	6	83%
Tschad	0	0	0	0											0	0	0	0	1	100%
Turkey	1	0	0	0											11	0	0	0	13	85%
USA	0	0	0	0											0	14	0	0	16	88%
Uganda	0	0	0	0											0	0	7	0	9	78%
Uzbekistan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	100%
Total	**4**	**6**	**4**	**6**	**5**	**5**	**8**	**5**	**5**	**2**	**1**	**1**	**7**	**2**	**11**	**14**	**8**	**6**	100	**90,00%**



Let´s expand the database….

agroisolab

Agroisolab.

What kind of databases?

1) **Closed database**: exclusive database for a producer / retailier

- Customers use the database to monitor their own supply chain.

2) restricted database:

- mainly databases from associations / consortiums;
  - ❖ European egg producers (KAT)
  - ❖ BPEX: British pork industry
  - ❖ Finnish Ministry: Strawberry

-> controlled access to the database

3) **Completely open database**

-> all data is available online

New procedure unmasks foreign strawberries posing as Finnish

Strawberry isotopes can now be checked to ascertain their origin and weed out fraud.

Some unscrupulous vendors try to hoodwink consumers into believing that imported berries are Finnish. Image: Petra Huau / Yle

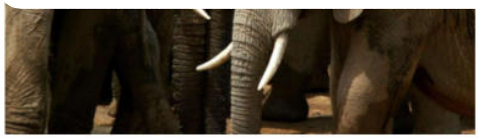
Consumers in Finland tend to be particular about buying domestically grown produce, especially when it comes to iconic summer treats such as strawberries – even though they are often pricier than imports. As a result, some vendors at markets and shops claim that foreign berries are domestic to boost sales and profit margins.

Now, in an effort to stamp out efforts to pass off imported strawberries as domestic, the Natural Resources Institute Finland (Luke) and the Finnish Food Safety Authority have developed a system to check the origin of berries. They have compiled a database on Finnish strawberries that should help to uncover fakes.

Offenbach district: Man from Neu-Isenburg caught with 1.2 tons of ivory

by world today news · November 6, 2020 · No Comments

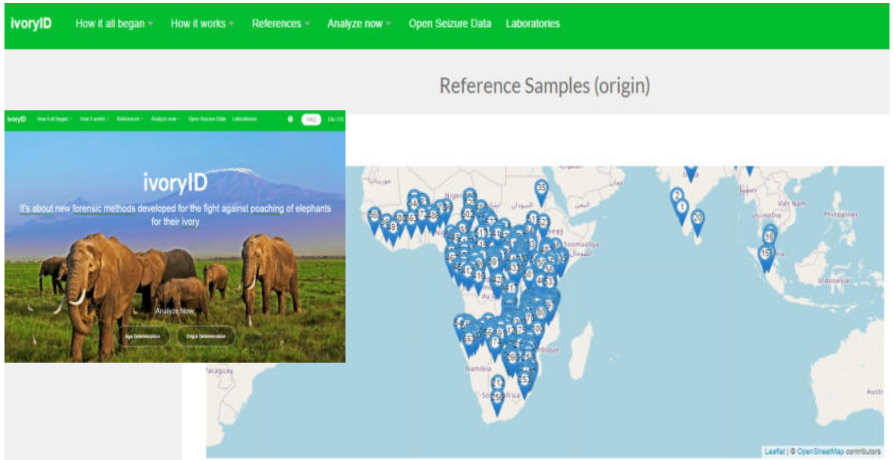
Court case: Nov. 2020
Stable isotope: origin check



Hilf uns, Tiere und ihren Lebensraum zu schützen.

It was the largest ivory find in **Germany** to date. The white gold should bring big money in Vietnam. A man from the Offenbach district is now on trial.

Because of **Ivory smuggling** the trial begins against a man **Neu-**



No.	Inventroy no.	Origin	Isotopes	CITES
1	40538	India, Trichoor Asia	$\delta^{13}C$: -22.0 $\delta^{15}N$: 7.7 $\delta^{18}O$: 15.3 $\delta^{2}H$: -48.2 $\delta^{34}S$: 10.9	Appendix I
2	40549	India, Mangalore Asia	$\delta^{13}C$: -19.8 $\delta^{15}N$: 6.7 $\delta^{18}O$: 15.1 $\delta^{2}H$: -50.9 $\delta^{34}S$: 7.3	Appendix I
3	ZD 1879.11.21.3	India Asia	$\delta^{13}C$: -20.9 $\delta^{15}N$: 11.2 $\delta^{18}O$: 15.5 $\delta^{2}H$: -52.9 $\delta^{34}S$: 10.1	Appendix I
4	ZD 1879.11.21.693	India, Tiperah=Tripura State Asia	$\delta^{13}C$: -23.0 $\delta^{15}N$: 8.3 $\delta^{18}O$: 13.7 $\delta^{2}H$: -66.1 $\delta^{34}S$: 7.5	Appendix I

agroisolab

Thank you very much for your attention

Agroisolab GmbH
Prof. Rehm Str. 6
52428 Jülich (Germany)
www.agroisolab.de

agroisolab

Agroisolab.

Why is stable isotope method currently the leading universal standard method to verify the origin?

	Stable Isotopes	**Genetic**
Robustness	The stable isotope information is available in the elements or in the main components of the product of cotton / textiles -> Cellulose ➔ very robust information. ➔ No processing effects	The genetic information is available but only as an add on component in cotton. Processing (e.g. drying, washing, boiling) destroys the genetic information in cotton / textiles.
	The stable-isotope information reflects the conditions of the location (hydrology, climate, geology).	The genetic information is only an indirect origin information, i.e. which variety is used or which population drifts exist (Nature). ➔ No direct origin information

Issues:

mixtures is still the greatest challenge in analytics and will never be completely solved. As a rule, only the predominant origin (>80%) will be testable.

Comparison between different test methods for the measurement of trash

Axel Drieling, Faserinstitut Bremen e.V.
Alica Malz, Universität Bremen

Presented at the ITMF International Committee on Cotton Testing Methods Meeting
Bremen, September 27, 2022

Aims

- Comparison of results between laboratories (ICA Bremen Round Trials)

- Correlation between test methods

- Repeatability for each test method
- Interlaboratory variation / Reproducibility for each test method
  - Interlaboratory variation under daily prerequisites (ICA Bremen Round Trials)
  - Reproduciblity under improved prerequisites (extra Round Trials for the study)

- Influences

Trash Test Methods

Several test methods → Possible classification

- Mechanical separation / gravimetric testing
  - Simple mechanical separation into lint and trash:
    - Shirley (ASTM D-2812) and similar
    - G-Trash
  - Simple mechanical separation, separating into trash, dust, microdust/fibre fragments:
    - Shirley with separation
    - MAG Accutrash, Statex Auto Trash Separator
  - MDTA Analysis
    - MDTA 3
    - MDTA 4
- Mechanical separation with additional analysis
  - MDTA 4 with NTDA
  - Mesdan Contest
- Pure optical tests
  - HVI
- Mechanical separation of neps and trash with additional analysis
  - AFIS
  - NATI
- Other
  - YG102a, Y101, YG042, YG041, MC101
  - TT2000 (MDTA3), Sisi

Which methods can be grouped, which should be separated?

- **Method**
- **Parameters**
- **Statistics**

→ For the RTs

→ For this analysis

Standard Test Methods

- Currently given:
  - ASTM D 2812 Standard Test Method for the non-lint content of cotton
    → Simple mechanical separation → for Shirley

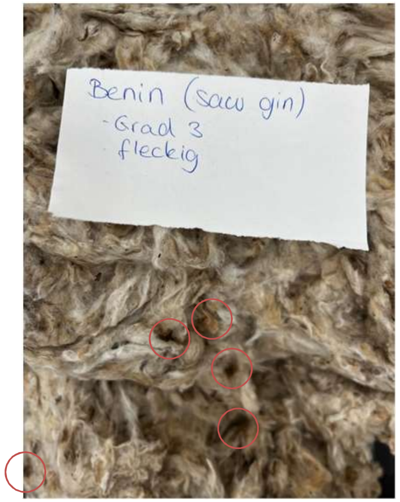
  - Other?

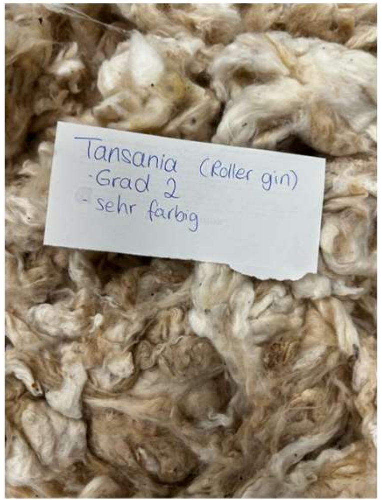
Materials

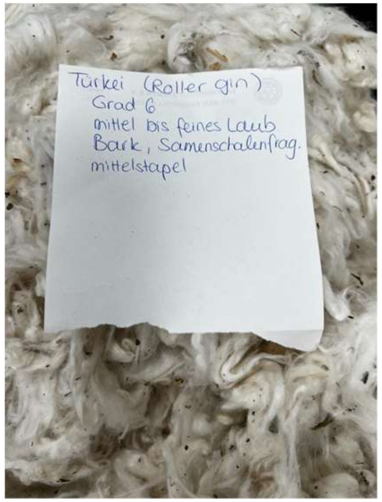
Rep	Cotton		HVI Trash-Area	HVI-Trash-ID	UHML [mm]	Strength	Micronaire	Colour-Grade	Leaf	Specifics
	Egypt Giza 86	RM 42	0,555	4	32,74	44,05	4,62	21-4	Large part.	RG
x	Israel Acala	RM 41	0,158	1	29,06	29,8	4,43	13-3	-	Clean
x	Central Asia	RM 53	1,1265	7	27,158	27,765	5,19	42-1	fine part.	Very trashy
	US MOT	RM 36	0,517	4	27,76	23,35	4,26	43-1	-	-

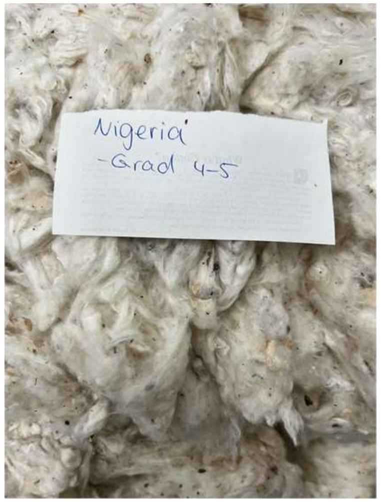
Cotton	Leaf (manual)	HVI Trash-Area	HVI-Trash-ID	UHML [mm]	Strength	Micronaire	Colour-Grade	Leaf size	Specifics	Ginning
Benin G1	1	0,14	1	26,92	26,5	4,34	21-3	-	Clean	Saw
Benin G2	2	0,26	2	28,65	30,4	4,49	22-1	normal	-	Saw
Benin G3	3	2,33	8	27,73	27,2	4,63	84-5	normal	Very spotty	Saw
Tanzania G2	2	0,57	4	27,68	23	4,01	44-3	normal	very colored	Roller
Tanzania G3	3	0,55	4	28,82	28,9	4,06	22-1	normal	Variation in Mic. & Str.	Roller
Turkey G6	6	2,53	8	29,36	31,5	4,94	42-2	normal & coarse	seed coat fragments	Roller
Nigeria G4	4	0,93	6	28,42	29,8	4,17	33-2	normal	seed coat fragments, seed	Saw
Kazachstan G5	5	0,67	5	27,86	28,8	4,87	33-1	fine	knotted	Saw

Materials


Benin (saw gin)
-Grad 3
fleckig

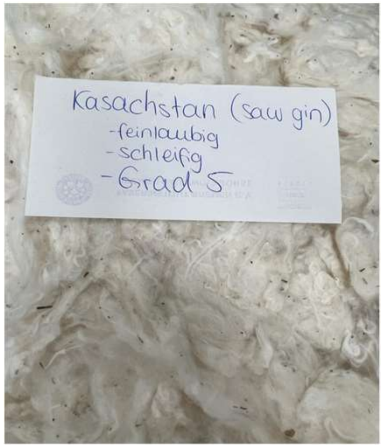

Tansania (Roller gin)
-Grad 2
-sehr farbig


Türkei (Roller gin)
Grad 6
mittel bis feines Laub
Bark, Samenschalenfrag.
mittelstapel


Nigeria
-Grad 4-5


Benin (saw gin)
Grad 2
normalgroßes Laub


FASERINSTITUT BREMEN E.V.
BREMER BAUMWOLLBÖRSE
Benin (saw gin)
Grad 1 normalgroßes Laub


Kasachstan (saw gin)
-feinlaubig
-schleifig
-Grad 5

Methods used

- ICA Bremen Round Tests
  - Separation into lint and trash
  - Separation into trash, dust, micro-dust / fiber fragments
- Tests at Faserinstitut Bremen
  - HVI
  - AFIS
  - G-Trash
  - AccuTrash
- Tests at cooperating laboratories
  - Shirley(Trützschler Spinning, SRRC ARS USDA)
  - (G-Trash)
  - AccuTrash (MAG and some customers)
  - Statex Auto Trash Separator (Markou, Greece)
  - MDTA 3 (Cotton Incorporated, Saurer, Trützschler, DITF, FBRI)
  - MDTA 4 (Textechno, Groz Beckert)

Interlaboratory Variation – in the ICA Bremen Round Test

- Inclusion of gravimetric trash testing in the ICA Bremen RTs since RT-2022-1

- RT 2022-1
  - Cotton: RM 36 – US MOT
  - HVI Median Trash Area 0.5%, Leaf 4
  - Table: simple trash
  - Table: trash/dust/fragments

- RT 2022-2
  - Cotton: RM 53 – Central Asia
  - HVI Average Trash Area 0.85%, Leaf 5
  - Table: simple trash
  - Table: trash/dust/fragments

ICA Bremen RT Results 2022-1

Trash Test

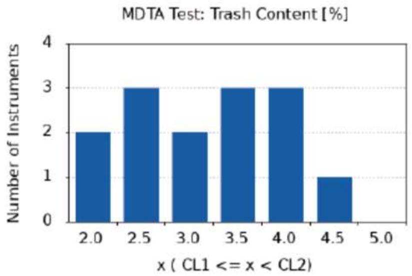
	Instrument	Manuf.	Type	Std. Test Method	Repetitions	Sample Size (g)	Trash Content (%)	Lint Content (%)
Average					2.18	80.83	4.56	95.3
Median					2.0	100.0	3.92	95.27
Stddev							3.51	0.92
CV							77.0	1.0
Min					1	10.0	1.66	81.8
Max					6	200.0	33.0	97.0
n					11	12	13	10

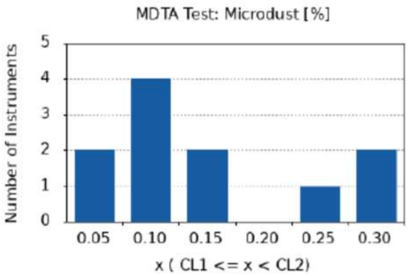
Laboratory	Instrument	Manuf.	Type	Std. Test Method	Repetitions	Sample Size (g)	Trash Content (%)	Lint Content (%)
	Gravimetric & Bouyance	statex	Trash sperator 400		2	50.0	2.7	97.0
	Shirley Analyser		MK2	Internal	2	50.0	15.4	81.8 ()
			YG042A	GB/T 6499-2012	2	100.0	4.3	95.7
		3SENSE		SI	2		33.0 ()	
		shuangyi	YG042	GB6499-2012	1	100.0	3.12	
		Premier	G-Trash	internal	3	10.0	1.66	
	Trash Analyzer	Eureka	Eureka Trash Analyzer	ASTM D 2812-07(2021)		100.0	4.3	94.8
	Shirley Analyzer	Changzhou NO.2 Textile Instrument Factory	YG041		1	100.0	3.63	95.27
	Shirley Analyzer	Shriley	MK2	ASTM D1234		50.0	3.72	95.54
	Shirley Analyzer	China			1	100.0	4.12	93.66
	Shirley Analyzer		MK2		3	100.0	4.64	94.68
	Shirley Analyzer	Platt Bros.LTD			1	200.0	3.03	95.18
	Auto Trash Separator	STATEX	E-49		6	10.0	4.15	95.85

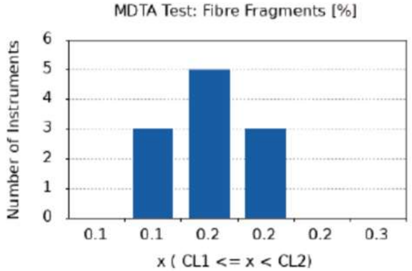
ICA Bremen RT Results 2022-1

Trash, Dust, Micro-dust, Fibre Fragments Test

	Type	Device	Instrument	Manufacturer	Std.Test Method	Repetitions	Sample Size (g)	Lint Content (%)	Non-Lint Content (%)	Trash (%)	Micro-Dust (%)	Fibre Fragments (%)
Average						2.64	27.07	95.97	2.34	3.19	0.15	0.15
Median						2.0	15.0	96.135	2.57	3.189	0.12	0.14
Stddev							33.07	1.19		0.79	0.09	0.04
CV							122.1	1.2		24.8	62.6	24.3
Min						1	5.0	93.5	0.39	2.14	0.03	0.09
Max						5	100.0	97.35	24.2	4.705	0.57	0.55
n						14	14	12	6	14	12	12
Laboratory	**Type**	**Device**	**Instrument**	**Manufacturer**	**Std.Test Method**	**Repetitions**	**Sample Size (g)**	**Lint Content (%)**	**Non-Lint Content (%)**	**Trash (%)**	**Micro-Dust (%)**	**Fibre Fragments (%)**
	MDTA 4		MDTA	Textechno		5	5.0	94.75	2.57	2.14	0.26	0.17
	MDTA 3	MDTA3		Uster		2	20.0	95.84		3.865	0.101	0.185
	MDTA 3	MDTA3		Uster		2	20.0	96.43		3.298	0.101	0.171
	MDTA -3	MDTA-3	Micro-Dust and Trash Analyzer	SUESSEN	ASTM-D1234-2012	4	5.0	94.7765		4.705	0.307	0.212
	MDTA 3	MDTA	Dust-Trash-Microfibers	SDL MDTA3 Made by HOLLINGSWORTH	ASTMD 1776	2	7.0	93.5	24.2 ()	4.14	0.29	0.14
	MDTA 3	MDTA3	Micro-Dust and Trash Analyser		Internal	3	10.0	96.82		2.2	0.13	0.14
	MC101	MC101		shuangyi	GB6499-2012	1	100.0			3.77		
		MDTA				5	7.0	95.32	4.65	3.52	0.57 ()	0.55 ()
	AccuTrash			MAG	internal	2	50.0			3.72	0.03	0.14
	MDTA 4	Micro-Dust and Trash Analyzer	Micro-Dust and Trash Analyzer	Textechno		5	5.0	97.283		2.464	0.057	0.196
	TT-2000		Dust and Trashtester	Hollingworth		2	20.0	97.002	3.0	2.792	0.092	0.115
	TT 1000		Trash Tester	Hollingsworth		2	10.0	97.35		2.44	0.12	0.09
			Shirley Analyser	Platts	ABNT NBR 12718	1	100.0	95.81	1.11	3.08		
	MDTA 3		Trash Analyzer	Uster		1	20.0	96.74	0.39	2.567	0.172	0.123







ICA Bremen RT Results 2022-1

Universität Bremen

FASERINSTITUT FIBRE BREMEN

Trash, Dust, Micro-dust, Fibre Fragments Test

	Type	Device	Instrument	Manufacturer	Std.Test Method	Repetitions	Sample Size (g)	Lint Content (%)	Non-Lint Content (%)	Trash (%)	Micro-Dust (%)	Fibre Fragments (%)
Average						2.64	27.07	95.97	2.34	3.19	0.15	0.15
Median						2.0	15.0	96.135	2.57	3.189	0.12	0.14
Stddev							33.07	1.19		0.79	0.09	0.04
CV							122.1	1.2		24.8	62.6	24.3
Min						1	5.0	93.5	0.39	2.14	0.03	0.09
Max						5	100.0	97.35	24.2	4.705	0.57	0.55
n						14	14	12	6	14	12	12
Laboratory	**Type**	**Device**	**Instrument**	**Manufacturer**	**Std.Test Method**	**Repetitions**	**Sample Size (g)**	**Lint Content (%)**	**Non-Lint Content (%)**	**Trash (%)**	**Micro-Dust (%)**	**Fibre Fragments (%)**
	MDTA 4		MDTA	Textechno		5	5.0	94.75	2.57	2.14	0.26	0.17
	MDTA 3	MDTA3		Uster		2	20.0	95.84		3.865	0.101	0.185
	MDTA 3	MDTA3		Uster		2	20.0	96.43		3.298	0.101	0.171
	MDTA -3	MDTA-3	Micro-Dust and Trash Analyzer	SUESSEN	ASTM-D1234-2012	4	5.0	94.7765		4.705	0.307	0.212
	MDTA 3	MDTA	Dust-Trash-Microfibers	SDL MDTA3 Made by HOLLINGSWORTH	ASTMD 1776	2	7.0	93.5	24.2 ()	4.14	0.29	0.14
	MDTA	MDTA3	Micro-Dust and		Internal	3	10.0	96.82		2.2	0.13	0.14

ICA Bremen RT Results 2022-2

Trash Test

	Instrument	Manuf.	Type	Std. Test Method	Repetitions	Sample Size (g)	Trash Content (%)	Lint Content (%)
Average					2.62	73.93	6.98	91.92
Median					2.0	100.0	7.18	91.485
Stddev							1.71	2.43
CV							24.5	2.6
Min					1	5.0	3.89	81.6
Max					6	200.0	16.5	96.06
n					13	14	14	13
Laboratory	**Instrument**	**Manuf.**	**Type**	**Std. Test Method**	**Repetitions**	**Sample Size (g)**	**Trash Content (%)**	**Lint Content (%)**
7-1	shirley Analyzer	mesdan		ASTMD281207	2	100.0	8.86	90.34
	MDTA	Textechno	MDTA 4		5	5.0	6.06	91.25
	Gravimetric & Boouyance	Statex	Trash sperator 400	ASTM	2	100.0	6.46	93.3
	Shirley Analyser		MK2	Internal	2	50.0	16.5 ()	81.6 ()
	Shirley	Uster	MK2		2	100.0	4.8	95.2
		Textechno	MK 2		5	10.0	3.89	96.06
	G-Trash	Premier		internal	3	10.0	5.99	
	Shirley Analyzer	Eureka	Trash Analyzer	ASTM D-2812-07(2021)	2	100.0	7.7	88.5
	Shirley Analyzer	Changzhou NO.2 Textile Instrument Factory	YG041		1	100.0	5.8	94.2
	Shirley Analyzer	Shriley	MK2	ASTM D1234		50.0	8.34	91.14
	Shirley Analyzer	Platts		ABNT NBR 12718	1	100.0	7.43	91.29
	Shirley Analyzer	Platts		ASTM-D2812-07 RA2012	2	100.0	10.13	88.17
	Shirley Analyser	Platt Bros. LTD			1	200.0	7.18	91.68
	Auto Trash Separator	STATEX	E-49		6	10.0	8.1	91.9

ICA Bremen RT Results 2022-2

Universität Bremen

FASERINSTITUT FIBRE BREMEN

Trash, Dust, Micro-dust, Fibre Fragments Test

	Device	Type	Instrument	Manufacturer	Std. Test Method	Repetitions	Sample Size (g)	Lint Content (%)	Non-Lint Content (%)	Trash (%)	Micro-Dust (%)	Fibre Fragments (%)
Average						2.91	15.18	92.65	5.85	6.46	0.2	0.12
Median						3.0	10.0	92.6	6.26	6.13	0.19	0.086
Stddev								1.98		1.76	0.09	0.1
CV								2.1		27.2	47.5	87.1
Min						1	5.0	89.43	4.07	3.31	0.03	0.02
Max						5	50.0	95.96	95.038	9.06	0.38	0.34
n						11	11	10	6	11	11	11
Laboratory	**Device**	**Type**	**Instrument**	**Manufacturer**	**Std. Test Method**	**Repetitions**	**Sample Size (g)**	**Lint Content (%)**	**Non-Lint Content (%)**	**Trash (%)**	**Micro-Dust (%)**	**Fibre Fragments (%)**
		MDTA 4	MDTA	Textechno		5	5.0	91.25	6.33	6.06	0.19	0.08
		MDTA3		Uster		2	20.0	95.0	95.038 ()	4.683	0.193	0.086
		MDTA-3	Micro-Dust and Trash Analyzer	Suessen	ASTM-D1234-2012	4	5.0	90.498		9.0415	0.3385	0.122
		MDTA3	MDTA	MDTA3 Made by HOLLINGSWORTH	ASTM D 1776	4	7.0	89.43	6.26	7.89	0.18	0.29
		MDTA3	Micro-Dust and Trash Analyser		Internal	3	10.0	93.23		5.161	0.159	0.095
		MDTA 3		Textechno		5	10.0	95.96	4.07	3.31	0.38	0.34
			AccuTrash	MAG	internal	1	50.0			9.06	0.03	0.02
		TT-2000	Dust and Trashtester	Hollingworth		2	20.0	93.74	6.18	6.044	0.16	0.07
		TT 1000	Trash Tester	Hollingsworth		2	10.0	92.9		6.93	0.13	0.04
		MDTA3	MDTA	Suessen		3	10.0	92.3	6.41	6.13	0.23	0.05
		MDTA 3	Trash Analyser	Uster		1	20.0	92.18		6.75	0.21	0.1

ICA Bremen RT Results 2022-2

Universität Bremen

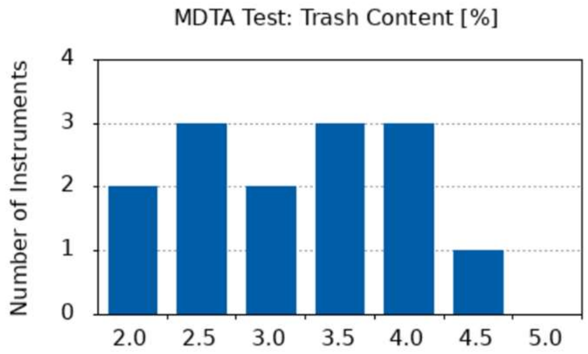
FASERINSTITUT FIBRE BREMEN

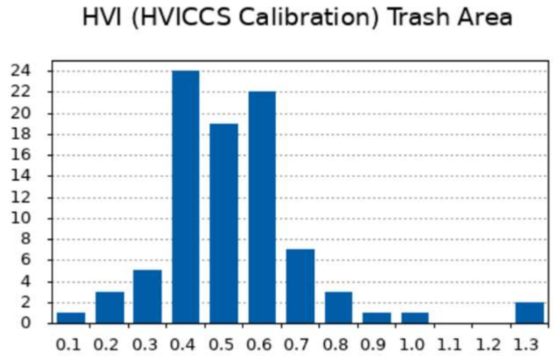
Trash, Dust, Micro-dust, Fibre Fragments Test

	Device	Type	Instrument	Manufacturer	Std. Test Method	Repetitions	Sample Size (g)	Lint Content (%)	Non-Lint Content (%)	Trash (%)	Micro-Dust (%)	Fibre Fragments (%)
Average						2.91	15.18	92.65	5.85	6.46	0.2	0.12
Median						3.0	10.0	92.6	6.26	6.13	0.19	0.086
Stddev								1.98		1.76	0.09	0.1
CV								2.1		27.2	47.5	87.1
Min						1	5.0	89.43	4.07	3.31	0.03	0.02
Max						5	50.0	95.96	95.038	9.06	0.38	0.34
n						11	11	10	6	11	11	11
Laboratory	**Device**	**Type**	**Instrument**	**Manufacturer**	**Std. Test Method**	**Repetitions**	**Sample Size (g)**	**Lint Content (%)**	**Non-Lint Content (%)**	**Trash (%)**	**Micro-Dust (%)**	**Fibre Fragments (%)**
		MDTA 4	MDTA	Textechno		5	5.0	91.25	6.33	6.06	0.19	0.08
		MDTA3		Uster		2	20.0	95.0	95.038 ()	4.683	0.193	0.086
		MDTA-3	Micro-Dust and Trash Analyzer	Suessen	ASTM-D1234-2012	4	5.0	90.498		9.0415	0.3385	0.122
		MDTA3	MDTA	MDTA3 Made by HOLLINGSWORTH	ASTM D 1776	4	7.0	89.43	6.26	7.89	0.18	0.29
		MDTA3	Micro-Dust and Trash Analyser		Internal	3	10.0	93.23		5.161	0.159	0.095
1		MDT		Textechno		5	10.0	95.96	4.07	3.31	0.38	0.34

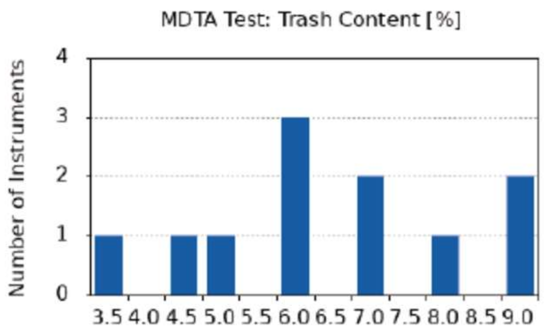
Interlab Variation – in the ICA Bremen Round Test

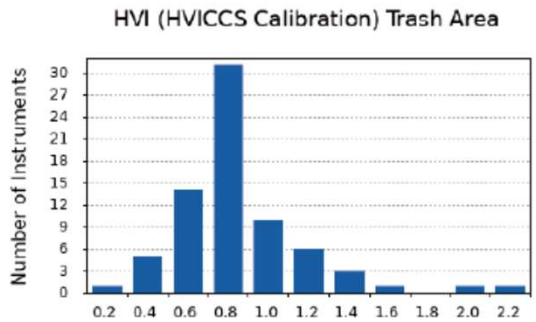
RT 2022-1 (US-MOT)				
Device groups	Trash Test	Trash, Dust, Micro-Dust, FF Test	HVI Trash Area	AFIS VFM
Average	3,58	3,19	0,52	2,05
SD	0,88	0,79	0,19	0,33
CV	24.6	24.8	37,60	15,90





RT 2022-2 (Central Asia)				
Device groups	Trash Test	Trash, Dust, Micro-Dust, FF Test	HVI Trash Area	AFIS VFM
Average	6,98	6,46	0,85	4,55
SD	1,71	1,76	0,32	0,56
CV	27.2	27,20	37,10	12,20





Definitions of tests

Definition „Full Test“ for the different measurement methods for this bachelor thesis

- HVI
  - Full test = 1 measurement on one cotton sample (2 images)
- AccuTrash
  - Full test = 2 measurements / 2 samples with each 50g cotton = 100g
- G-Trash
  - Full test = 3 measurements / 3 samples with 10g each cotton = 30g
- MDTA3
  - Full test = 5 measurements / 5 samples with 20g each cotton = 100g
- MDTA4
  - Full test = 5 measurements / 5 samples with 5g each cotton = 25g
- AFIS
  - Full test = 5 measurements / 5 samples with each 0.5g cotton = 2.5g
- Shirley
  - Full test = 2 measurements / 2 samples with each 100g cotton = 200g
  - Each 100g sample is put into the analyzer a second time

→ Used for correlation, repeatability, reproducibility (except stated differently)

Correlations

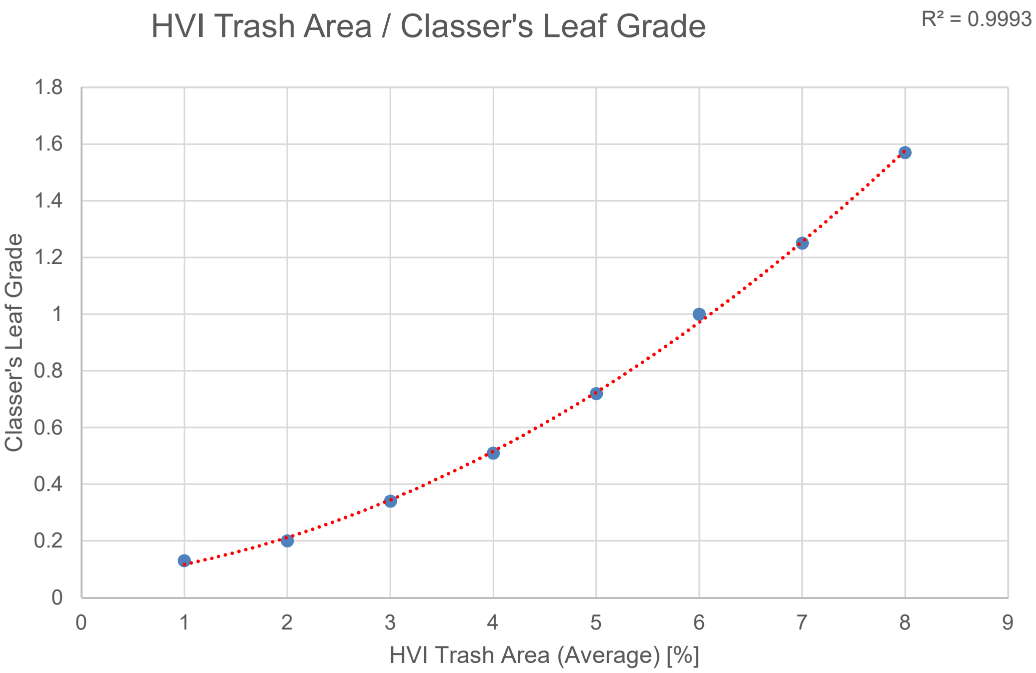
- Use of 11 cottons

- Instruments / applied parameters
  - HVI: 6 full tests (with each 1 measurement) at FIBRE
  - AccuTrash: 6 full tests (each 100g) at FIBRE
  - G-Trash: 6 full tests (each 30g) at FIBRE
  - MDTA3: 2 full tests (each 100g) at Saurer and DITF
  - MDTA4: 6 full tests (each 25g) at Textechno, 2 full tests (each 25g) at Groz Beckert
  - AFIS: RM53 and RM41 6 full tests (each 25g), RM42 2 full tests at FIBRE
  - Cotton for influences: 1 full test for each instrument

Correlations

Tested Cotton	Leaf (manual)	HVI Trash-Area [%]	AccuTrash Total Trash Content [%]	G-Trash Total Trash Content [%]	MDTA3 Total Trash Content [%]	MDTA4 Total Trash Content [%]	AFIS VFM
Egypt Giza 86		0,56	2,88	1,98	3,47	2,21	1,78
Israel Acala		0,16	1,15	1,34	1,31	1,37	0,83
Central Asia		1,13	7,62	6,38	5,45	6,60	4,41
Benin G1	1	0,14	1,70	1,12		1,29	0,55
Benin G2	2	0,26	1,87	2,21		1,40	0,87
Benin G3	3	2,33	6,65	5,46		5,48	4,05
Tansania G2	2	0,57	5,38	5,06		3,47	3,93
Tansania G3	3	0,55	4,20	3,20		2,67	0,98
Türkei G6	6	2,53	9,97	9,62		8,90	4,23
Nigeria G4	5	0,93	8,71	8,43		10,53	3,75
Kazakhstan G5	5	0,67	6,44	3,17		3,35	2,80

Definition: HVI Leaf Grade / Trash Area %



Classer's Leaf Grade	HVI Trash % Area Average*	HVI Trash % Area Limits
1	0.13	< 0.18
2	0.20	< 0.28
3	0.34	< 0.44
4	0.51	< 0.63
5	0.72	< 0.87
6	1.00	< 1.14
7	1.25	< 1.42
8	1.57	>= 1.42

* Based on USDA 2001 crop data (4 year average)

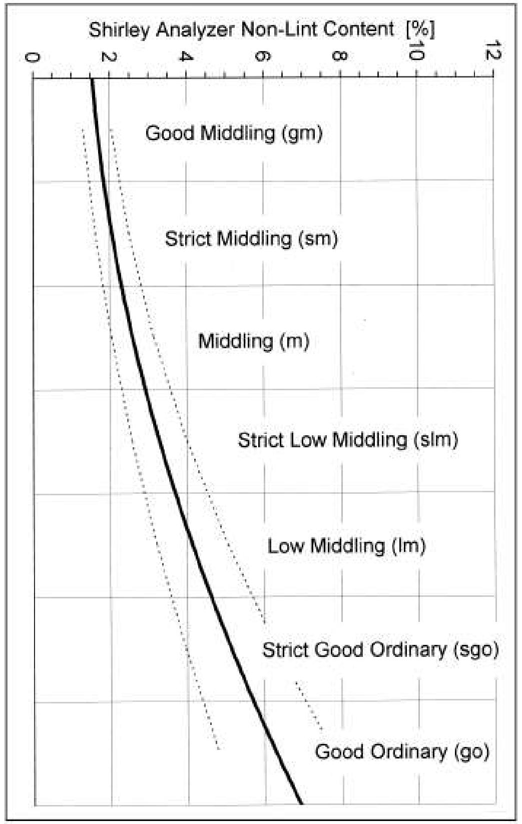
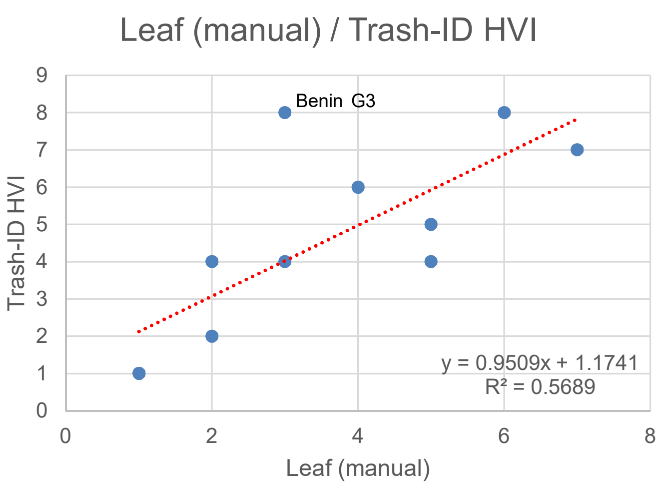
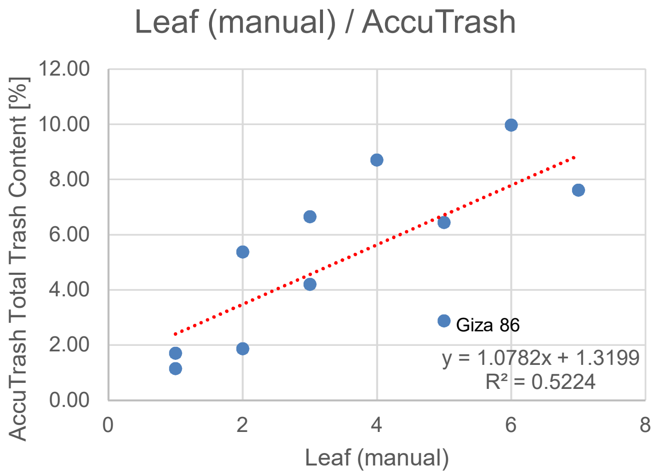
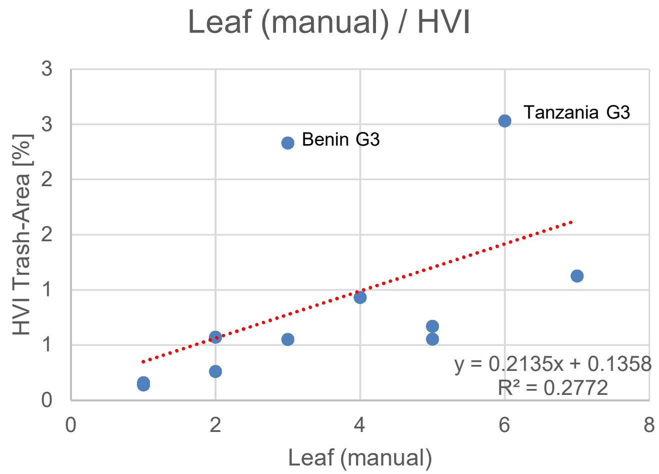


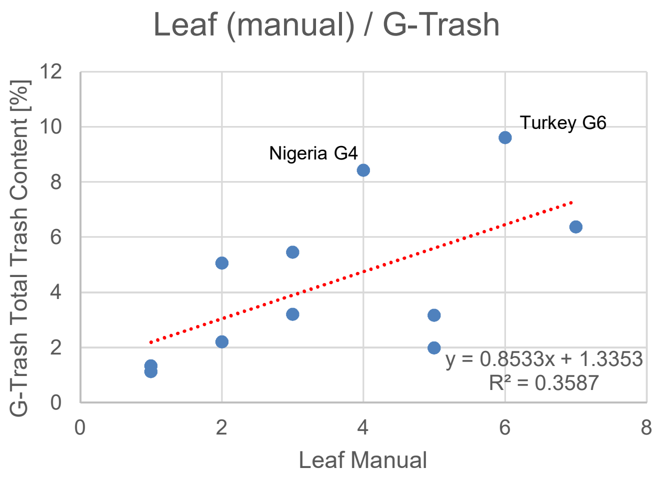
Abb. 39: Durchschnittlicher Schmutzgehalt internationaler Baumwollen in Abhängigkeit von der Klassierklasse nach den US-Universal Standards
(Quelle: H. Drews, F. Leifeld, C. Färber, Trützschler GmbH, Mönchengladbach)

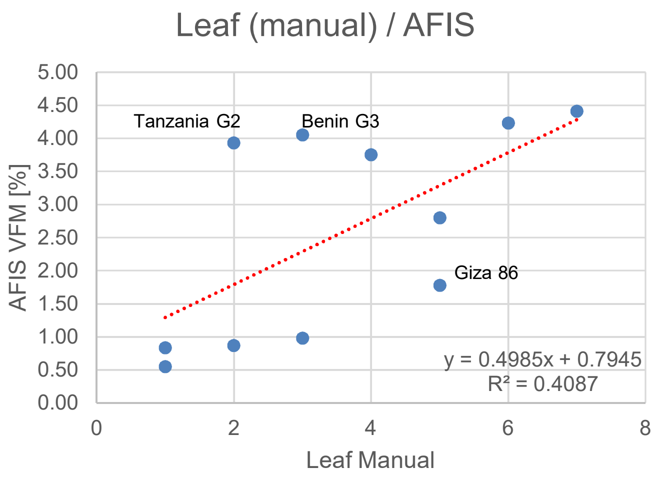
Correlations – based on Manual Classing

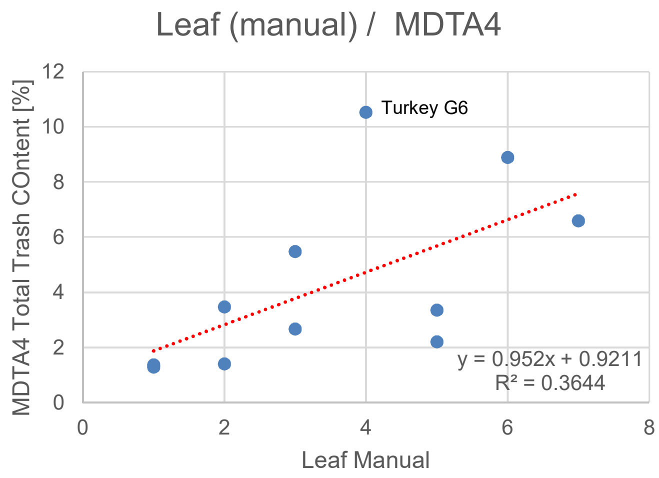








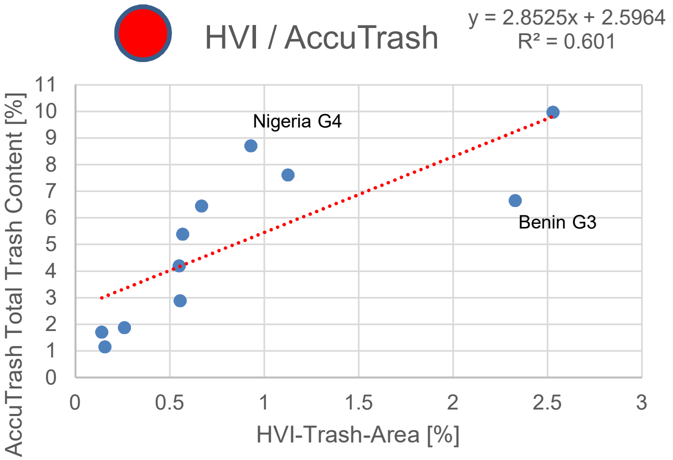


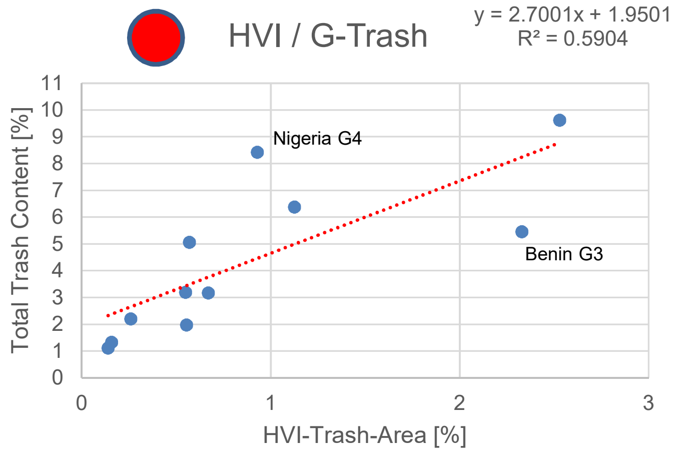


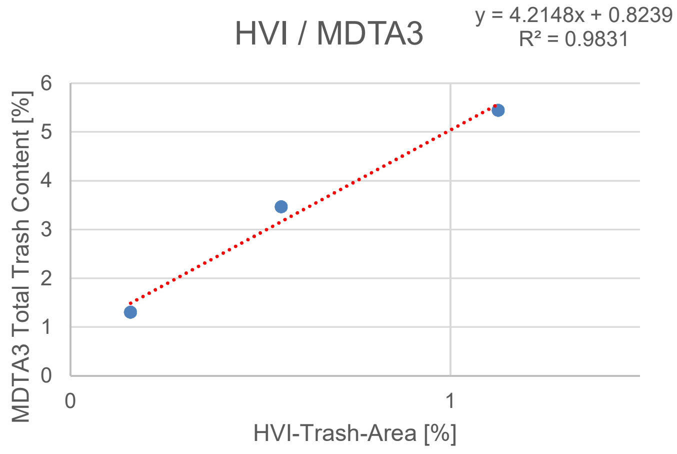
Correlations – based on HVI

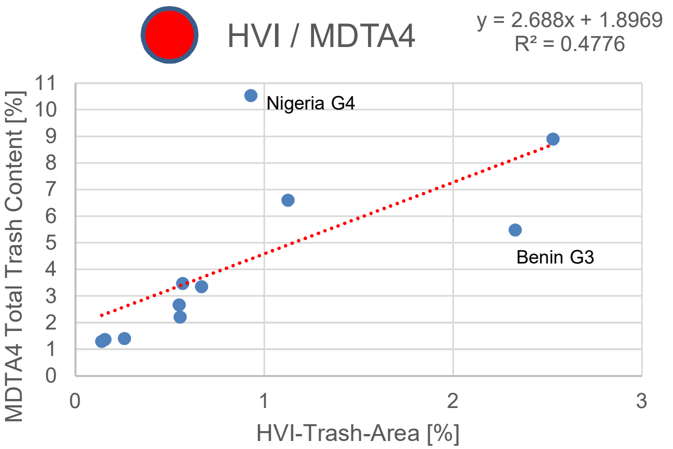
Universität Bremen

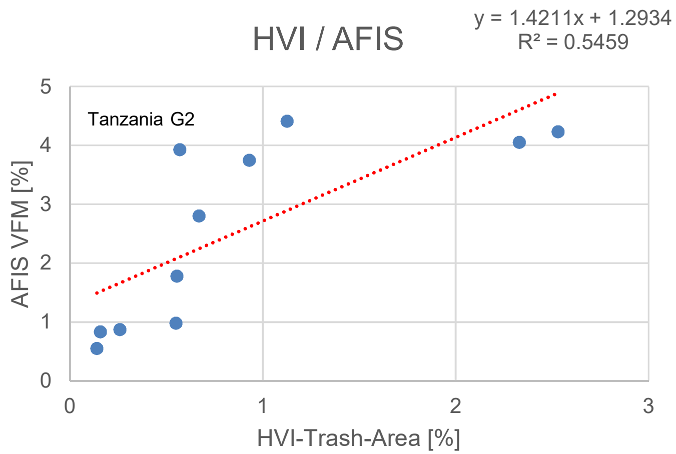
FASERINSTITUT FIBRE BREMEN

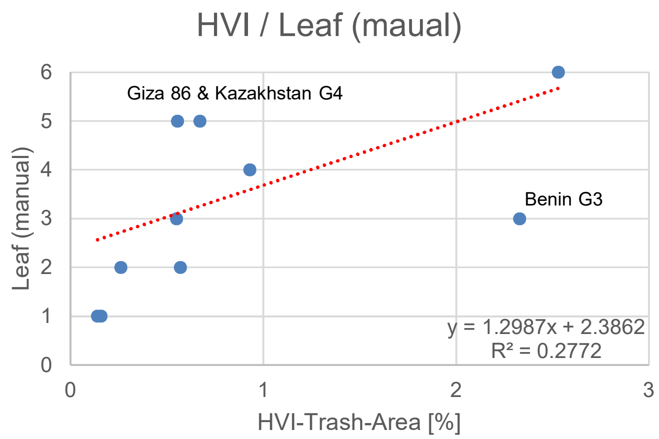




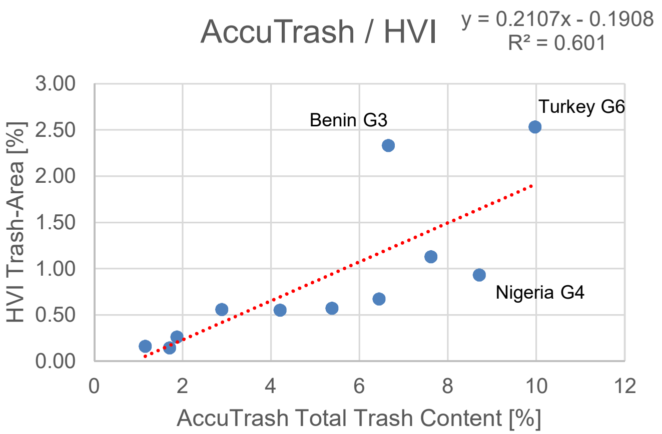


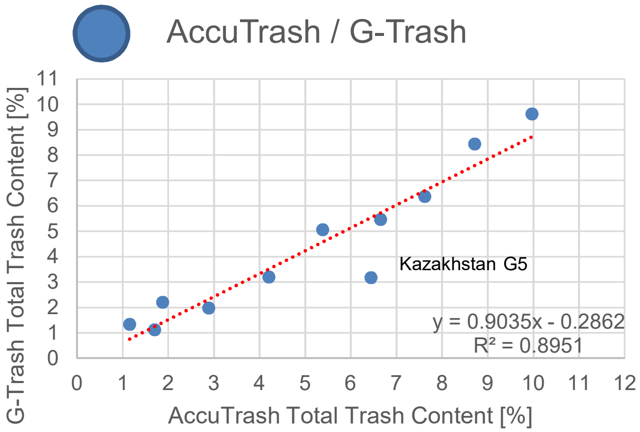


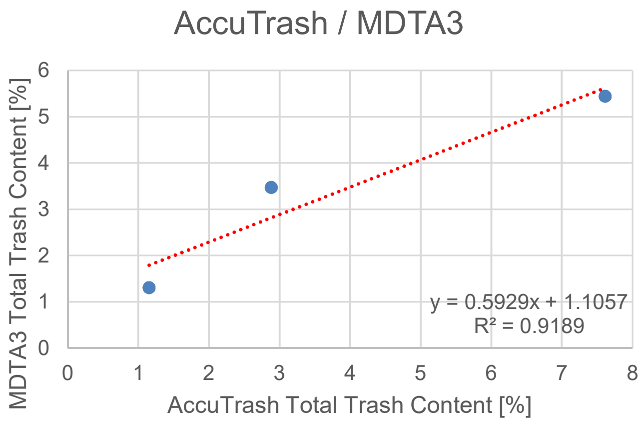


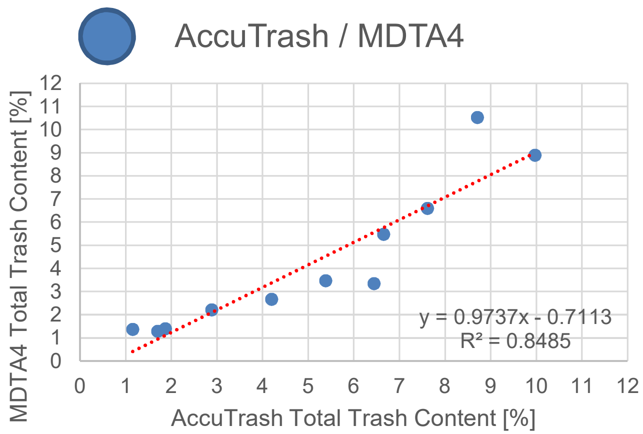


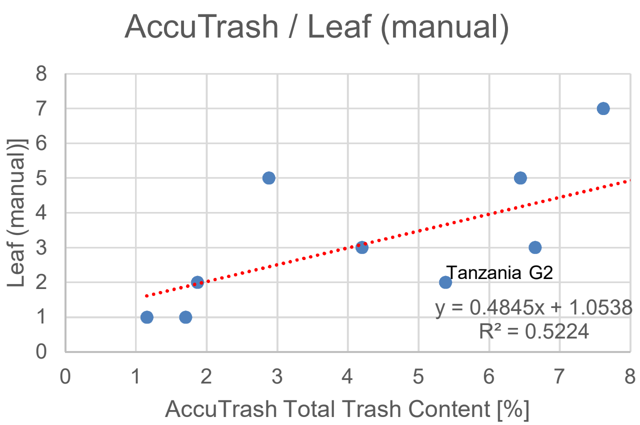
Correlations – based on AccuTrash

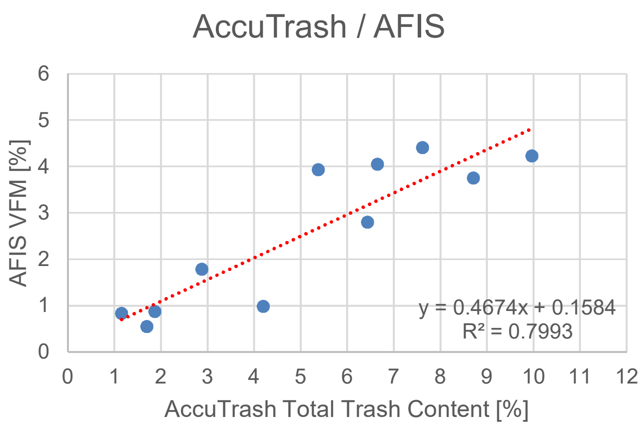




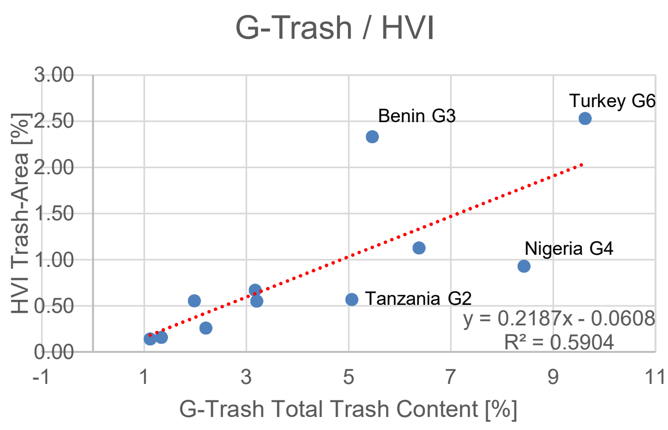


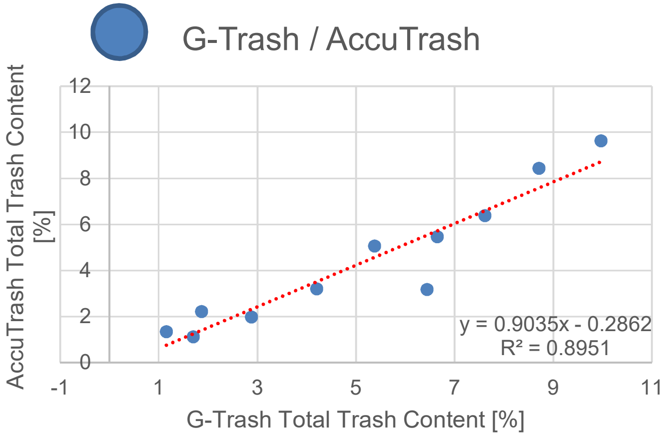


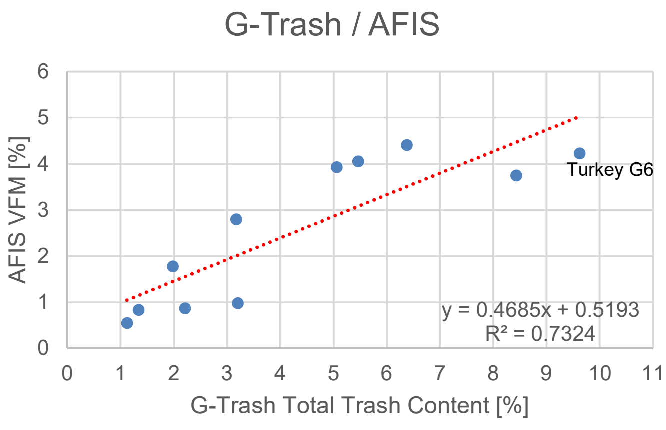


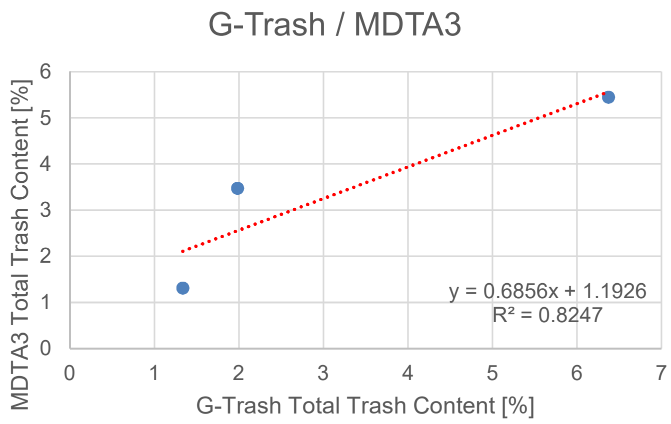


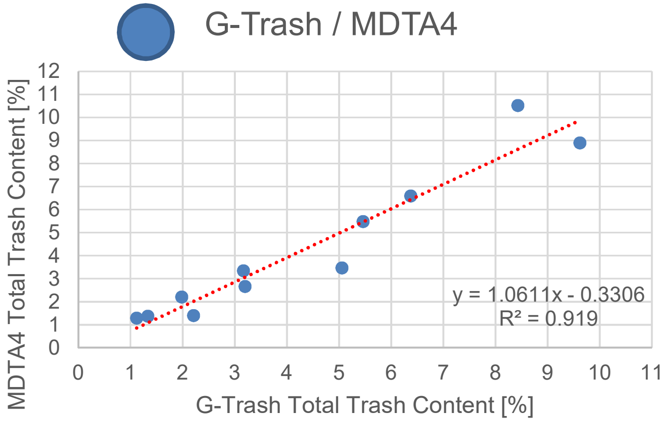
Correlations – based on G-Trash

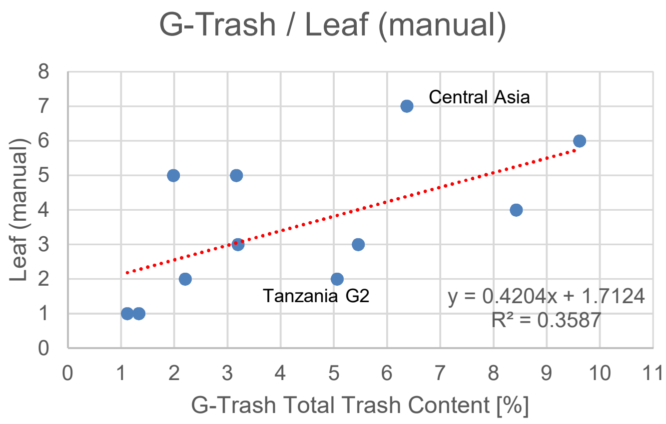






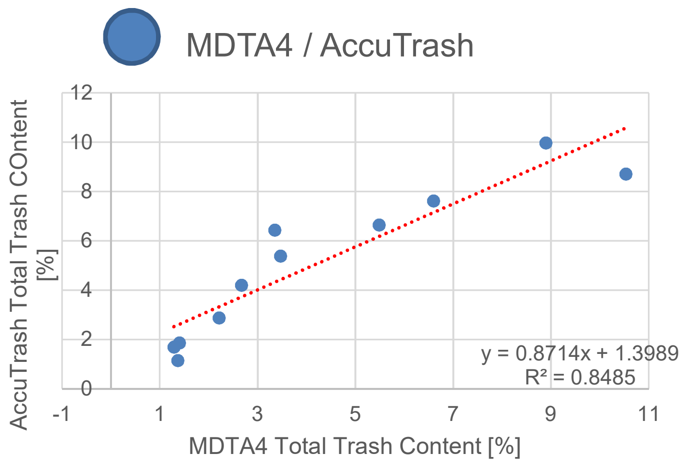


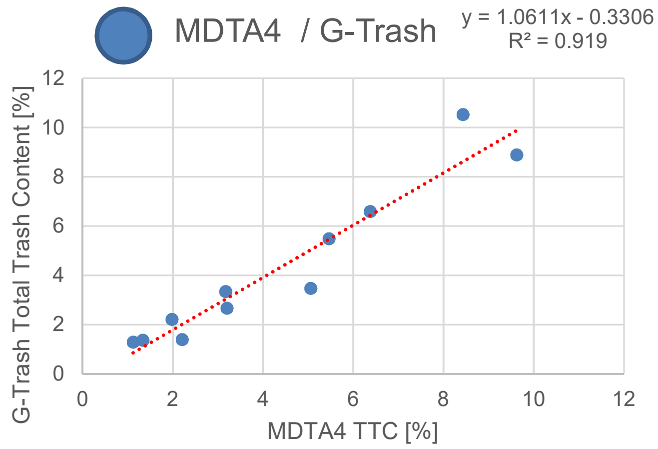


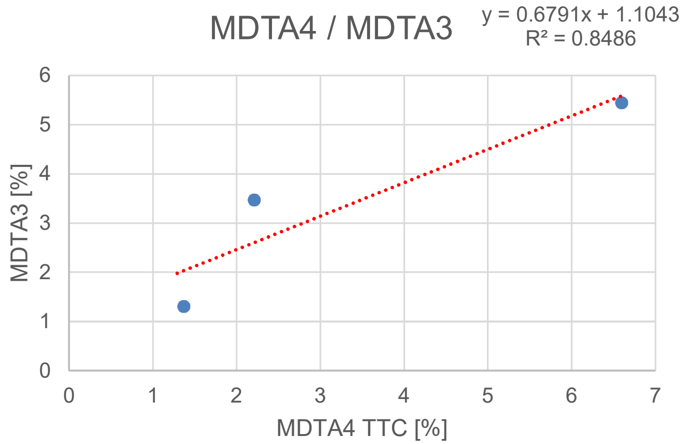


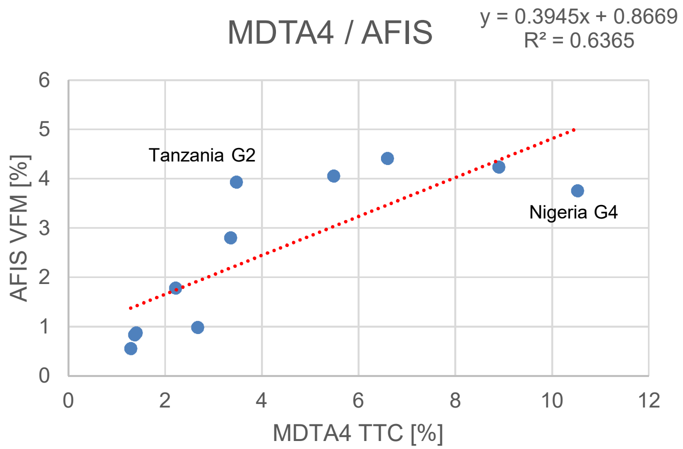
Correlations – based on MDTA4

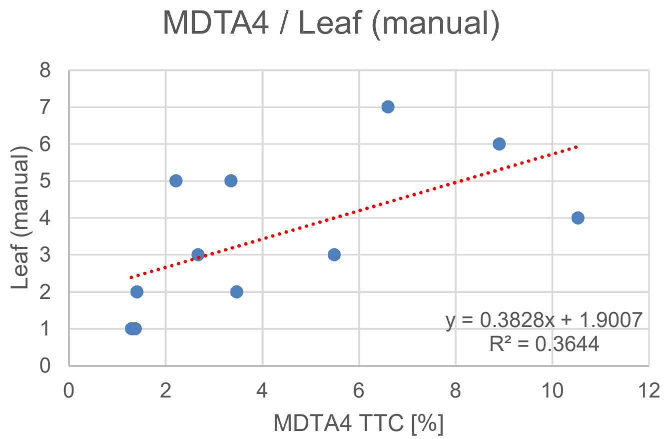
Universität Bremen
FASERINSTITUT FIBRE BREMEN



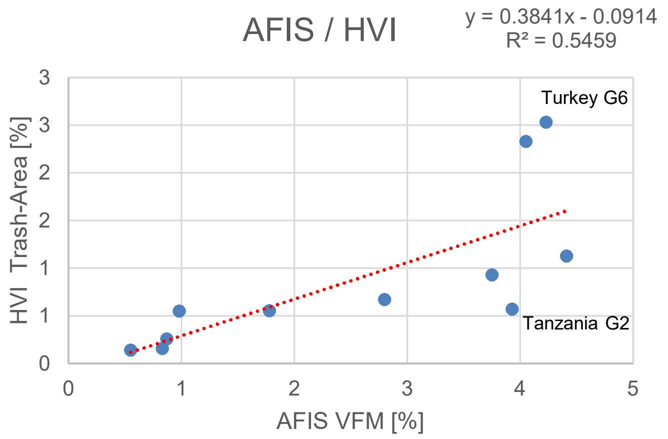


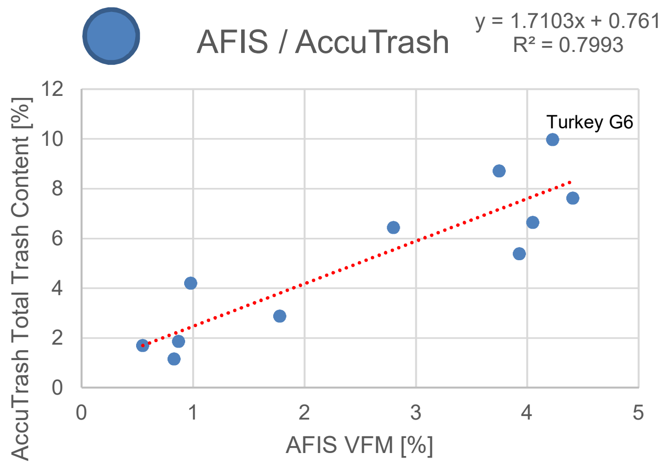


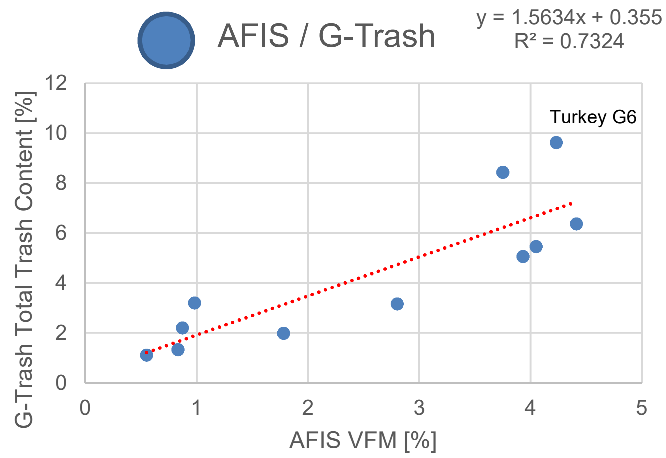


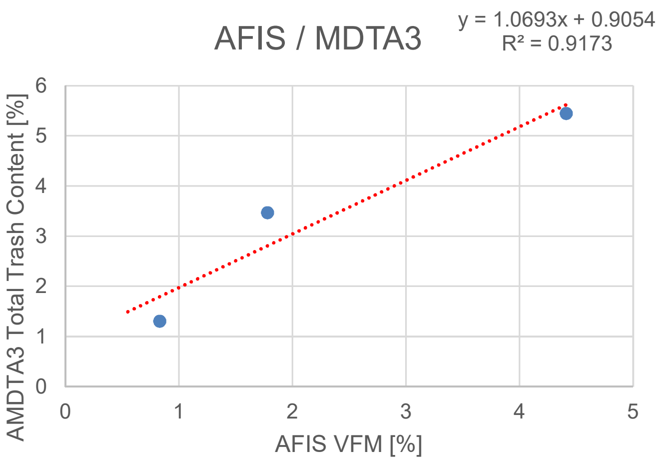


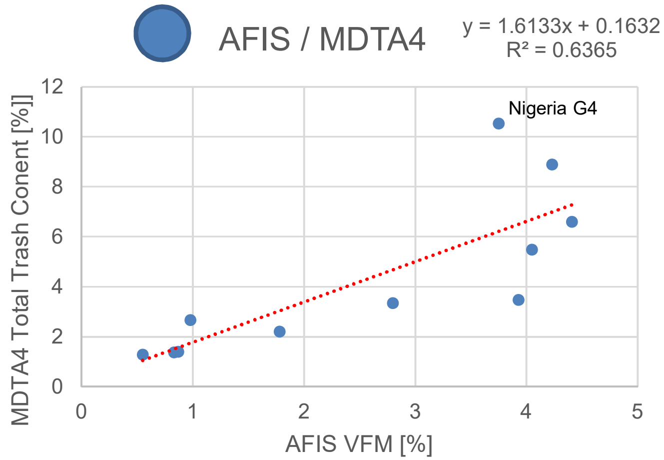
Correlations – based on AFIS

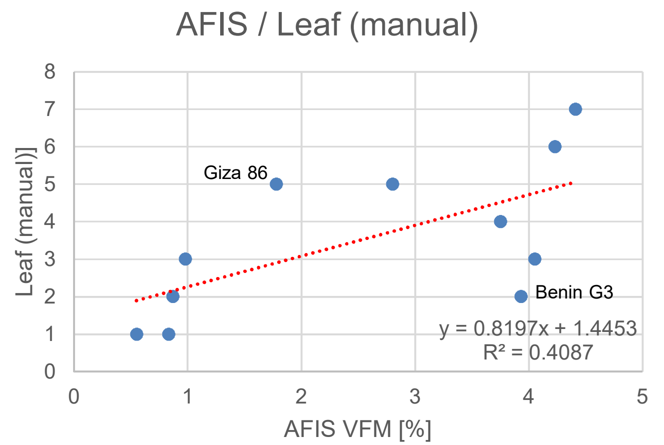












Correlation Summary (1/2)

R^2	HVI	Leaf (manual)	AccuTrash	G-Trash	AFIS	MDTA4
HVI	-					
Leaf (manual)	0,27	-				
AccuTrash	0,6	0,52	-			
G-Trash	0,59	0,36	0,9	-		
AFIS	0,55	0,41	0,8	0,73	-	
MDTA4	0,48	0,36	0,85	0,92	0,64	-

Current conclusions for the correlations:

- Correlations between gravimetric methods seem to have the highest R^2
- AFIS results currently promising, although only 5 times 0.5g

Correlation Summary (2/2)

m	HVI	Leaf (manual)	AccuTrash	G-Trash	AFIS	MDTA4
HVI	-					
Leaf (manual)	1,30	-				
AccuTrash	2,85	1,08	-			
G-Trash	2,70	0,85	0.90	-		
AFIS	1,42	0,50	0,47	0,47	-	
MDTA4	2,69	0,95	0,97	1,06	1,63	-

(How to read: G-Trash results = 2.7 x HVI Trash Area)

Current conclusions for slopes

- Slopes not suitable with the current definitions of leaf grades (manual, HVI)
- Solely slopes are not suitable, as there are considerable offsets in the given data
- Slope between the gravimectric systems is close to 1.0
- A first approx. value for the slope between HVI Trash Area% and gravimetric tests can be estimated to a factor of approx 3

Repeatability (ongoing)

Definitions based on ISO 5725

- s_r Repeatablity SD within one laboratory: SD between repeated full tests in one laboratory
  - → Best prerequisites for repeated testing

Results based on 6 full tests on each of the 2 cottons

Repeatability MDTA4			
Cotton	Average	sr	CV
Israel Acala	6,60	0,13	9,31
Central Asia	6,60	0,26	3,92

Repeatability AccuTrash			
Cotton	Average	sr	CV
Israel Acala	1,15	0,20	16,94
Central Asia	7,72	0,75	9,75

Repeatability G-Trash			
Cotton	Average	sr	CV
Israel Acala	1,34	0,19	14,37
Central Asia	6,38	0,48	7,60
US-MOT	2,65	0,55	20,61

Repeatability AFIS			
Cotton	Average	sr	CV
Israel Acala	0,83	0,09	11,2
Central Asia	4,2	0,22	5,33

Result: The repeatability is much better than the interlab. Variation.
Still there is a considerable variation – based mainly on varations in the sample?

Reproducibility – under improved prerequisites (started)

Universität Bremen

FASERINSTITUT FIBRE BREMEN

Definitions based on ISO 5725

- s_r Repeatablity SD within one laboratory
  - → Best prerequisites for repeated testing
- s_R Reproducibility SD between laboratories

Tests

- 2 full tests on three different cottons
- AccuTrash with MAG and 4 other labs
- G-Trash –
- Shirley: Trützschler, SRRC, USDA-ARS, FBRI
- MDTA3: Cotton Inc., Saurer, Trützschler, Denkendorf
- MDTA4: Textechno, Groz Beckert, additional?
- HVI based on ICA Bremen RT
- AFIS based on ICA Bremen RT

Influences on the correlation between test methods

- Cotton color
  - Colored spots on HVI → influence given, visible on Benin and samples (spots yes),
  - Color on HVI → less influence, visible on Tanzania (color not)
- Trash color?
- Neps
- Seed coat neps, seed (Turkish and Nigerian samples) → influence?
- Trash particle size
- Leaf vs bark/grass
- Saw ginned / roller ginned
- Fibre properties as length, micronaire
- …?

Outlook

- Continue tests for Bachelor thesis
  - Continue repeatability and reproducibility tests
  - Additional instruments?
  - Additional partner labs?

- ICA Bremen RT
  - Which tables would be suitable?
  - Other proposals for changes?

- For ITMF ICCTM
  - Definitions? (Invisible trash…)
  - Comparable definitions / parameters
  - Standard test methods?

Interpretation and use of instrument measured cotton characteristics

A guideline by ITMF International Committee on Cotton Testing Methods (ICCTM)

ICAC Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC)

Interpretation and use of instrument measured cotton characteristics

Table of content

How do instrument measured cotton characteristics impact the textile value chain

Cotton characteristic

Micronaire

- The micronaire of a given sample of cotton is affected by both **genetics** and **environmental** factors during the **growing season**.
- When comparing samples of cotton of the same growth, differences in micronaire reflect differences in maturity. However, when comparing samples of different growths but similar levels of maturity, differences in micronaire reflect differences in fineness.
- For producers, micronaire can assist in the **comparison of seed varieties**.
- For trading, it is used as an easy and reliable guide regarding the combination of **fineness and maturity.**
- For spinners, fineness is crucial in predicting the **spinnability** of cotton and the **fineness, evenness and strength** of the yarn that might be produced from it.
- Micronaire (fineness & maturity) is important to predict the **dyeability, fiber neps** and the appearance of yarn and fabric.

Cotton characteristic

Micronaire : Maturity

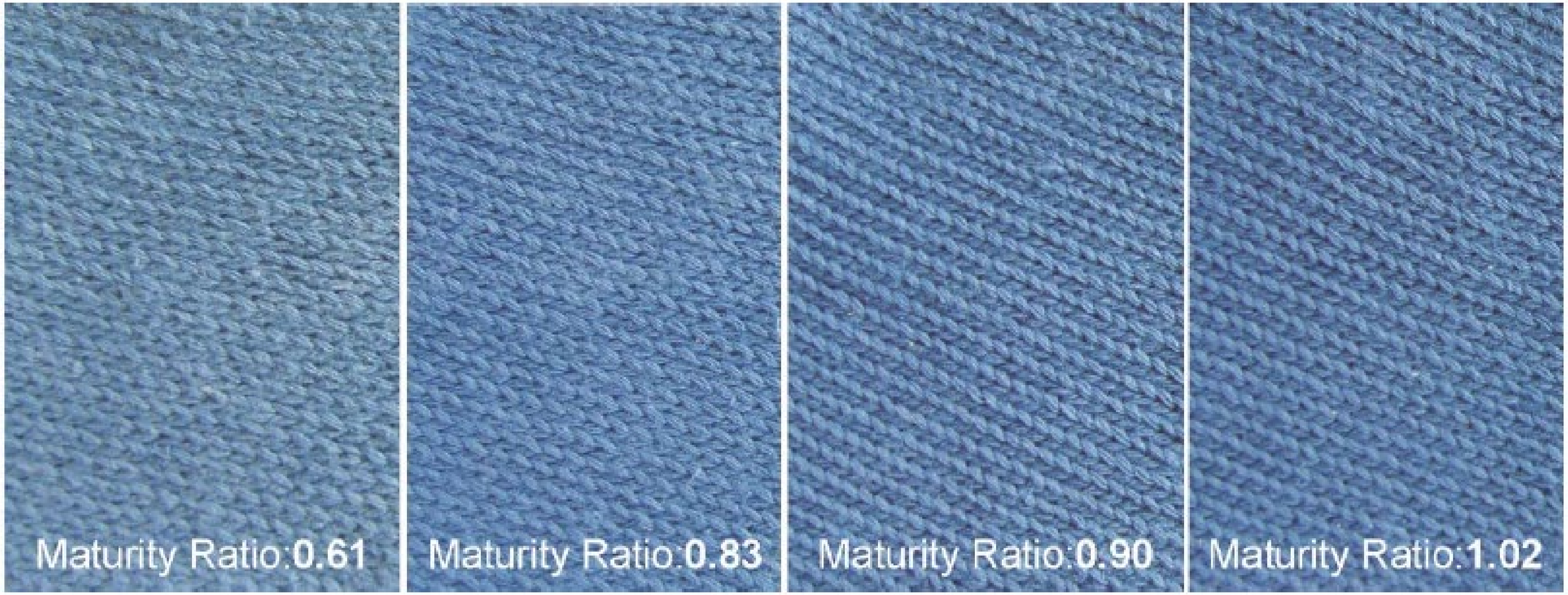
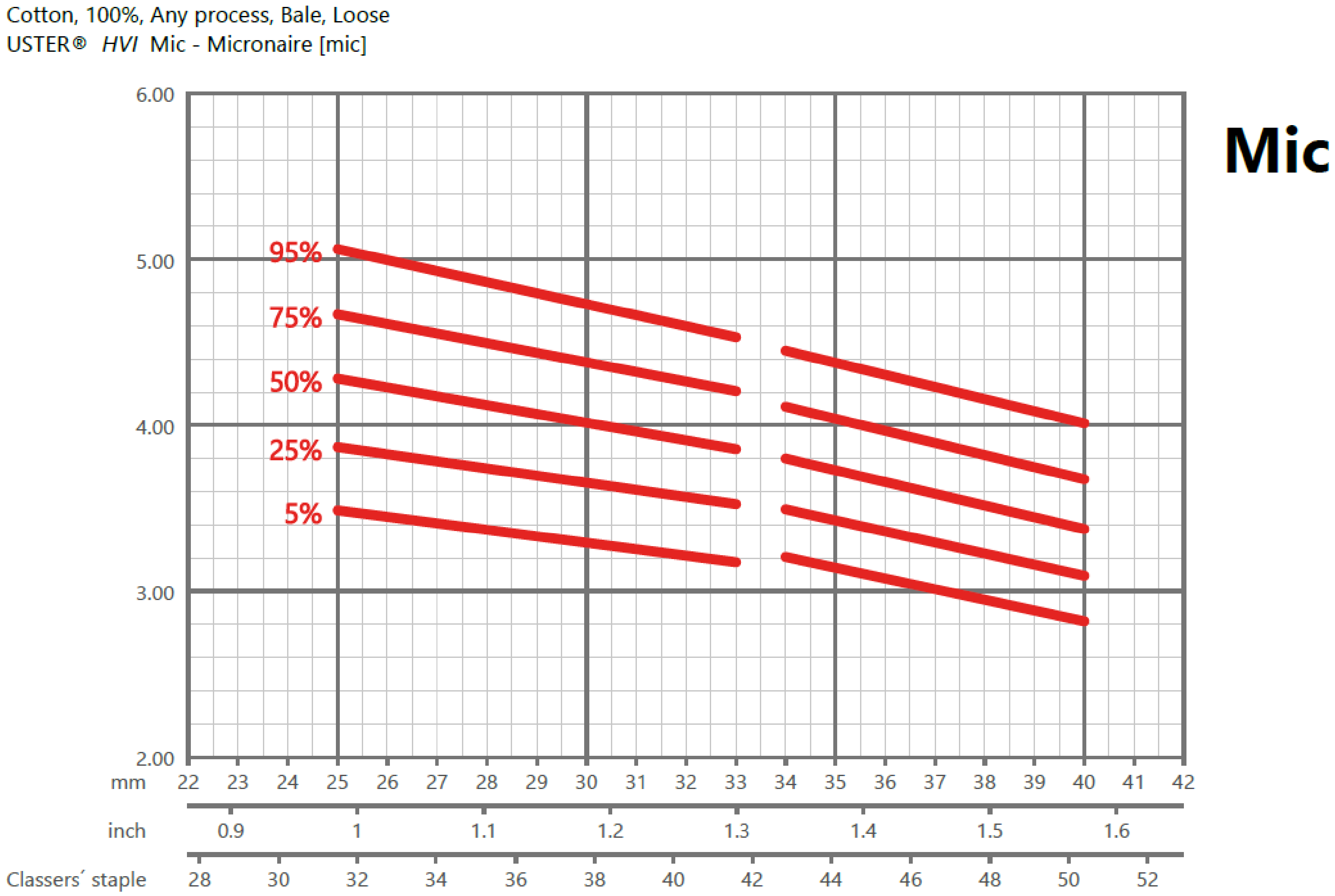


Figure 14: Fabric samples with common genetic backgrounds, harvested at different dates and processed into a single knitted fabric that was then dyed. The photos show the improvement in fabric in terms of color depth, evenness and appearance as maturity (Micronaire) increases

Uster Statistics on raw cotton
Micronaire over staple length



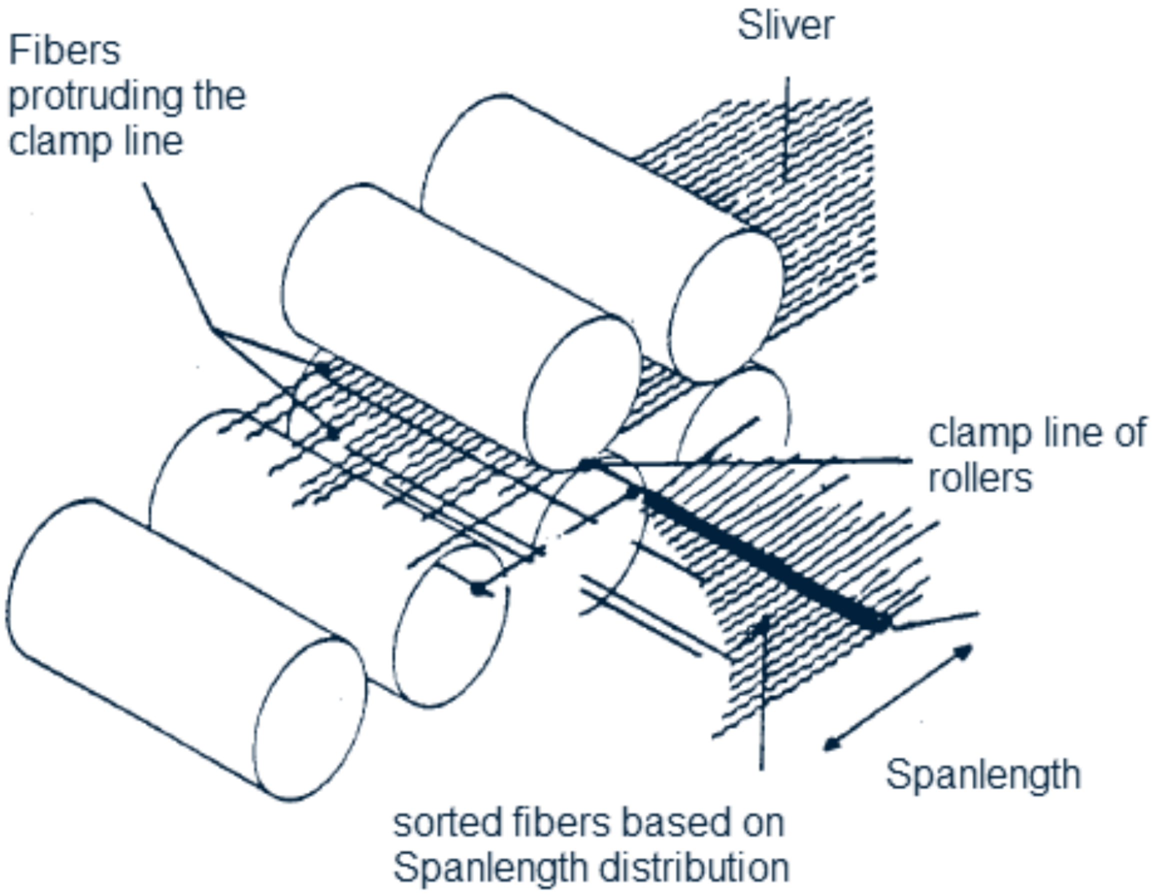
Courtesy of Uster Technologies AG

Cotton characteristic

Length

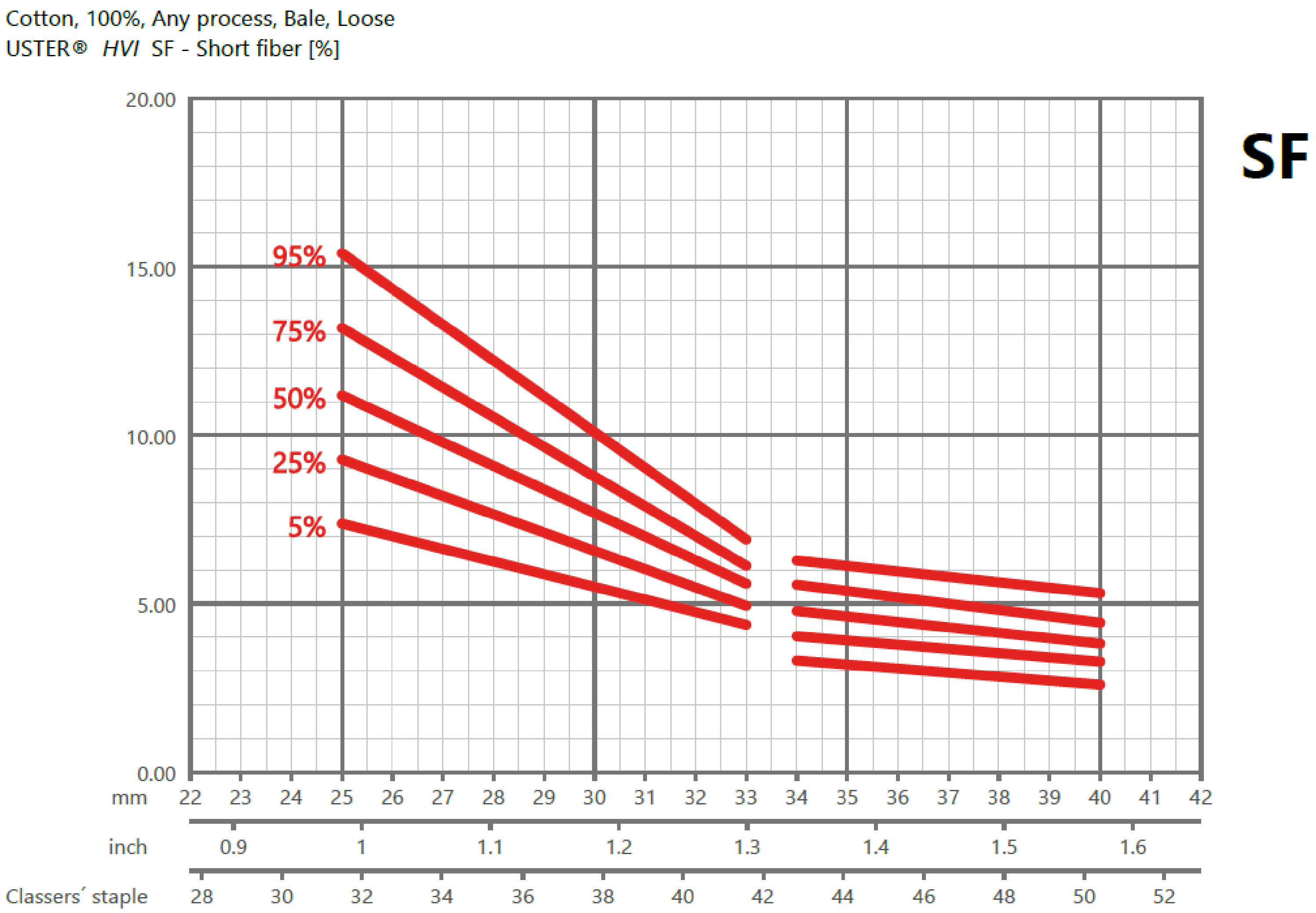
- Length is affected by genetics, environment during the growing season, and ginning
- Instrument measurements of UHML are usually similar to the results assigned by classers pulling staple. Classers assign **staple lengths** in 32nds of an inch, whereas instrument results are given in hundredths of an inch or millimeters and are more easily used in calculations of the mean or standard deviation over a number of samples.
- Length is one of the most important parameters used in all segments of the cotton value chain including trade
- Length is the most important property in the production of ring spun yarn.
- Length affects the **spinnability** of cotton and influences the number of twists per inch of yarn required to achieve a given level of strength. Length is the most important property in **setting drafting** parameters within a textile mill.
- Length distribution strongly influences nearly all **yarn quality parameters**. UHML affects yarn strength. Length uniformity influences evenness, and SFI affects hairiness.

Figure 18: Fiber length distribution in a drafting zone



Uster Statistics on raw cotton

Short Fiber Index over staple length



Courtesy of Uster Technologies AG

Cotton characteristic
Strength

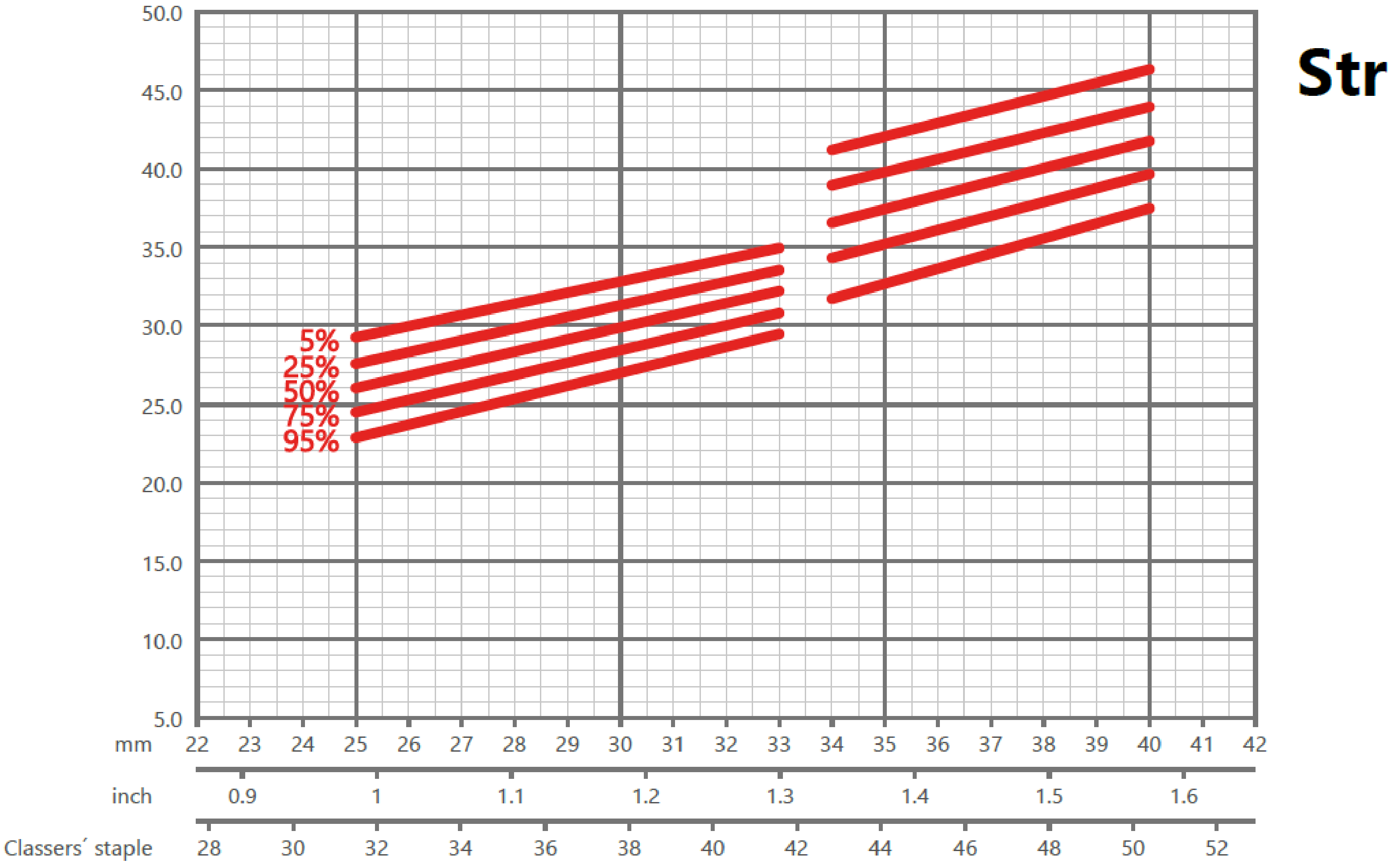
- Strength is a result of seed variety and growing conditions.
- Excessive drying and the use of lint cleaners during ginning will reduce strength and lead to increased **fiber breakage**.
- Strength is the most important property for Open End (Rotor) and Air-Jet spinning.
- Fiber strength and length influence **yarn strength**, which is crucial in **weaving yarns**.

ITMF

Uster Statistics on raw cotton

Strength over staple length

Cotton, 100%, Any process, Bale, Loose
USTER® *HVI* Str - Strength [g/tex]



Courtesy of Uster Technologies AG

Table 11: Priorities and significant parameters for the different spinning systems

Ring spun yarns	OE rotor yarns	Air jet yarns
Length	Strength	Strength
Length uniformity	Fineness	Length
Strength	Cleanness	Cleanness
Maturity	Length	Fineness
Fineness	Length uniformity	Length uniformity
Elongation	Elongation	Elongation
Cleanness	Maturity	Maturity
Color	Color	Color

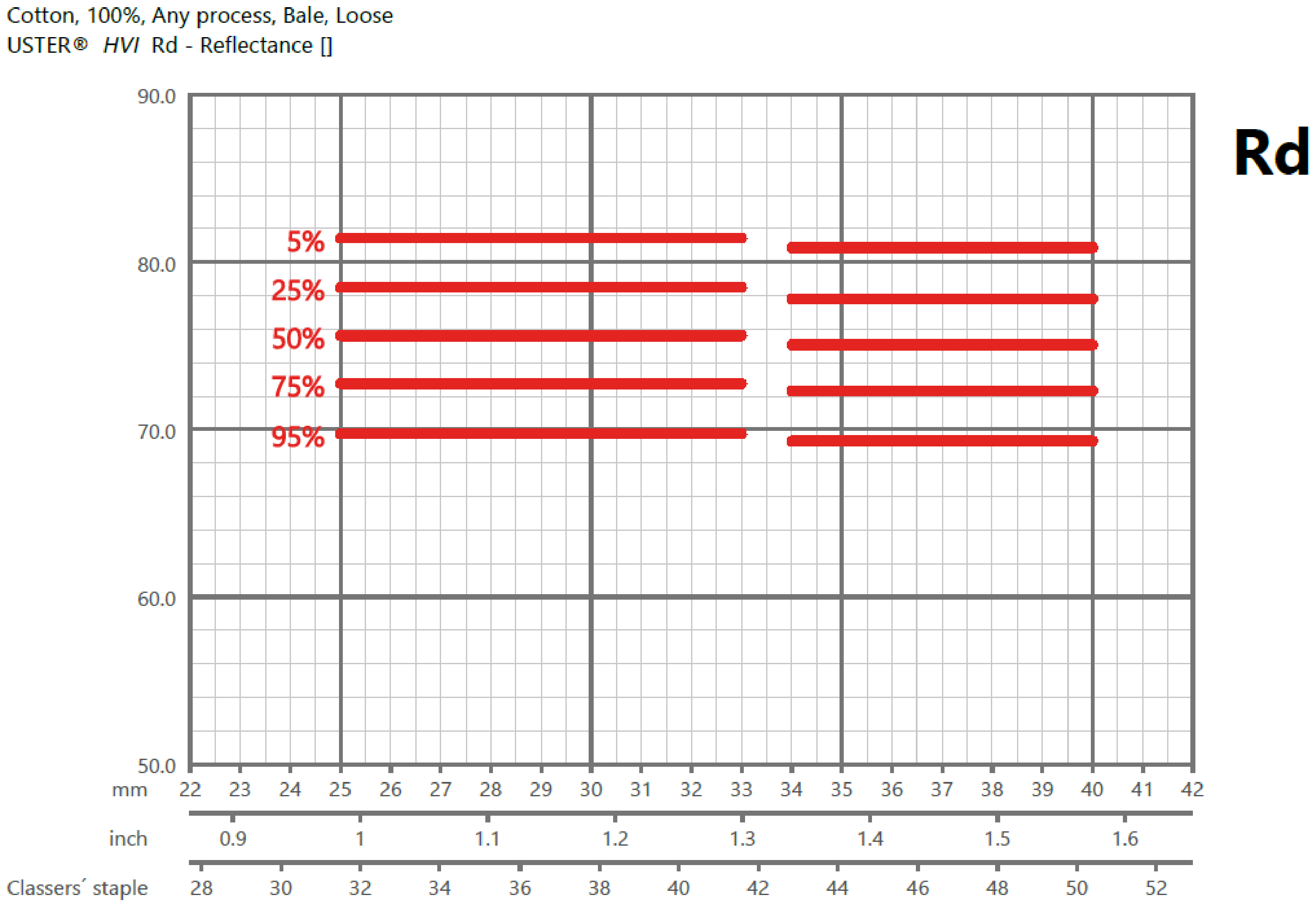
Cotton characteristic
Color

Changes in color indicate the history of a bale of cotton. Cotton can change in color from white to grey or yellow, depending on how it was **grown and harvested**, whether it rained during harvest, how much moisture was in the seed cotton and how long it was **stored** prior to ginning. Grey or yellow cotton will generally be weaker than white cotton.

In processing, color is important for **dyeing** and the **homogeneity of dyeing**.

Uster Statistics on raw cotton

Reflectance over staple length

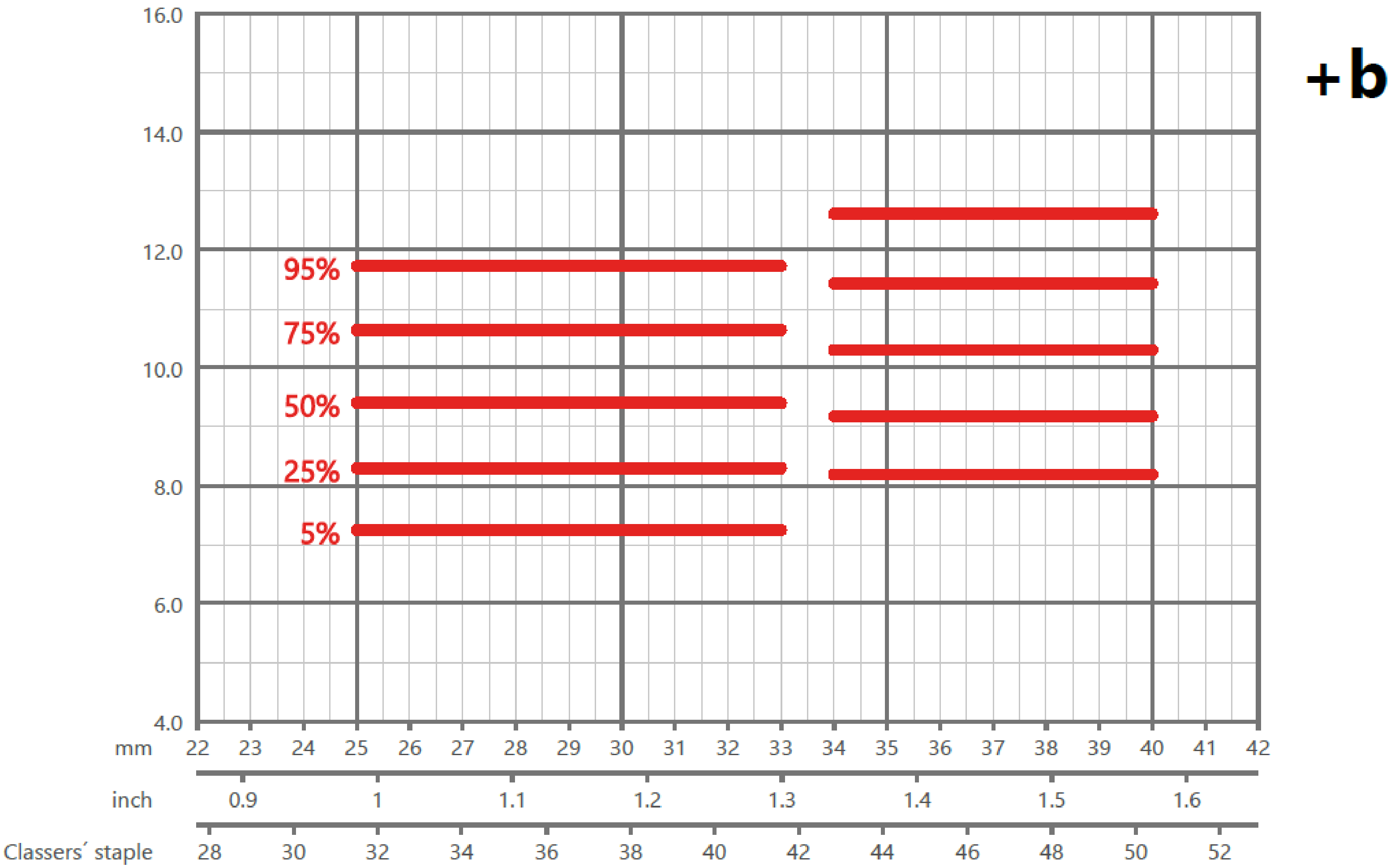


Courtesy of Uster Technologies AG

Uster Statistics on raw cotton

Yellowness over staple length

Cotton, 100%, Any process, Bale, Loose
USTER® *HVI* +b - Yellowness []

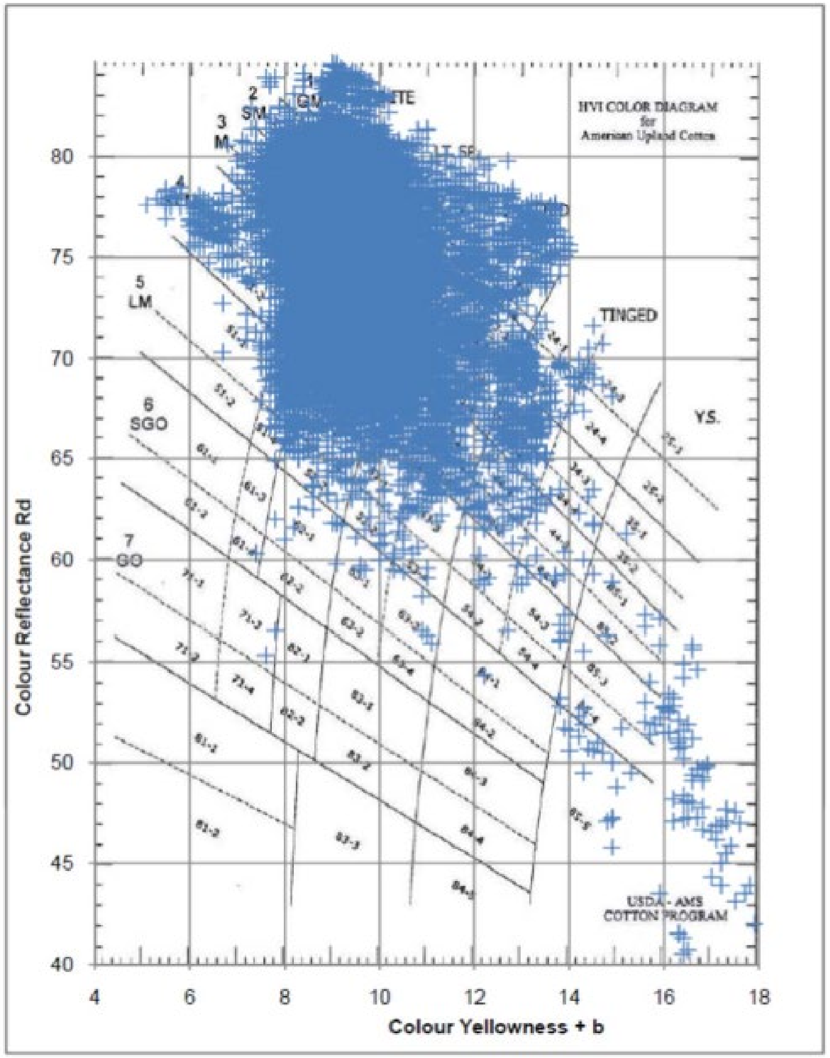


Courtesy of Uster Technologies AG

Table 13: Color grades of Upland cotton (* - Physical standards for color grade # - Physical standards for leaf grade)

	White	Light spotted	Spotted	Tinged	Yellow stained
Good Middling (GM)	11*	12	13	-	-
Strict Middling (SM)	21*#	22	23*	24	25
Middling (M)	31*#	32	33*	34*	35
Strict Low Middling (SLM)	41*#	42	43*	44*	-
Low Middling (LM)	51*#	52	53*	54*	-
Strict Good Ordinery (SGO)	61*#	62	63*	-	-
Good Ordinery (GO)	71*#	-	-	-	-
Below Grade (BG)	81	82	83	84	85

Figure 24: Color chart with 17 000 data points from ICA Bremen, worldwide cottons



Cotton characteristic
Trash

Trash is influenced by **harvesting method:** hand, spindle or stripper.

For a given harvest method, **ginning** will have the dominant impact on trash content.

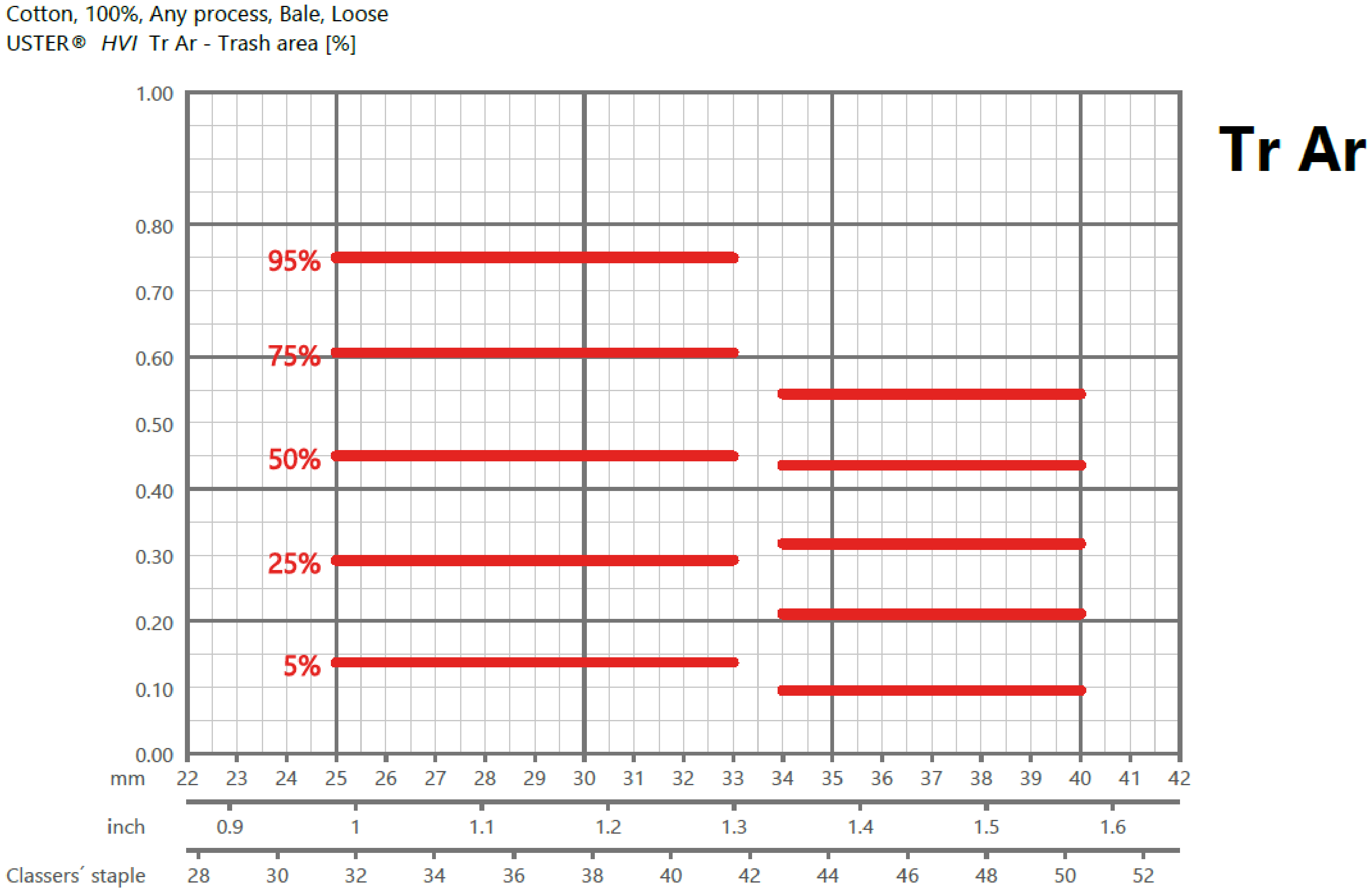
In trading, trash represents **non-lint content** of bales and thus has a negative impact on **prices**.

Trash can be partially **removed** at the gin using lint cleaners or in the carding and combing processes at the textile mill prior to the cotton reaching the spinning frames.

Trash has a **negative impact** on textile **processing** and possibly on the **appearance** of the final product

Uster Statistics on raw cotton

Trash Area over staple length



Courtesy of Uster Technologies AG

Cotton characteristics

Neps, Stickiness, Spinning Consistency Index, Moisture

Nep formation (**fiber entanglement**) is influenced by fiber maturity and the intensity with which cotton is processed. Slow and careful processing from ginning through spinning reduces nep formation.

Neps influence the yarn and fabric **appearance** negatively.

Stickiness caused by white fly or aphid infestation interferes with the spinning process, particularly in drafting. Very sticky cotton can bring a textile mill to a halt.

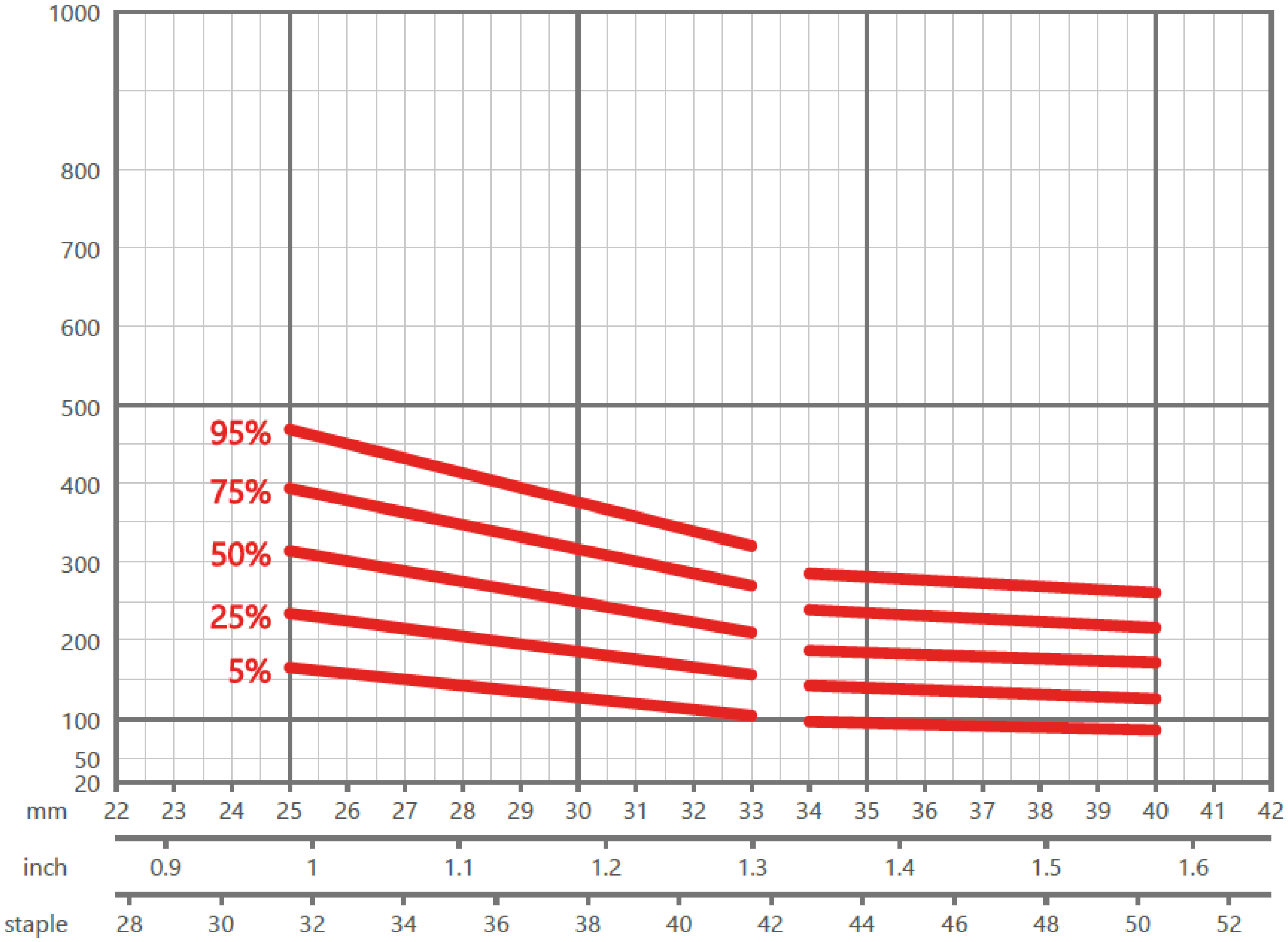
Spinning Consistency Index is a summary parameter that is determined by the results of micronaire, strength, length, length uniformity and color in high volume testing instruments.

Fiber moisture affects processing. Dry fiber is prone to higher rates of breakage.

Uster Statistics on raw cotton

Total neps over staple length

Cotton, 100%, Any process, Bale, Loose
USTER® *AFIS* tot N Cnt - Total nep count [/g]



tot N Cnt

Courtesy of Uster Technologies AG

Fiber properties, their use and influence,

Influence of the fiber properties depending on the stage in the value chain

Property	Use in ginning	Use in trading	Use in spinning	Influence on yarn quality	Influence on further textile processing
Micronaire	-	XX	XX	XX	X
Length	X	XX	XX	XX	-
Strength	-	X	XX	XX	-
Color	-	XX	-	X	X
Trash	XX	XX	X	XX	-X
Neps	-	-	X	XX	X
Stickiness	-	X	XX	X	X

ITMF

Table 19: Influence of fiber properties on yarn quality properties

	Evennness CVm	Thick places	Thin places	Neps	Hairiness	Strength	Elongation	Appearance	Dyeability
Micronaire/Fineness	XX	XX	XX	XX	XX	XX	XX	XX	XX
Maturity	XX	XX	XX	XX	-	XX	XX	XX	XX
Length	XX	XX	XX	XX	XX	XX	XX	XX	-
Short Fiber Content	XX	XX	XX	XX	XX	XX	XX	XX	-
Strength	-	-	-	-	-	XX	XX	-	-
Elongation	-	-	-	-	-	XX	XX	-	-
Nep content	X	-	-	XX	-	-	-	XX	XX
Dust & trash content	X	XX	XX	XX	-	XX	XX	XX	-
Color/color deviation within lot	-	-	-	-	-	-	-	XX	XX
"xx" direct relationship, "x" indirect relationship, "-" no relationship									

Courtesy of Uster Technologies AG

Table 20: Influence of process stages in ring spinning operations on yarn quality properties

	Evennness CVm	Thick places	Thin places	Neps	Hairiness	Count	Strength	Elongation
Bale Lay-down	XX	XX	XX	XX	XX	-	XX	XX
Blowroom	XX	XX	XX	XX	-	-	XX	XX
Card	XX	XX	XX	XX	XX	XX	X	X
Drawframe	X	XX	X	X	-	XX	X	X
Comber	XX	XX	XX	XX	XX	-	XX	XX
Roving frame	X	X	X	-	X	X	X	X
Spinning frame	X	X	X	X	X	X	X	X
Winding machine	X	X	X	XX	XX	-	X	XX
"xx" direct relationship, "x" indirect relationship, "-" no relationship								

Courtesy of Uster Technologies AG

ITMF

Table 21: Influence of yarn properties on knitted fabric characteristics

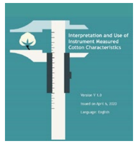
	Appearance	Dimensional stability	Thickness	Hand /Drapé	Pilling	Ward and weft breakage rate	Holes, knitting	Spiralty	Dyeability/color, intensity, fastness	Wash and wear properties	Strength	Elongation
Mass variation CVm	X			X		X	X		X		X	X
Thick places	X			X		X	X		X			
Thin places	X			X		X	X		X			
Neps	X			X					X			
Hairiness	X		X	X	X	X			X	X		
Hairiness variation	X		X	X	X	X						
Diameter	X		X						X			
Diameter variation	X								X			
Shape	X		X						X			
Density	X		X	X					X	X		
Trash, Dust	X					X	X				X	
Strength		X				X	X				X	
Elongation		X				X	X				X	X
Twist	X	X		X	X	X	X	X		X	X	X

Courtesy of Uster Technologies AG

Big thanks for the contribution and support

- **Jean-Paul Gourlot**, CIRAD, UPR AÏDA, F-34398 Montpellier, France, and AÏDA, Univ Montpellier, CIRAD, Montpellier, France.
- **Axel Drieling,** Faserinstitut Bremen e.V. (FIBRE) / ICA Bremen, Bremen, Germany.
- **Mona Qaud**, Uster Technologies, Uster, Switzerland.
- **Stuart Gordon**, CSIRO, Geelong, Australia.
- **James Knowlton**, USDA AMS, Memphis, USA.
- **Malgorzata Matusiak**, Lodz University of Technology, Lodz, Poland.
- **Marinus van der Sluijs**, Textile Technical Services, Geelong, Australia.
- **Karsten Froese,** Bremer Baumwollbörse, ICA-Bremen, Bremen, Germany.
- **Chris Delhom**, USDA-ARS-SRRC, New Orleans, USA
- **Vikki Martin**, Cotton Incorporated, Cary, USA.

Cotton Inc



Big thanks for the contribution and support

- **Terry Townsend**, Cotton Analytics and Secretary of the ITMF-ICCTM Steering Committee,
- USA for his support along time to this work
- **Andrew Macdonalds**, Chair of the CSITC Task Force and of the ITMF-Spinning Committee for providing his knowledge from production through to use into
- All Members of the **ICAC-CSITC** Task Force and of the **ICCTM-ITMF** Working Groups for their inputs in the reviewing process
- **Bruno Bachelier**, Cirad, France, for his valuable comments during the reviewing phases of this document.
- Courtesy of **Uster Technologies** for the use of USTER® STATISTICS for cotton (www.uster.com/statistics2018) in most chapters of this document.
- **Cotton Incorporated** for designing the cover page of this document.
- **International Cotton Advisory Committee**, for their support to the CSITC-Task Force.
- **International Textile Manufacturers Federation**, for their support to the ICCTM.
- All **Organizations supporting** the presence and attendance of their Experts to all working groups working at the **harmonization of fiber quality assessments**.
- All **Interpreters** for translating the official English book into other languages similarly to what has usually been done for the 'CSITC Testing Guide'.

Link for download

The userguide Version 1.0 of 2020 is available here

ITMF

ICAC

CSITC

ITMF

Guideline for Standardized Instrument Testing of Cotton

ICAC Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC)

and

ITMF International Committee on Cotton Testing Methods (ICCTM)

Editors:

- Axel Drieling, Faserinstitut Bremen e.V. (FIBRE) / ICA Bremen, Bremen, Germany
- Jean-Paul Gourlot, CIRAD-LTC, Montpellier, France
- James Knowlton, USDA-AMS, Memphis, TN, USA

Contributors:

- Axel Drieling, Faserinstitut Bremen e.V. (FIBRE) / ICA Bremen, Bremen, Germany
- Jean-Paul Gourlot, CIRAD-LTC, Montpellier, France
- James Knowlton, USDA-AMS, Memphis, TN, USA
- Lawrance Hunter, CSIR and Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
- Philipp Lehne, Faserinstitut Bremen e.V. (FIBRE), Bremen, Germany
- Andrew Macdonald, AMCON Consulting, Sao Paulo, Brazil
- Greg Parle, Auscott, Sydney, Australia
- Mona Qaud, Rieter, Switzerland / ITMF ICCTM HVI Working Group
- Anja Schleth, Uster Technologies Inc., Knoxville, TN, USA
- Ralph Schulzé, Consultant, Narrabri, Australia
- Marinus van der Sluijs, CSIRO, Materials Science and Engineering, Geelong, Australia
- V. Srinivasan, Premier Evolvics, Coimbatore, India

Published by:

- International Cotton Advisory Committee (ICAC), Washington, D.C., USA
- International Textile Manufacturers Federation (ITMF), Zurich, Switzerland

This publication is available at:

- www.csitc.org
- www.icac.org
- www.itmf.org

Available in English (valid version), Arabic, Chinese, French, Portuguese, Russian and Spanish (translated; possibly not in the latest version)

Date of issue: V3.0 – March 19, 2018

Version: Long

INTERNATIONAL COTTON ADVISORY COMMITTEE

1629 K Street NW, Suite 702,
Washington DC 20006
USA

Telephone +1-202-463-6660
Fax +1-202-463-6950
e-mail: secretariat@icac.org

INTERNATIONAL TEXTILE MANUFACTURERS FEDERATION

Wiedingstrasse 9
CH-8055 Zürich
Switzerland

Telephone +41-44-283-6380
Fax +41-44-283-6389
e-mail: secretariat@itmf.org

Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC)

International Committee on Cotton Testing Methods (ICCTM)

Common Fund for Commodities
Stadhouderskade 55
1072 AB Amsterdam
The Netherlands

Web: www.common-fund.org
E-mail: managing.director@common-fund.org

European Commission
Directorate-General for Development and Co-operation
EuropeAid
Rue de la Loi 41
B 1049 Bruxelles, Belgium

http://ec.europa.eu/europeaid/index_en.htm

This publication is an output of the project CFC/ICAC/33 Commercial Standardization of Instrument Testing of Cotton, which was funded by the Common Fund for Commodities, an intergovernmental financial institution established within the framework of the United Nations, headquartered in Amsterdam, the Netherlands, and by the European Union in the framework of its "All ACP Agricultural Commodities Programme", at the request of the International Cotton Advisory Committee (ICAC).

The views expressed in the publication are those of the authors and are not necessarily shared by the Common Fund for Commodities and/or the European Union and/or the International Cotton Advisory Committee. The designation employed and the representation of material in this report do not imply the expression of any opinion whatsoever on the part of the Common Fund for Commodities and/or the European Commission or the International Cotton Advisory Committee concerning the legal status of any country, territory, city or area or its authorities, or concerning the delineation of its frontier or boundaries.

Contents

1. Preamble

Standardized high volume instrument testing of cotton is carried out widely today and is becoming more and more the basis for cotton trading instead of manual classing. The aim of the ICAC Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC Task Force) is to facilitate instrument testing for commercial use. For this, it is important to obtain reliable and comparable test results from all involved laboratories worldwide.

The findings of the 6th Breakout Session – Best Practices in Instrument Testing – of the 68th International Cotton Advisory Committee (ICAC) Plenary Meeting in Cape Town, South Africa, in 2009 confirmed the need for designing a universally acceptable and comprehensive manual covering best practices for commercial instrument testing of cotton fibers from sampling to data reporting.

The CSITC Task Force and the International Textile Manufacturers Federation (ITMF) International Committee on Cotton Testing Methods (ITMF-ICCTM) agreed to jointly work on this important topic, together with representatives from the United States Department of Agriculture, Agricultural Marketing Service (USDA-AMS) and the instrument manufacturers. The CFC/ICAC/33 project, funded by the Common Fund for Commodities and the European Commission, served as a framework to develop this Guideline and to acquire some of the relevant knowledge.

The Guideline combines into an operational guide information from:

- The ASTM Standard Test Methods
- The ITMF HVI User Guide
- The USDA Guidelines for HVI Testing
- Manufacturers' instructions
- The recommendations from the CSITC Task Force and the ITMF International Committee on Cotton Testing Methods
- And up-to-date knowledge.

2. Introduction

For the production, trading and processing of cotton, including the prediction of its processing performance and product quality, it is important to know the quality of the fibers. Instrument testing offers the opportunity to rapidly measure the most important characteristics of each single cotton bale, and many countries include the test results in commercial cotton trading. As cotton is traded worldwide, test results need to be obtained and expressed in the same standardized way and on the same result level, no matter where in the world the tests are carried out.

After sampling in a standard way, samples should be tested in a standardized way, which includes the following steps:

- Standardization – utilizing approved physical calibration standards and standardized calibration and test procedures
- Verification – utilizing approved methods to validate testing levels
  - Inter-laboratory Round Trials
  - Instrument qualification (ASTM D7410)
  - Within-laboratory verification

For the CSITC purpose, standardized instrument testing may be defined as:

- Testing, according to a standardized method (ASTM D5867) and on a common scale, for any one or more of the following characteristics as defined in ASTM D5867 and currently recommended by the CSITC Task Force:
  - Micronaire
  - Strength
  - Upper Half Mean Length, Length Uniformity
  - Color Reflectance (Rd) and Yellowness (+b)
- Calibration with Universal Standard Materials as currently provided by USDA
- Comparison and verification of instruments in CSITC Round Trials, which may be accompanied by re-tests in an independent laboratory

Definition is not confined to a specific instrument manufacturer, model or technology, and is not dependent on the speed of testing of the instrument.

The testing instruments usually measure other characteristics in addition to the above mentioned CSITC parameters. ASTM D 5867 also additionally includes Trash Area and Trash Particle Count and Elongation. Besides these, instruments may also measure or derive other characteristics, such as Short Fiber Index, Maturity, Color Grade, Trash Grade and CSP.

The CSITC Guideline is specifically directed at testing of Upland cotton varieties, which account for over 95% of world cotton production. Nevertheless, this Guideline covers extra fine cotton testing in the calibration and testing sections.

Any process output or effect can be defined as a function of its various inputs, which might be categorized for testing of cotton samples as:

- Test material
  (see sections: Sampling, Conditioning, Sample Handling)
- Environment
  (see sections: Laboratory Environment, Atmospheric Conditions, Conditioning)

- Test method
  (see sections: Calibration, Testing)
- Instrument
  (see sections: Testing Instruments, Instrument Service, Maintenance)
- Personnel
  (see section: Personnel)
- Management
  (see sections: Laboratory Management, Sample Handling, Data Recording)

The objective of this Guideline is to cover all inputs in order to assist cotton testing laboratories in obtaining accurate test results, with testing costs only a secondary focus. The various inputs will be detailed in the sections below.

As the topic is very complex and at the same time laboratories need an easily understandable guide, each topic in the text is divided up into:

- Explanations
  → in order to understand the subject
- Requirements
  → that must be met (marked in a box)
- Recommendations
  →to improve testing reliability (marked as "Recommendations")
- More information
  →for a deeper understanding

3. Necessary Basic Documents

The following documents shall be referenced by laboratories for testing purposes:

→ The current version of the ASTM D 5867 "Standard Test Methods for Measurement of Physical Properties of Cotton Fibers by High Volume Instruments" (current version: 2012)

→ Manufacturers' instrument manual(s)

→ ASTM D 1776 "Practice for Conditioning and Testing Textiles (current version: 2016)

→ ASTM D7410 "Standard Practice for Qualification of Cotton Classification Instruments for Cotton Marketing" (current version: 2007, reapproved 2012)

(Recommendations): Besides the above, it is recommended that there is access to the latest versions of the following:

- ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories" (version 2005)
- USDA Guidelines for HVI Testing (based on version June 2005)
- ISO 139 "Textiles – Standard Atmospheres for Conditioning and Testing" (version 2005 + Amd. 1: 2011)
- "The Classification of Cotton" – USDA AMS Agricultural Handbook 566 / Cotton Incorporated 2013 (available at http://www.cottoninc.com/fiber/quality/Classification-Of-Cotton/Classing-booklet.pdf)

All documents shall be maintained in their latest versions.

4. Definitions

Definitions regarding samples

- Test specimen: the fibers being actually tested in one measurement of the instrument (e.g. one Micronaire plug, one beard)
- Subsample: a defined part of a sample (e.g. a portion)
- Portion (or Side): One half of a bale sample when sampling both sides of a bale. The two portions are combined into one bale sample.
- Bale sample: A sample representing one bale.
- Gin sample: A bale sample taken during the ginning process from the final cotton lint product.
- Control sample: A bale sample taken subsequently to ginning e.g. in the warehouse.
- Other samples: Samples not specifically representing one bale.

Definitions regarding testing

- Measurement: One measurement on one specimen in one module of the instrument (e.g. one Micronaire plug, one beard)
- Test: Combination of measurements on one sample in one or more modules of the instrument for one result (one result line in the instrument report).
- Number of tests: Multiple repeats of tests to arrive at an average result for one sample.

5. CSITC Requirements for Cotton Testing

The objective of the CSITC Task Force is to facilitate instrument testing for commercial use by creating confidence in instrument testing results. This is mainly achieved by agreeing on the various requirements in a completely transparent process.

The following requirements have been specified by the CSITC Task Force.

Currently the test results of the following six characteristics are confirmed by the CSITC Task Force to be sufficiently reliable for commercial purposes

→ Micronaire

→ Strength in g/tex

→ Length UHML in mm or decimal inches

→ Uniformity Index UI in %

→ Color Reflectance Rd

→ Color Yellowness +b

Sampling

→ Mechanical sampling at gin/press

→ Samples of not less than 200 g

→ Identify samples clearly (gin ID, bale number).

(Recommendations) Aim to achieve 100% sampling of all bales.

Additionally, the origin could be mentioned on the label.

Only calibration with the following calibration material is allowed

→ Universal HVI Calibration Cotton Standards (U-HVI-CCS) for length and strength parameters. For testing Extra Fine varieties[1] the USDA Extra Long Staple Standards shall be used as described in section 11.

→ Universal HVI Micronaire Calibration Cotton Standards for Micronaire shall be used.

→ USDA Color and Trash Calibration Materials for Rd / +b and for trash percent area and particle count

→ The aforementioned calibration materials are available from USDA-AMS (order at www.ams.usda.gov/cotton → Standardization) or from the instrument manufacturers.

Only for specific instrument types and customers, alternatively 2 USDA Calibration Orifices and USDA Chamber Calibration Cottons can be used for Micronaire calibration, strictly following the relevant procedure. Instrument's setup 4.0 orifice must not be used for this purpose (contact USDA-AMS for more information).

Testing shall be done according to ASTM D5867

[1] For this type of cotton, the ICAC wording "extra fine" is used in this guideline. Else it is often referred to as extra long staple or Pima or G. barbadense.

(*Recommendation*) ISO 17025 offers an appropriate framework for assuring suitable testing conditions and laboratory management. Laboratories are encouraged to acquire ISO 17025 accreditation or at least to follow its technical requirements.

The CSITC characteristics are defined as named above AND combined with the named calibrations AND combined with testing according to the named standard test method.

Participation in the International CSITC Round Trials is necessary.

Adhering to the given CSITC requirements and assessing the accuracy in the CSITC Round Trials will ensure test results at the CSITC recognized level.

More information can be obtained from the CSITC Task Force Reports. Information is also given on csitc.org or icac.org. More details about each topic are given in the specific section which follows.

6. Sampling

Sampling shall be performed after the bale is formed (or being formed) and can be done either at the gin ("gin samples") or warehouse ("control samples"). Preferably, sampling should be done at the gin.

In order to cover the whole color measurement window, the sample size should be approximately 150 to 300mm long and 150mm wide. The weight should be at least 200g.

Each sample shall be identified with a tag (coupon) placed within the sample (between the portions for a two-sided sample), giving at least the gin or warehouse identification and bale number.

(*Recommendations*)

- Sampling to be done mechanically (mechanical bale press knives “cookie cutters” or warehouse mechanical saws)
- Sampling to be done at the stage when the bale is formed (or being formed) in the gin
- Draw samples from both sides of each bale for forming a "two portion sample" per bale.
- Alternatively, take the appropriate number of samples from each bale, to accurately represent the quality of the bale and to meet the allowed trading tolerances.

(*Recommendations*) In the case of control samples, remove 1 or 2 bands from near the center of the bale. Cut the covers to expose the surface of the baled cotton. Knives at the gin bale press may have already made the cut into the bale. If not, mechanical saws may be used at the warehouse to cut into the bale. Reach into the pre-cut hole and insert the fingers into the layers of cotton and draw fibers across the bale in a rolling motion, removing a large flake (layer) of approximately 100g. This should be repeated on the other side of the bale. When sampling, ensure that the outer layer of cotton is firstly removed, as this layer may be dirty.

Sample all (i.e. 100%) bales. Alternatively, a sampling plan can be agreed upon between the supplier and the purchaser and applied.

If the seed cotton is consistent within a seed cotton module, then module averaging across multiple bales can be considered.

(*Recommendations*) Samples should be packed immediately after sampling without any other kind of handling. Packages and samples should be clearly identified by gin, optionally lot reference, and bale numbers. Samples should be wrapped in packages of no more than 100 samples per package. Samples should only be packed in heavy paper, cotton covers or heavy duty plastic. Packing of single samples in plastic bags is not permitted.

7. Laboratory Environment

7.1. Electrical

A consistent and reliable power supply is necessary to ensure proper operation and protection of instruments and personnel.

Follow the instrument manufacturers' specifications as published in their technical manual.

(*Recommendations*) The equipment in the laboratory should be protected by separate circuit breakers.

(Recommendations) A separate electrical line to be used which should be free from transient voltage.

An uninterruptable power supply (UPS) or suitable surge protection is required for the testing instrument as specified by the instrument manufacturer.

(*Recommendations*) For the UPS, the minimum requirement is to protect the instrument's computer. With an adequate UPS capacity, the whole machine can be protected. The UPS has to be such that it at least allows the computer/instrument to be shut down safely. At least 10 minutes is considered necessary.

(*Recommendations*) The UPS should include a "Line Interactive" or "AVR = Automatic Voltage Regulation" for maximum protection against under/reduced voltages (brownouts) and over/excessive voltages (spikes).

Emergency power generators can allow continued work in the laboratory independently from the grid, but a UPS is still required. In the case that testing is to be continued with an emergency power generator, the UPS has to cover the period up to the start of the power generator.

In the case of power interruptions it is important that testing only be continued if the air conditioning is functional and the actual atmospheric conditions remain within the allowed limits.

7.2. Compressed Air

The instruments require

- An air pressure within the range specified by the manufacturer
- Clean air – by means of a suitable filter
- Dry air – by means of a suitable air drier / water trap
- Oil free compressed air
- Sufficient air volume of the compressor
- Sufficiently wide air tubes

Follow the instrument manufacturer's specifications as published in their technical data sheet.

For defining the air supply, the number of instruments and a safety margin shall be considered.

In case of having multiple instruments using a common air supply, ensure that each instrument always gets the required pressure and flow, even in case of all operating at the same time.

7.3. Space

Sufficient space shall be available for the instrument, the operator and the samples.

(*Recommendations*)

- For the instrument, besides the instrument size itself, at least a 70 cm space should be provided on each side to allow for instrument maintenance.
- For the operator, sufficient space has to be provided to move and operate the instrument as well as to handle the samples being tested.
- Space is also required for conditioning the samples. This is considered in the sections dealing with sample conditioning.

8. Atmospheric Conditions / Conditioning

8.1. Standard Temperature, Standard Humidity and Monitoring/Recording

As the measured characteristics (mainly strength) are influenced by the cotton moisture content and methodology of conditioning, samples must be brought to a moisture content which is in equilibrium with the approved atmospheric conditions before and during testing.

The relevant ASTM Standard Practice is ASTM D 1776 "Standard Practice for Conditioning and Testing Textiles. For cotton testing".

→ The allowed temperature range is fixed at 21 +/- 1°C (70 +/- 2°F)

→ The allowed relative humidity range is fixed at 65 +/- 2% RH

The tolerance range around the humidity target (+/-2%RH) is even more important than the target (65%RH) itself, as calibration with cotton standards can compensate for slight variations in the absolute RH level, but cannot compensate for short term variations shorter than the time difference between two calibrations.

(*Recommendations*) Alternatively, ISO 139 Textiles Standard Atmosphere for Conditioning and Testing can be applied. For testing,

- The allowed standard temperature is fixed at 20°C, with a tolerance of +/-2°C minus the measurement uncertainty of the sensor – so in practice a conformity zone of not more than +/-1°C is allowed
- The allowed standard relative humidity is fixed at 65%RH with a tolerance zone of +/- 4%RH minus the measurement uncertainty of the sensor– so in practice a conformity zone of not more than +/- 2%RH is allowed

The laboratory has to be conditioned to the above conditions 24 hours a day, 7 days a week during the cotton classing season or when testing is on a continuous basis.

If, at any time the conditions exceed the tolerances, instrument testing must cease, and the conditions re-established. Records for the deviations and corrective actions must be maintained.

It is necessary to monitor the temperature and humidity continuously with independent sensors.

The monitoring can be done either with an electronic system (logger), or with a mechanical thermo-hygrograph, or by manually recording temperature and humidity periodically. The sensors need to have a sufficient sensitivity and resolution, suitable to detect and record short term fluctuations.

Sensors should be periodically calibrated and certified by an external body.

(*Recommendations*) An electronic monitoring system is preferred. Measurements should be done at least every 2 minutes.

Besides monitoring, the temperature and humidity records must be kept and documented for traceability.

(*Recommendations*) A psychrometer, ventilated by aspiration, or a similar measuring device, can be used for verifying the recorded relative humidity and avoiding systematic deviations.

Whereas ASTM D 1776 does not give any information about the time period of a moving average of the temperature / humidity for approving, ISO 139 defines a period of not longer than one hour for the moving average in order to exclude short term fluctuations.

(*Recommendations*) For cotton fiber testing, it is useful to apply a moving average to the climate data of each sensor for a maximum period of 5 to 15 minutes. Nevertheless the individual readings should be inspected frequently for any short term fluctuations. The overall aim should be to avoid short term variations, which are responsible for most of the cotton measurement variations, as well as drifts over longer periods.

As the temperature and humidity may vary at different positions in the laboratory, a sufficient number of sensors has to be used to cover all testing relevant zones of a laboratory. At least two sensors have to be used even in small laboratories for covering the samples and the instrument(s). The best position for the sensors is close to the instrument as well as close to the samples.

(*Recommendations*) ISO 139 requires one sensor for at maximum every 50 m^3. Locations near the middle of the room at heights approx. 1.5 to 2.5 m from the floor are generally desirable.

With the acquired temperature and humidity data it is possible to check if the atmospheric conditions were as specified for both the testing and the conditioning of the samples. Sample testing should only be conducted when

→ the climate conditions do not exceed the allowed tolerances

→ and did not exceed the allowed tolerances during conditioning.

8.2. Building / Laboratory Design

For maintaining the laboratory conditions within the allowed range, it is necessary to optimize the laboratory building. The most important factors affecting the laboratory conditions are the outside heat / radiation and vapor transfer, and their impacts have to be minimized.

(*Recommendations*)

- The best insulation is obtained by surrounding the conditioned laboratory and conditioning rooms with other rooms, thereby avoiding outside walls. At least there should be no doors to the outside.
- Windows usually do not provide good insulation and allow direct radiation and consequently allow heat to pass through, and should definitely be avoided.
- To reduce heating of the walls, direct solar radiation has to be avoided. This can be achieved by having large awnings on the East and West sides of the building. In locations further from the equator, the laboratory has to be protected from midday sun.

- Good heat and vapor barriers (insulation) will help in maintaining constant atmospheric conditions in the laboratory. Any investments in insulation will reduce daily energy costs and will stabilize laboratory conditions.
- Insulation should also be provided for the floor and the ceiling.
- The room size / volume influences the required capacity of the air management system and the daily energy costs. For this reason, the room area and height should not be larger than necessary.

In order to avoid rapid changes in atmospheric conditions, the exchange of air with other rooms should be at a minimum. For small labs (less than 150 m^2), air locks for every door leading to unconditioned areas are highly recommended. For all laboratories, the doors should close automatically.

(*Recommendations*) A positive air pressure in the laboratory will minimize outside impacts.

For conditioning the samples, a preconditioning room is not essential.

- For relatively moist samples, a preconditioning room might nevertheless be desirable or necessary for conditioning the samples to the dry side without using an oven. For this, the relative humidity of the preconditioning room should be kept at a maximum of 50% RH.
- For samples coming from relatively dry conditions, the preconditioning room, although not essential, can be beneficial. The room should have a relative humidity similar or slightly below the humidity of the testing room.
- With sufficient time for conditioning in the testing room, the required precision of the preconditioning room might be lower, saving costs.

8.3. Ambient Air Management System and its Design

To achieve accurate climatic conditions, the temperature as well as the relative humidity shall be controlled. Since the temperature and relative humidity of the air interact in terms of the absolute moisture content of the air, it is not possible to control temperature and relative humidity independently.

For sample conditioning and testing, an integrated Air Management System for simultaneously controlling temperature and humidity (integrated AMS, sometimes called "Heating, Ventilating and Air Conditioning System – HVAC") of the ambient air is required, rather than individual devices for temperature and humidity.

An integrated AMS consists of the following components with an interconnected control:

- Cooling system
- Heating system
- Steam humidifying system
- Drying system (optional)
- Control/regulation system, including sensors and comparator/regulator and command system
- Air flow components
- Air distribution

For achieving constant conditions, the integrated AMS should have a sufficient capacity to allow sufficient impact of the AMS components and a good homogenization of the air for its control.

The integrated AMS has to be designed specifically for the laboratory or room to be conditioned in order to achieve constant climatic conditions and to avoid fluctuations. This should be done by an experienced, licensed company.

The basis for the design includes:

- Historic distribution data of the outside temperature and humidity (or dry bulb and wet bulb temperatures) (for the relevant testing period)
- Typical daily maximum and minimum temperatures (relevant to the testing period)
- Extreme temperature and humidity levels (relevant to the testing period)
- General building design, position of the room(s) to be conditioned
- Room volumes
- Wall construction/insulation: material, thickness and dimensions / insulation of internal walls, external walls, floor and ceiling
- Roof construction/insulation
- Windows, shadings, doors, air locks
- Instruments involved and their power consumption
- Any system using the conditioned air of the room
- Minimum value of fresh air per minute, acceptable max. air speed
- People, lights, other heat sources
- Amount of moisture absorbing material (daily sample weight) and its moisture content

(For more information, see e.g. British Standard 4194: Recommendations on the design requirements and testing of controlled-atmosphere laboratories (withdrawn in 1992) or similar sources).

(*Recommendations*) In order to maintain constant conditions in the entire testing room it is important to distribute the conditioned air evenly. This can be done, for example, by suitable ventilation ducts with several outlet vents. Additional ventilators may be used. Care must be taken that there are no air drafts disturbing the measurements (e.g. balance), cross-contaminating the samples, or distributing dust.

(Recommendations) The total room air exchange rate should be at least 1 air exchange every four minutes.

(*Recommendations*) In addition to maintaining constant atmospheric conditions, adequate fresh air has to be supplied to the rooms.

Any installed conditioning system has to be maintained and serviced at least according to the manufacturer's specification.

A log book is an indispensable tool to store all relevant maintenance and service related information.

8.4. Passive Conditioning of the Samples

According to ASTM D 5867, the only requirement is to bring the laboratory samples to moisture equilibrium for testing in the atmosphere specified for testing textiles. Conditioned cotton samples will have to exhibit moisture content between 6.75 and 8.25% on a dry weight basis for Upland cottons when reaching moisture equilibrium[2, 3].

Unfortunately different cottons exhibite different moisture content despite their exposure to the same standard atmosphere.

Samples should be conditioned from the dry side. Moist samples requiring preconditioning need to be brought to a relatively low moisture content in a dry atmosphere.

(*Recommendations*) This can either be done in an oven having a temperature not higher than 50°C or in a preconditioning room with a humidity not higher than 50%.

Samples not requiring preconditioning are brought to moisture equilibrium.

Conditioning time must under no circumstances be shorter than 12h [ASTM D 5867]. It is recommended to condition samples for at least 24 to 48 hours [ITMF].

After any event during which the conditions exceeded the tolerances and conditions were re-established, the cotton must reach the conditioned moisture content before instrument testing resumes.

(*Recommendations*) To ensure the minimum conditioning time, the starting time for conditioning should be recorded.

Calibration cottons and test samples must be conditioned in the same conditioning area for a minimum of 72 h to ensure consistent moisture equilibrium.

Samples, including calibration materials, must be stored open in the conditioned laboratory. Conditioning of samples in sacks, wrappers or other coverings is not permissible. The samples have to be placed in single layers. The air needs to be able to penetrate the samples from all sides.

(*Recommendations*) Forced conditioned air moving across the surfaces of the samples is preferable. Open-wire shelves are preferred; plastic mesh baskets or suitable cardboard trays can be used when stored in mesh wire racks.

(*Recommendations*) When the samples are laid on the packing, more space around the samples has to be allowed for sufficient air penetration.

[2] An immature cotton cannot absorb as much moisture as a mature one.
[3] Extra fine / *Barbadense* cottons typically condition with a slightly lower moisture content.

Figures: Storage of samples for conditioning [Uster]

(*Recommendations*) It is important to undertake regular checks of the moisture content of the cotton samples. For Upland cottons, the moisture content should not exceed the range of 6.75 to 8.25% (dry basis) and should not vary by more than 1 percentage point from that of the Calibration Cottons. Out of range samples should be allowed additional conditioning time. If the range is still not achieved, then the sample should be marked as exceptional.

(*Recommendations*) Moisture content should be measured using the "oven dry" method or moisture meters (like the Strandberg Model 200D or equivalent), calibrated strictly according to the oven dry method.

8.5. Rapid or Active Conditioning of the Samples

The same requirements as for passive conditioning are valid for rapid conditioning: to bring the laboratory samples to moisture equilibrium for testing in the appropriate atmosphere for testing textiles (ASTM D 1776).

Rapid or active conditioning of cotton samples is done in laboratories equipped with Rapid Conditioning Units and may replace passive conditioning of the samples.

A Rapid Conditioning System cannot, however, replace appropriate laboratory climatic conditions during testing.

The principle of Rapid Conditioning Systems is that conditioned air is drawn through the cotton until equilibrium with the surrounding atmosphere is reached. The time of conditioning is usually less than one hour. It depends on:

- The rate of air flow
- Obstructions to the air flow (samples laid on sample wrappers)
- The moisture differential between the current sample moisture and the moisture of the sample at equilibrium
- The direction of conditioning (conditioning from the high moisture content side is much slower than from the low side).

Attention: The use of a rapid conditioner will increase the demands on the laboratory conditioning system capacity. It must be able to source considerably more moisture. The usual loss of moisture in a 24 hour period can now take place within ~ 15 minutes.

When rapid conditioning, air should be forced through the samples for at least 15 min.

Care has to be taken that air penetrates to the inner portion of the samples, too, so that the whole cotton sample reaches equilibrium moisture content.

The manufacturer's instructions should be followed.

The moisture content of the samples must be checked periodically to verify that the appropriate equilibrium moisture content has been reached. Conditioned cotton samples will have to exhibit moisture content between 6.75 and 8.25% on a dry weight basis for Upland cottons when reaching moisture equilibrium.

8.6. Instrument Correction for Moisture

Any moisture correction must not replace laboratory conditioning and sample conditioning.

At this stage, moisture correction must not be applied to any measured characteristic.

However, if moisture correction is applied, it must be reported with the results that a moisture correction has been applied and that the results are therefore not adhering to CSITC requirements.

9. Sample Handling in the Laboratory

The laboratory should ensure that any sample can be identified at any time, and that all relevant information can be allocated to the sample.

Deterioration, loss or damage to the test samples during storage, handling and preparation must be avoided and the integrity of the sample must be maintained.

(*Recommendations*)

- At any time, abnormalities or deviations from normal or specified conditions should be recorded.
- Lots / groups of samples should be kept together.
- The testing conditions, results and storage details should be recorded and stored. This data should be traceable to the physical sample.
- For possible re-tests, samples should be kept for a fixed period.

The identification, with all associated documentation, can best be achieved with a recording form accompanying the lot / group of samples.

(*Recommendations*) For best practice and efficiency, the sample handling should be organized in detail, so that it is followed at all times and known by all the relevant laboratory staff.

10.Standardized Instruments for Testing of Cotton (SITC)

10.1. General

Standardized **I**nstruments for **T**esting **C**otton, often referred to as High Volume Instruments or HVI (abbreviation protected by Uster), from here on called "**SITC**"[4], are able to measure at least the six characteristics recommended by the CSITC Task Force and defined in section 5. The instruments usually consist of the following modules:

- Micronaire Module
- Length/Strength Module
- Color/Trash Module
- plus supporting tools (e.g. balance, fibrosampler)

The above is not confined to a specific instrument manufacturer or model, and is not dependent on the speed of testing of the instrument.

The recommendations and comments in this guideline are based upon the experience with the following instruments:

- Uster HVI 1000, HVI Spectrum, HVI 900 types
- Premier ART, ART2 and HFT types

This guideline applies to stand-alone instruments, too, as far as they are designed to provide the CSITC Task Force defined characteristics.

An instrument must not be used for classification of cotton if it cannot be calibrated within the acceptable manufacturer's tolerance for any fiber property measurements.

The following table shows the instrument test results, format and abbreviations as provided directly from the instrument.

Test Result	Format	Abbreviation
1.Micronaire	**X.XX**	Mic
2.Maturity Index	**X.XX**	Mat
3.Upper Half Mean Length	**(in) X.XXX** **(mm) XX.XX**	UHML
4.Uniformity Index	**XX.X**	UI
5.Short Fiber Index	**XX.X**	SFI
6.Strength	**XX.X**	Str
7.Elongation	**XX.X**	Elg
8. Reflectance	**XX.X**	Rd
9. Yellowness	**XX.X**	+b
10. Color Grade	**XX-X**	C Grade
11. Trash Count	**XXX**	Tr Cnt
12. Trash Area	**XX.XX**	Tr Area
13. Trash Grade	**XX**	Tr ID

[4] Another suitable abbreviation is e.g. HVCT for High Volume Cotton Tester

10.2. Instrument Preparation / Maintenance

Instruments must be thoroughly checked at the beginning and end of each continuous testing period (e.g. season).

Always install and use the latest given manufacturer's software as soon as possible, as the modifications may affect the test results.

(*Recommendations*) Instruments must be serviced at least at the beginning of each testing season or once a year.

(*Recommendations*) Before being taken into service, the equipment, including support tools, should be checked to establish that it meets the laboratory's specifications and complies with the relevant standard specifications.

(*Recommendations*) The instrument should be qualified at the beginning of each testing season according to ASTM D 7410 "Standard Practice for Qualification of Cotton Classification Instruments for Cotton Marketing". Verification material is available at cotton.standards@usda.gov. / www.ams.usda.gov/cnstandards. Records of the annual verification results must be maintained.

For maintenance, follow the instrument manufacturer's procedures as published in their manual.

(*Recommendations*) Run the maintenance according to an instrument specific maintenance plan and check-list.

(*Recommendations*) A thorough mechanical check is recommended on a regular scheduled basis, particularly for SITCs with high daily testing volumes.

(*Recommendations*) The color/trash module will show deviating results with a scratched color window. This should be checked frequently, putting a white paper on it and looking at the camera image.

(*Recommendations*) Use a log book to record all events that may help in detecting or solving problems.

Each instrument should be rechecked for operation and accuracy after any corrective action / modification / update has taken place.

(*Recommendations*) For major corrective actions, relevant requalification procedures (ASTM 7410) should be performed. Records for the corrective actions and the subsequent verification should be maintained.

10.3. Operation / Testing

Unless otherwise defined, each test (=result line) should consist of at least
→ 1 Micronaire measurement = 1 specimen
→ 2 combs for the length/uniformity index/strength measurement = 2 specimens/beards
→ 2 color readings for Rd and +b = 2 specimens

For bale samples forming a lot, unless otherwise defined, one test per Upland cotton sample is carried out. In the case of extra fine cotton, roller ginned cotton or non homogenous cotton, the number of tests or the number of measurements per test shall be doubled.

(*Recommendations*) The number of measurements per test or the number of tests per sample should enable results of an acceptable accuracy to be achieved in accordance with the internationally recognized tolerances (see section 12).

(*Recommendations*) In order to identify and address outlying results, define and apply rules for repeating tests and for replacing or averaging test results. This might e.g. be lot limits or variation thresholds.

The instrument should be checked in terms of its condition and functioning at least at the beginning of each testing shift in accordance with the manufacturer's instructions.

Items to check include the condition of the instrument:

- General
  - State of the instrument (e.g. cleanliness, cotton residues, unusual sound)
  - Trash bin (empty)
  - Filters
- Length/Strength Module
  - Sampler (e.g. cleanliness, card cloth, homogenous cotton distribution on the comb)
  - Combs (e.g. missing teeth)
  - Brush (e.g. cleanliness, bent bristles)
  - Clamps (e.g. smooth surface, cleanliness)
  - Pressure at the clamps
  - Vacuum at the length/strength module
- Color/Trash Module
  - Color window (e.g. cleanliness, scratches)
  - Plate pressure
  - Light bulb / illumination
- Micronaire Module
  - Balance
  - Cleanliness

The surrounding area has to be checked at the beginning of each testing day.
→ Power supply
→ Compressed air (e.g. sufficient pressure, clean filter, empty water trap)
→ Air management system
→ Atmospheric conditions (current and during conditioning time)

The instrument should be kept "on" 24h / 7 days during the testing period, or else, the instrument must be warmed up for a sufficient period prior to the commencement of calibration and testing.

Tests should be performed according to the manufacturer's instructions.

When starting testing and periodically during testing, the operators must
→ Check the current atmospheric conditions
→ Check the calibration (see section 11)
→ Organize their working space
→ Organize the sample supply

10.3.1. Micronaire Module

A predetermined mass of raw cotton is placed in the measurement space and compressed. For measuring, a constant air pressure method is used.

Take one specimen from the bale sample and place the specimen into the instrument's micronaire measurement space for testing. For two portion samples, the specimen can be taken from either one portion or can be a combination of equal amounts from each portion.

For the bale sample, Micronaire is reported to the nearest 1/100 of a unit.

Any large foreign particles such as large pieces of trash, leaf and seeds must be removed manually from the sample before testing.
Fluff the fibers of the test specimen to eliminate dense clumps of fibers or knotty balls.

(*Recommendations*)

- Recommended sample size, as specified by the instrument manufacturer, should be strictly followed during testing.
- If the bale sample consists of 2 portions, the Micronaire specimen should represent both portions.
- The sample weighing balance should be properly calibrated and maintained according to the specifications of the manufacturer.
- Care must be taken not to lose any of the weighed material.
- The sample density should be as uniform as possible. Do not for example "poke" a finger through the middle of the sample when inserting the sample.
- External air disturbances around the Micronaire module and weighing balance should be strictly avoided.

10.3.2. Length/Strength Module

The length and length uniformity index of cotton fibers in a tapered beard are derived from the measured length distribution of the cotton fibers. Fibers are caught at random along their lengths to form a tapered beard. The tapered beard is scanned from base to tip to generate the fiber length distribution. The breaking tenacity (strength) is measured, based on breaking the tapered beards using 3.2 mm (1/8 inch) clamp spacing.

In the case of two portion bale samples for Upland cottons, take one specimen from each portion of the sample. In the case of extra fine or roller ginned cottons, take two specimens from each portion.

For the bale sample,
the Upper Half Mean Length is reported to the nearest 1/100 of a mm or 1/1000 of an inch,
the Length Uniformity Index is reported to the nearest 1/10 of a unit,
and the strength is reported to the nearest 1/10 of a gram force per tex unit.

(*Recommendations*)

- The recommended sample size for the sampler, as specified by the instrument manufacturer, should be strictly followed during testing.
- In semi-automatic specimen preparation
  - The amount of fibers in the beard can be influenced by the pressure on the sample as well as by the number of turns. The specimen preparation technique during testing should be as close as possible to the technique used during calibration and checking. The sample should be placed so that it is evenly spread over the width of the sample drum.
  - Take care that the beard does not show large holes or gaps without fibers.
  - Take care that the amount of fiber in the beard does not vary too much from comb to comb.
  - Clean the card clothing on the sampler periodically.
  - Take care that the card clothing is not damaged.
- Automatic sample preparation
  - Monitor the cleanliness of the card clothing.
- Check the combs frequently to detect any problems like missing teeth.
- Check that the combs are brushed out at every test.
- Monitor the brush in order to avoid previously attached fibers.
- Check the strength clamps routinely for dirt / particles / sticking fibers.

10.3.3. Color/Trash Module

A smooth representative surface of a cotton sample is placed in the color measurement area and pressed flat with a minimum force of 0.6 kg per square centimeter.

In the case of two portion bale samples, perform at least one measurement on each portion of the sample.

The surface of each subsample should be large enough to cover the instrument measurement area and thick enough to be opaque (no light transmitted through the sample). An uncompressed minimum thickness of 50 mm and a minimum measurement surface area of 100 cm² of each subsample are required.

For a bale sample, Rd and +b are reported to the nearest 1/10 of a unit.

For a bale sample, the percent area (trash), given in decimal form, is reported to the nearest 1/100 of a unit, and the particle count to the nearest whole number.

(*Recommendations*)

- The recommended sample size, as specified by the instrument manufacturer, should be strictly followed during testing.
- Take care to cover the full window for each measurement. This can be checked by the control monitor, too.
- The sample has to be thick enough to be opaque (no light transmitted through the sample). The thickness of the sample should be uniform.
- Select a smooth surface of the laboratory sample that is judged to be representative for color, avoiding lumps or folds.
- Check the color window frequently for cleanliness and scratches.

11.Calibration

11.1. Calibration Standards

Only calibration with the following calibration material is allowed:

→Universal HVI Calibration Cotton Standards (U-HVI-CCS) for length, uniformity index and strength parameters should be used. For testing of all Upland varieties, it is recommended to use the Upland Short/Weak standard combined with the Upland Long/Strong standard. For testing Extra Fine varieties, it is recommended to use the Upland Short/Weak standard combined with the ELS Long/Strong standard.

→ Universal HVI Micronaire Calibration Cotton Standards for Micronaire: One low Micronaire cotton and one high Micronaire cotton (or USDA orifice calibration method). The standards have to cover the entire range of cottons being tested and need to have a Micronaire difference of at least 1.5.

→ USDA Color and Trash Calibration Materials for Rd / +b and for trash percent area and particle count.

→ The above mentioned calibration material may be obtained from USDA-AMS (order at www.ams.usda.gov/cotton → Standardization).

(*Recommendations*) Micronaire Only Calibration Cotton Standards (ICCS), provided by the USDA, offer a choice of 6 cottons in the Micronaire range. They are recommended for Micronaire Calibration checking, but should not be used for calibration.

Generally the approximate test values for the calibration cottons are [USDA]: [5]

For testing Upland cottons				
	UHM Length, In.	Uniformity Index, %	Strength, g/tex	Micronaire
Upland Short Staple	below 1.01	77 – 81	22 – 26	3.6 – 4.4
Upland Long Staple	1.13 – 1.22	83 – 90	30 – 35	3.6 – 4.4
For testing ELS / Extra fine cottons				
	UHM Length, In.	Uniformity Index, %	Strength, g/tex	Micronaire
Upland Short Staple	below 1.01	77 – 81	22 – 26	3.6 – 4.4
ELS Long Staple	1.30 +	84 – 90	37 +	3.6 – 4.4

Calibration Cotton	Micronaire Level
Low Micronaire	approximately Mic 2.6
High Micronaire	approximately Mic 5.5

The standard deviation of the values of the Universal calibration cottons can be requested from the USDA. The following table gives typical examples for the Standard Deviations

[5] ELS Short Staple should not be used anymore.

[ITMF] and are generally representative of all calibration cottons obtained from USDA. The variations for ELS Standards can be significantly higher. This table can help in calculating tolerances / measurement uncertainties.

Examples of Universal HVI Calibration Cottons				
Property	Short-Weak		Long-Strong	
	Designated Values	Standard Deviation (SD)	Designated Values	Standard Deviation (SD)
Micronaire	4.04	0.08	4.32	0.08
Strength (g/tex)	23.2	0.74	33.9	0.94
UHM (inch)	0.975	0.012	1.167	0.012
UI (%)	79.8	0.64	84.0	0.71

Calibration cottons for length and strength have an expiration date that must be observed. Calibration cottons should not be used for calibration after these dates.

Calibration cottons need to be replaced when they have been used very frequently ("overused").

Calibration cottons must be replaced when there is any chance that they have been mixed up.

(*Recommendations*) The more the calibration cottons are used, the earlier they must be replaced, independently of their expiration date. An annual replacement should be considered. In the case of non-frequent use, the calibration cottons should nevertheless be replaced after the expiration date or, when no expiration date is given, after no more than 4 years.

Calibration cottons must be conditioned within the same laboratory and under the same conditions as the test samples and where they will be tested. The moisture content should be between 6.75 and 8.25% (dry basis) when fully conditioned. The calibration material must be kept in an atmospherically conditioned space at all times.

(*Recommendations*) The surface of the color tiles must be clean to ensure accurate calibration. An effective procedure for cleaning the tiles is to spray a diluted non-abrasive liquid detergent on the tile surface, followed by wiping with a clean cloth or tissue. Detergents containing bleach, abrasive or other harsh cleaning agents should not be used.

Color tiles are adapted to the different colorimeter types / light sources (e.g. incandescent, Xenon). The tile set assigned with the SITC should stay with this instrument. Never try to use a tile set other than the one assigned to your instrument, or, if ordering new tiles, strictly choose a tile set appropriate for the colorimeter type / light source of your instrument. The type of the color tile is encoded in its serial number (e.g. "X2" for Uster HVI 1000).

Color tiles should be returned to the USDA every 2 years for re-evaluation to ensure accurate colorimeter calibration.

(*Recommendations*) Labs should at least have two color tile sets to ensure continuity of testing whenever a tile set becomes unavailable for use.

USDA additionally offers calibration check cottons for verification of color and trash measurements using actual cotton. For color, a color check box, consisting of 6 or 12 cottons, is available. Color grade boxes include an expiration date due to the natural change in cotton color over time. Care must be taken that the Color Grade Boxes are used within the specified one (1) year of their validity.

For trash, a set of 6 or 12 cotton samples, mounted under glass with established percent area and count values, is available.

11.2. Internal Check Material

In addition to the Universal Calibration Standards, there is an option to use an internal check material for verification of testing levels. The advantage of internal checks is the reduced consumption of Calibration Standards and the ability to utilize cottons for check testing that are similar to those that are generally tested.

Internal standard material can be used for check testing, but not for calibration.

- Select bales of homogenous, even running cotton with low variation of SITC values. Saw ginned cotton is highly recommended. The check cotton must be clean and without any preparation.
- The properties of the bale should be representative of the general type of material that is tested routinely.
- Two bales are actually preferred over one – one of relatively long-strong and one of relatively short-weak cotton.
- Establish the mean and standard deviation by testing at least 60 samples with x specimens per sample; the samples being taken throughout the bale. The value of x should be the same as that which will be used for routine check testing.
- These tests should be made at a time when it is known that all systems, including the conditioning, are functioning correctly. It is advisable that the samples be conditioned for at least 48 hours before testing. Take care that during testing, the instrument is regularly checked with Universal Standard Material.
- Compare the obtained standard deviation with the standard deviation of the Universal Calibration Standards. At most, the obtained standard deviation should not exceed the standard deviation of the Universal Calibration Standards by much. With this, the tolerances that are applied for calibration checks with Universal Calibration Standards can be applied for the internal standards as well.

(*Recommendations*) When using internal check material, the instrument should also be frequently checked with Universal Standard Material.

11.3. Calibration / Calibration Check

Calibration contributes to the accuracy of the instrument testing levels by using the internal software to adjust for variations in such things as mechanical, electrical and cotton moisture influences. In fact, the instrument results are adjusted to a specific level of measurement set at an internationally agreed level. Calibration is not a substitute for maintaining the equipment in good operating condition or maintaining properly adjusted and controlled atmospheric conditions.

Calibration in this document means that the instrument parameters are adjusted to come to a specific measurement level. Calibration check means that compliance with the specific measurement level is checked. Typically, the instrument software combines a calibration check with an automatic calibration in the case of out of tolerance deviations from the expected level.

Calibrations should be performed according to the manufacturer's instructions for each of the fiber property measurements.

Calibrations may be done on an "as needed" basis, given that these detailed check procedures are fully implemented.

For example, in the case of:

- Deviations from the expected level in the calibration check procedure
- Consistent deviations found (e.g. in independent checks or in interlaboratory comparisons)
- Change of the calibration material
- Changes in the instrument mechanical setup
- Repair / corrective maintenance
- Changes in the laboratory environment

Calibration tolerances are instrument type specific. Typical tolerances are given in the table below[6]:

Instrument	**Micronaire**	**Strength, g/tex**	**UHML inch / mm**	**UI %**
HVI 1000 HVI 900 HVI Spectrum	± 0,1	± 1,0	± 0,013 / 0.33mm	± 1,0
Premier ART Premier ART 2 Premier HFT	±0,1	±1,0	± 0,013 / 0.33mm	±1,0

(*Recommendations*)

- The average of the Micronaire specimens used to calibrate the Micronaire reading must be within +/- 0.1 Micronaire units of the values established for the standards.
- The average of the test results of the specimens tested to calibrate for length, length uniformity index and strength must be within
    - +/- 0.013 inch / 0.33mm UHML
    - +/- 1% UI

[6] Tolerances can be set in the instrument software. Do not change unless advised to do so by the manufacturer.

    - +/- 1 g/tex Strength
- The colorimeter Rd and +b values must calibrate within +/- 0.4 of the established values for each of the colorimeter tiles.
- Acceptable trashmeter calibration requires calibration within +/- 0.05 percent area of the established trash tile percent area.

Calibration checks must be performed frequently in order to ensure the accuracy of the data.

→ For Micronaire and length/strength, at least at the beginning, middle and end of each shift.

→ For color/trash, the frequency depends on the light system used in the instrument. With incandescent bulbs, the calibration check should be conducted at least every 2 hours. For flash light, the calibration check can be synchronized with the checks for the other instrument modules.

Records of calibration results and of calibration check results must be maintained systematically for each instrument within the laboratory. The results should be examined for trends.

(Recommendations) When doing calibration checks on cotton samples independently from calibration, recommendations for tolerances (based on the average of 4 tests) are:

- Micronaire +/- 0.10 units
- Strength +/- 1.5 g/tex
- Length +/- 0.015 inch (0.4 mm)
- Length Uniformity +/- 1 unit
- Rd +/- 1.0 units
- +b +/- 0.5 units
- Trash area +/- 0.1 %
- Particle count +/- 5 counts

The level of testing can be operator sensitive on semi-automatic instruments, therefore this should be calibrated/checked when the operator changes.

There are at least three possible approaches for calibration checks:

a) Using the manufacturer's software menu for the internal Calibration/Calibration Check routine. This has to be started for each module of the instrument. The routine will involve testing the relevant calibration material, and will detect compliance with the standard level ("pass") or deviations larger than the allowed calibration tolerances ("fail"). Based on the measurements, the system will in the case of deviations calculate a new calibration. With this approach it is easy to conduct the calibration check, but it is dependent upon Universal calibration material and cannot detect small, but consistent deviations.

b) Conducting an independent test in system testing mode . Suitable cotton samples are tested in the usual system testing mode. The user has to compare the results of the tests to the established results of these cotton samples. If the deviation between the tested results and the established results exceed given limits, then the same follow-up activities as for calibration have to be conducted. This approach allows the use of internal check material and enables small but consistent deviations to be detected. Nevertheless, as each step has to be initiated manually, it is only suitable for users with a good background in data interpretation.

Control charts, in which the test results are plotted, will help to detect constant deviations, trends, or sudden discrepancies.

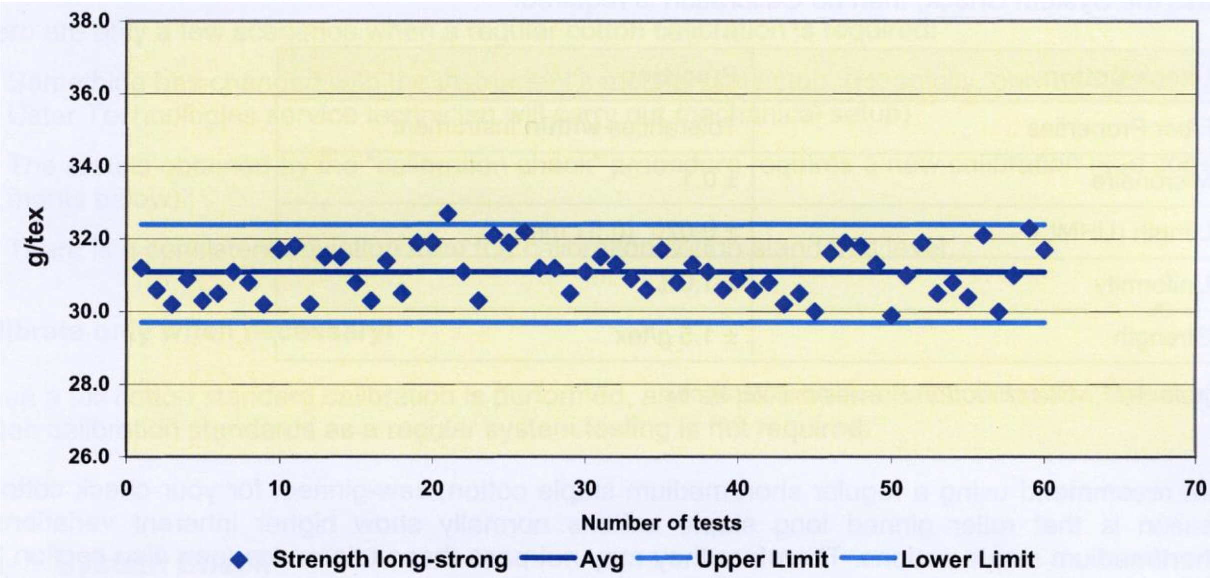


Figure: Control chart [Uster]

When conducting solely independent tests in system testing, the number of measurements per sample should be equal to, or higher than, the number of measurements in calibration mode. With an equal number of measurements, the calibration tolerances can be applied for the test. With a different number of measurements, the tolerances must be adapted accordingly. The number cottons should at least be two, covering the usual range of the properties.

c) Combining approaches a) and b). Besides using the internal Calibration/Calibration Check routine with Universal standard materials, additional independent tests in system testing can be undertaken on the same or other cottons during the day. This intense approach allows combining the advantages of both approaches. In this case, a lower number of tests per sample and only one sample for the independent tests are suitable.

When finding out of tolerance deviations, possible reasons for the deviations must be identified before calibrating.

If the laboratory operates multiple instruments, then a procedure should be adopted which ensures that instruments are operating on the same level based on calibration checks.

12. Variability of Data / Measurement Uncertainty

Test result data must be sufficiently reproducible for commercial or scientific use.

The CSITC Task Force selected 6 characteristics to be sufficiently reliable for commercial purposes:

- Micronaire (Mic)
- Strength (Str)
- Length (UHML), given in mm or decimal inches
- Uniformity (UI)
- Color Reflectance Rd
- Color Yellowness +b

For these 6 characteristics, suitable data can be obtained from the CSITC Round Trials.

The following data set has been extracted from CSITC Round Trials 2017-1 to 2017-4 for in sum 16 US Upland cotton samples and with an average of 137 participating instruments. All the given results are averages for the 16 cotton samples. For the results, 6 tests on 5 consecutive days were conducted with each instrument, hence, in total 30 tests per sample. Outliers according to Grubbs' algorithm were excluded from the calculation.

Within-Instrument Variations

The within-instrument variations are defined as the Median of the Standard Deviations of all participating instruments on a similar sample:

- Median of the within-instrument variation between different days with 6 tests on each day; this variation includes mainly between-day variability and additionally sample variability.
- Median of the within-instrument variation between 6 tests on the same sample on the same day; this variation includes mainly sample variability and short term fluctuations, but not between-day variability.
- Median of the within-instrument variation between 30 tests on the same sample; this variation includes sample variability as well as short term fluctuations and between-day variability.

Within-Instrument Variations (Average of the Median of the within-instrument SD for 16 US Upland cotton samples)						
Characteristic	Mic	Str	UHML	UI	Rd	+b
Unit		g/tex	inch	%		
between different days	0.024	0.30	0.0053	0.27	0.15	0.09
between single test on one day	0.035	0.50	0.0098	0.50	0.18	0.09
between 30 tests over 5 days	0.044	0.58	0.0109	0.56	0.25	0.14

(*Recommendations*) Each laboratory should compare its within-instrument variation with the averages given here in order to detect influences that reduce the repeatability of its data.

Inter-Instrument Variations

The inter-instrument variations are defined as the Standard Deviations between the results of all participating instruments. This evaluation is done after deleting outliers.

- The inter-instrument variation based on 30 tests. It reflects the systematic deviations between instruments/laboratories.
- The inter-instrument variation based on 6 tests.
- The inter-instrument variation based on single tests. It reflects the actual variation in daily commercial practice, as usually only one test per sample is done.

Inter-instrument variations (Average of the inter-instrument SD for 16 US Upland cotton samples)						
Characteristic	Mic	Str	UHML	UI	Rd	+b
Unit		g/tex	inch	%		-
based on 30 tests per instrument	0.057	0.71	0.010	0.46	0.52	0.27
based on 6 tests per instrument	0.063	0.82	0.012	0.54	0.55	0.28
based on single tests	0.072	0.96	0.015	0.73	0.60	0.32

The inter-instrument variations can be taken as a basis for fixing commercial trade limits. For this, a litigation risk based on tests on different samples of the same bale, conducted in two different laboratories has to be considered. Additionally, it is important to recognize that the given variations are solely based on US Upland cotton samples. For other origins of the cotton, different variations may exist e.g. based on the variety, production, harvesting or ginning.

(*Recommendations*) Besides using the variation found in inter-laboratory round trials, it is important for cotton testing laboratories to consider the measurement uncertainty of the test methods based on a knowledge and understanding of the various factors which influence the measurements and their values, and their significance. Only by knowing the influences on the tests and by estimating their significance, is it possible to systematically reduce the measurement uncertainty.

Preliminary Inter-Instrument Variations on Other Characteristics

For other characteristics, measured with the standardized instruments for testing of cotton, the inter-instrument variability is significantly higher, so that they were not considered by the CSITC Task Force for commercial use. The typical inter-instrument variations for Trash and Short Fibre Index are given in the following table, again based on the CSITC Round Trials 2017-1 to 2017-4 (16 US Upland samples).

Inter-instrument variations (Average of the inter-instrument SD for 16 US Upland cotton samples)			
Characteristic	Trash Count	Trash Area	SFI
Unit		%	-
based on 30 tests per instrument	6.4	0.052	1.06
based on 6 tests per instrument	6.7	0.057	1.09
based on single tests	7.2	0.065	1.23

For elongation, the inter-instrument variation can be seen based on results in the ICA Bremen Cotton Round Trials. Based on 6 Round Trials (2016-1 to 2017-3) with in sum 6 samples from different origins and based on an average participation of 95 instruments, the inter-instrument variation for elongation is (based on typically 12 tests per sample)

- SD 0.95%
- CV 15%

13.Round Trials / Reproducibility Check

Laboratories should participate in regular inter-laboratory Round Trials.

Participation in the International CSITC Round Trials is necessary for commercial trading of cotton. The results of the round trials should be used to detect and reduce systematic deviations in the inter-laboratory test result averages.

The CSITC Round Trial is the most comprehensive international testing programme offered for standardized instruments for testing of cotton (SITC). It is conducted 4 times a year, each with 4 cotton samples, each sample to be tested 30 times. Information: csitc.org . Registration: csitcsecretariat@icac.org.

(*Recommendations*)

- Compare the evaluation results of the properties for your instrument in order to determine, which modules / measurements have to be improved.
- Analyze the diagnostic graphs for each measurement in order to find possible reasons for deviations and to improve the accuracy.
- Analyze the diagnostic graphs and the precision table for improving the over-time variability of the data.
- Analyze the results of subsequent round trials in order to find trends.
- Compare the result deviations found in CSITC Round Trials with those from other round trial programmes.
- Document the Round Trial results and the relevant follow-up actions.

Besides the CSITC Round Trials, the following Round Trials can be considered for participation:

- The USDA HVI Checktest Programme allows monthly comparisons on each of 2 cotton samples. Contact: cotton.standards@usda.gov .
- The Bremen Cotton Round Test allows participation free of charge, and enables the SITC results to be compared with the SITC results of other laboratories as well as with the results of different cotton testing methods. Contact: drieling@faserinstitut.de .
- Regional Round Trials allow inter-laboratory comparisons using locally grown cottons. Information: csitc.org

Where more than one SITC instrument are operated in a laboratory, each instrument should be checked on the basis of its Round Trial results. In addition, the instruments should be compared on the basis of tests carried out specifically for comparative purposes between the instruments.

(*Recommendation*) Round Trials do not allow a daily check of the accuracy of the instrument results. For the purpose of daily verification, a Reproducibility Check is recommended. For a Reproducibility Check, a representative subset of all daily samples is sent to an independent laboratory, retested utilizing methods that provide a better accuracy/precision, and the results compared.

- USDA AMS is offering a non-periodic Checklot Program, re-testing single samples sent by any laboratory.

- In some regions, Regional Technical Centers offer a Reproducibility Check program under CSITC control for their surrounding countries.
- Laboratories can assign another independent laboratory for running reproducibility checks, if the assigned laboratory can prove
  - That it fulfills the requirements of this CSITC Guideline
  - and that it provides a better accuracy/precision.

14.Data Recording / Reporting / Export

The data which is saved on the instrument's hard drive must be copied to remote data storage device(s) to avoid loss of data.

(*Recommendations*)

- A routine for periodic data storage should be developed and applied.
- It is recommended to follow the manufacturer's instruction manual to best transfer the data in the appropriate format to other medias (disk, cable, USB memory sticks, etc.).
- The transfer from the instrument hard drive to the laboratory database can be facilitated by choosing the appropriate export format from the instrument; follow the manufacturer's instruction manual
- On yearly basis, during manufacturer's maintenance visit, it is recommended to clean the instruments hard drive from old data, as long as an external database is used to store the historical data from previous seasons.

(*Recommendations*)

A laboratory test result database, independent of the instrument data storage, is recommended for compiling all the necessary information. The laboratory test result database should be designed to fulfill the requirements for the use of the testing data, such as module averaging or delivery of one result from several to the customer.

The database should be permanently copied to a remote and safe place to avoid loss of data.

A procedure should be in place for continuously copying the data from the instrument's data storage to the database.

For any sample tested, in order to trace back all information, the database should store:

➔ All information relevant to the sample history
- Origin
- Processing gin
- Customer/provider name
- Sample type (gin or control)

➔ All information relevant to the applied method and / or settings applied for the testing of the samples
- The name and type of the instrument used
- The number of tests per samples per module of the instrument
- The applied method (testing made on portion of samples or representative samples),
- Technician and operator names

➔ All information relevant to the conditions of testing of the samples, such as:
- Calibration of the machine at the moment of testing of this sample (reference material names, expiry dates, results of the calibration verification
- Temperature and relative humidity conditions
- Any remarks

➔ All information relevant to the testing of the samples
  - Results
  - Remarks (for low sample mass or dirty cottons for instance)

Reporting is usually made from the laboratory test result database; it should respect rules given in ISO 17025 as well as the abbreviation and the format as given in Section 10.1 for better understanding between cotton stakeholders.

15.Commercial Use of the Data

The overall objective of this guide is to achieve accurate and repeatable results on instruments testing at high speed, so that the cotton spinner is able to accurately evaluate the raw material in order to be sure of the correct performance, not only in spinning, but through out the complete cycle of the cotton textile transformation process, including dyeing and finishing.

However there is also a commercial aspect of valuing the cotton in accordance with the characteristics as determined by the instruments, which can assist the seller, the farmer or ginner, and the final consumer, the spinner, to negotiate the price within the context of the overall market value at a given time.

Since a cotton lay down at the spinner's factory is made up of a large number of bales, the single bale test data is used to achieve an average of the mix, whilst still achieving the predetermined distribution of the characteristics or parameters.

On the production side, the cotton being a natural product, it is virtually impossible for each bale to have the same identical characteristics, therefore during the testing process some slight variations will occur from bale to bale. Also, at the spinners laboratories, such slight variations will become apparent, but this should not be considered a defect or inconsistency of the instrument, but rather an acceptable "commercial" tolerance or range of results, which has been agreed upon before hand between the buyer and seller. This commercial use, or "tolerances", of the data is defined in the Trade Rules of the Cotton Associations. However without accurate and repeatable instruments the cotton will fall outside of such variations or tolerances, and therefore prejudice the spinner's quality and the financial return to the seller.

The given variation inside the bales and the measurement uncertainties have to be regarded with appropriate limits in order to ensure proper trading with cotton.

Additionally the cotton properties vary between the bales. This can for example be considered by not trading based on single bale results, but on sales lot averages and allowed variations. Due to the statistical background, sales lot averages and variations with significantly lower tolerances than the single test results can be agreed upon.

16.Personnel

For instrument testing of cotton, all quality relevant tasks should be defined and listed.

Quality relevant tasks include calibration, testing, checking and signing test reports, maintenance of instruments, procurement etc. The necessary competence for the tasks has to be defined.

Each person involved in Instrument Testing of Cotton should be competent to perform the assigned quality relevant tasks.

Competence can be imparted by appropriate education, training, experience and/or demonstrated skills, as required.

(*Recommendations*) It is recommended that the laboratory maintains records of the relevant competence / training of personnel.

A laboratory representative must be designated and must have the necessary responsibility and authority.

A key testing competent person is mandatory.

The typical personnel involved in instrument testing is:

- A laboratory head / key testing competence person
- Instrument operators
- Assisting personnel
- Instrument maintenance technician.

(*Recommendations*)

It is recommended to not only train internally, but to also provide external competence training at least for the key personnel.

Operators should be trained to work on all the positions / modules of the test instrument and should periodically rotate. They should also be able to perform calibration, handle samples, use correct specimen preparation and testing techniques, and recognize instrument malfunctioning and errors.

For maintaining and improving the know-how it is useful to exchange knowledge with other cotton testing laboratories.

Documentation needs to be prepared, which assigns the authorization of each person to each quality relevant task (authorization matrix). Only the persons that are authorized to do a quality relevant task may be assigned to this task / may conduct this task.

(*Recommendations*)

The laboratory management should ensure that a sufficient number of qualified and authorized personnel are always available to perform the required tasks.

17.Laboratory Management

The laboratory management should document and prove how it ensures that all means are available and used before, during and after the performing of the testing of cotton samples and the corresponding reporting in accordance with the quality expected by its customer.

Suitable sample identification, combined with the corresponding documentation of all test related information, should be given, so that tracing of all information is possible.

(*Recommendations*) The laboratory should:

- Establish and maintain sample identification from collection to disposal as well as a method to ensure the security and confidentiality of the collected information in a system that stores the original information, derived data and any information to facilitate any research for easy traceability of the information.
- Have defined well trained managerial and technical personnel designated for realizing the required testing analysis in accordance with the quality demanded by the customer.
- Develop and apply procedures for the selection and the purchasing of services and supplies that affect the quality of the tests.
- Have and apply a policy that should be implemented when any aspect of its work or results of its work do not conform to the requirements agreed upon by the customer. This policy should include the overall description for implementing corrective actions and / or preventive measures.

ISO 17025 defines the corresponding requirements.

18.Additional Topics to be Included in Later Versions

- Other test instruments
- Requirements and rules for module averaging
- Bale tagging recommendations

19.Acknowledgements

This Guideline was developed in cooperation between the editors and several contributors. For this, the editors would like to thank all contributors, namely Lawrance Hunter, Philipp Lehne, Andrew Macdonald, Greg Parle, Mona Qaud, Anja Schleth, Ralph Schulzé, Marinus van der Sluijs and V. Srinivasan and their companies/organizations.

The editors want to express their gratitude to the International Cotton Advisory Committee (ICAC) and the International Textile Manufacturers Federation (ITMF) for encouraging the work on this Guideline and for publishing it. Thanks are also due to the corresponding committees and meetings for their support: The CSITC Task Force, the ICAC Plenary Meeting Outbreak Sessions and the ITMF International Committee on Cotton Testing Methods.

The editors wish to thank the funders who made this Guideline possible. The study was undertaken as part of project CFC/ICAC/33 Commercial Standardization of Instrument Testing of Cotton, which was funded by the Common Fund for Commodities, an intergovernmental financial institution established within the framework of the United Nations, headquartered in Amsterdam, the Netherlands, and by the European Union in the framework of its "All ACP Agricultural Commodities Programme" under the sponsorship of the International Cotton Advisory Committee (ICAC) Washington (USA) and implemented by the Faserinstitut Bremen (FIBRE), Germany.

Besides English, the guideline is available in Arabic, Chinese, French, Portuguese, Russian and Spanish, for which our special thanks go to the ICAC, Cotton Incorporated and ABRAPA for their assistance in providing the translated versions.

Take-Away

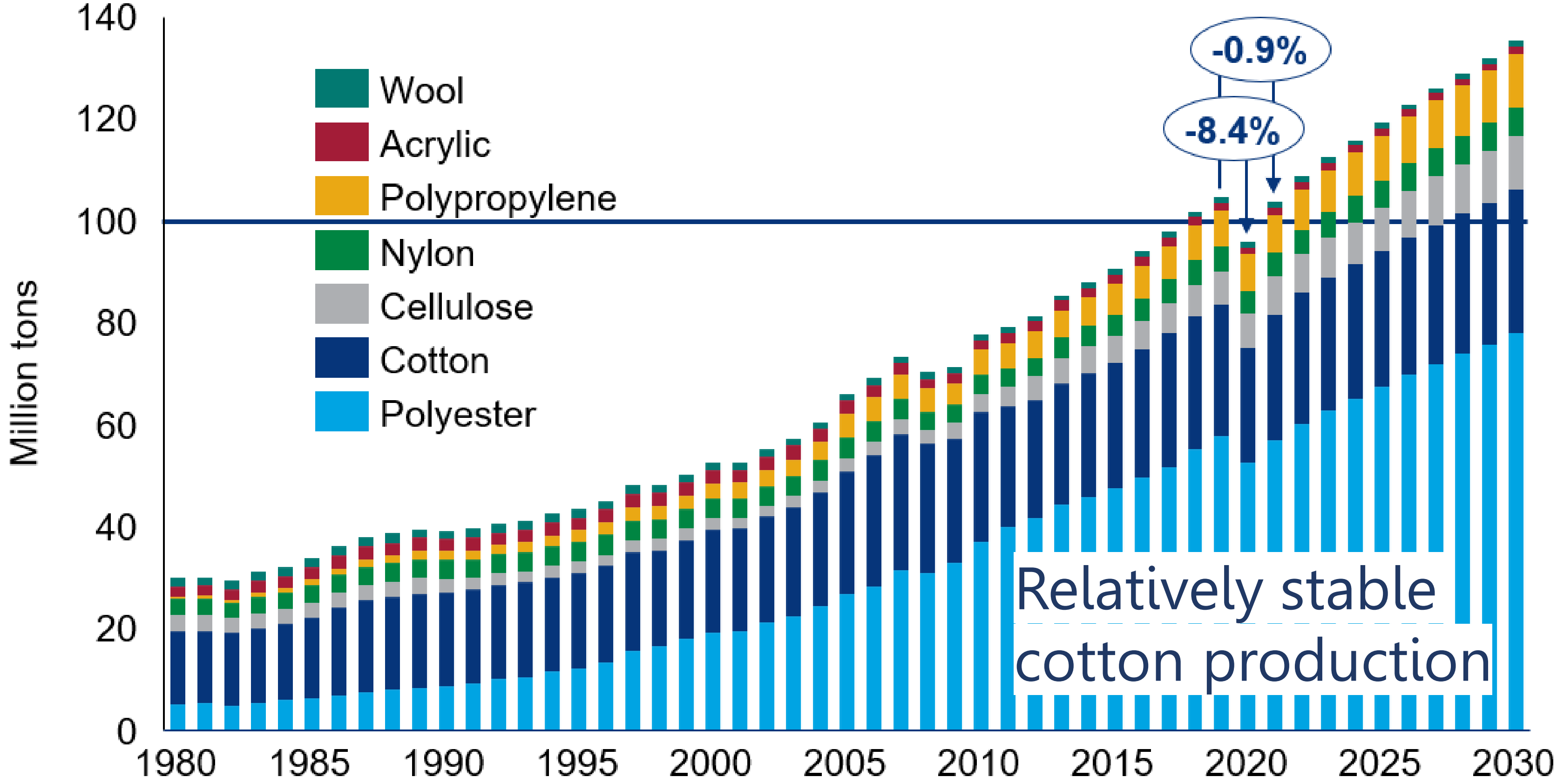
Olivier Zieschank| Director
International Textile Manufacturers
Federation (ITMF)

ICCTM Committee Meeting

September 27th, 2022

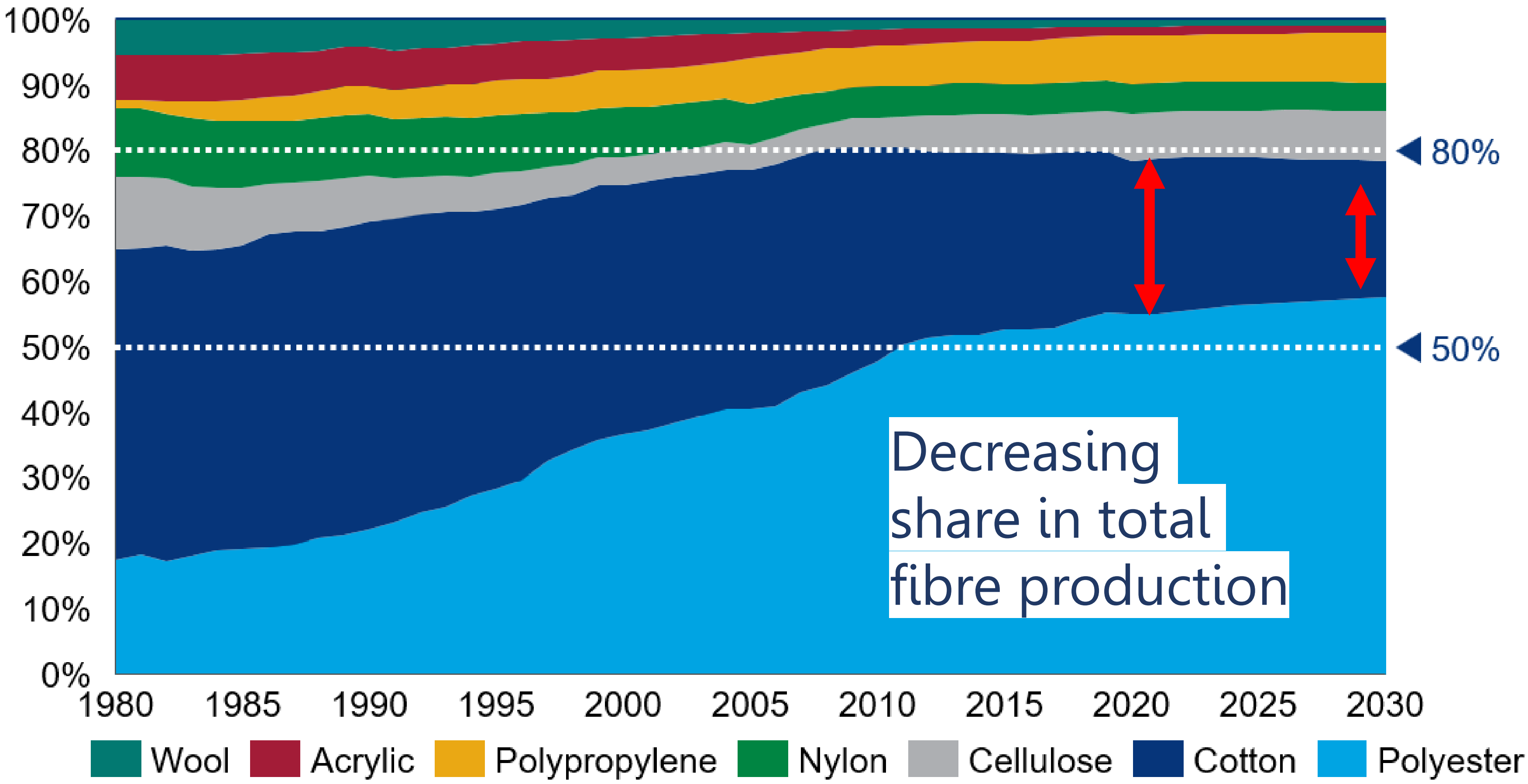
Bremen Cotton Exchange

Total Mill Consumption [volume]



Source: Wood Mackenzie Chemicals Fibres Strategic Planning Outlook H1 2022

Total Mill Consumption [share]



Source: Wood Mackenzie Chemicals Fibres Strategic Planning Outlook H1 2022

Challenges and Opportunities

Traceability

Profitabilty vs. Origin

How to guarantee origin throughout the value chain at a competitive cost?

It can be more profitable or even desireable to mix fibers from different origins or types.

Sustainability

Profitabilty vs. Responsibility

How to invest in sustainable production if return is uncertain?

It can be more profitable to use existing production means and processes as long as possible.

Consequence: fiber mix are used | fiber origin is hard to trace | traceable fibers are restricted to niche markets

Supima imposes penalties to the downstreem industry

R-Inove prints a binary code on the yarn

Brazil uses GMO and consolidation of production means, issues certificates

ReHubs collaboration hub for recycling

How to make mass sustainable production of textiles?

Textile and Clothing industry

Does it need to be?

New technologies need adoption

Source: Textile today, 2015

Old statistics,
what is it for real?
Modern water mgt?

Probably growing
Recyclable Qty?

Recycling

Mechanical

Profitabilty vs. Sustainability

How to increase value for a fiber of lower quality?

Get, sort and separate first work with raw material with shorter fiber length, or mixed colors, etc.

Chemical

Profitabilty vs. Sustainability

How to use chemicals in sustainable production?

Get, sort and separate, deal with mix-material, substances that cannot be recycled, make it cost-effective.

Consequence: success depends on collecting waste | creating circular polymers or extracting cellulosic from waste | using fibers of lower quality

Rieter proposes a solution to spin recycled fibres with higher short-fibre contents in ring spinning

Infinited Fiber's circular alternative to virgin materials | HeiQ AeoniQ Cellulosic Filament | Worn Again Polymer Recycling Solution for Poly/Cotton

Only 1% of textiles are recycled*, how to scale up?

* HeiQ AeoniQ

Sustainable production

Raw material

None fossil or reused

Plant based

Biomass

Agriculture waste

Recycled polymers

Technology

Speed or low carbon

Automatisation

Artificial intelligence

Low energy and water consumption

Business models

Cooperation and data

Networks [vertical integration of information]

Produce what is needed

Circular economy [from design to after-life]

Consequence: manufacturers must be sustainable from head to toe

Bcomp's solutions for sport to mobility | Seaqual's yarn form ocean plastic | Dimpora's high performance membranes

Sefar sustainable manuf. solutions | Frontier's Material Digitalization | FarbenPunkt waterless processing for dyeing and digital printing

Unifi's Reuse model to maximise Life Time Value | DMIx standardized workflows | Designovel trend recognition

Suppliers' abilities and customer's needs must be matched in every transaction

Where is spinning heading ?

Fibre variety

Versatility and resillience

How to match rapidly changing demand and static production means?

Deal with various fiber types and quality, increasingly regionalised value chains.

Networks

Integration and compliance

How to know what to produce when and for whom?

Integrate up- and downstream value chain in decsion making and comply to multiple standards.

Consequence: vertical integration of information in the value chain to improve collaboration / reduce cost / avoid waste

How to test recycled fibers, a new type of fibre that is likely to change the textile industry?

ITMF will persue in Keqiao, China, during the ITMF Annual Conference 2023