Use of Stickiness Test Results for Trading Purposes

Summary of findings[1], 2020-08-10

Introduction

Stickiness is causing drastic problems in processing and in yarn quality, hence it is important to evaluate the stickiness of cotton for trading. I was asked to summarize our findings with a view of implementing stickiness in trade rules. The findings are based on previous and current research as well as on the stickiness round trials, which we conducted since 2017. It is including summarized results, proposals for suitable test methods, and finally necessary next steps.

Stickiness and stickiness test methods

The main, but not the only source for stickiness is honeydew contamination, which means drops of sugar on the fibres.

Principally, several different methods and methodologies for determining stickiness are given (see fig. 1). Because of the clearly different methods and their specific sensitivity and influences, they produce different results and are therefore not interchangeable. For any commercial purpose, one suitable test method or few clearly defined test methods have to be chosen and fixed.

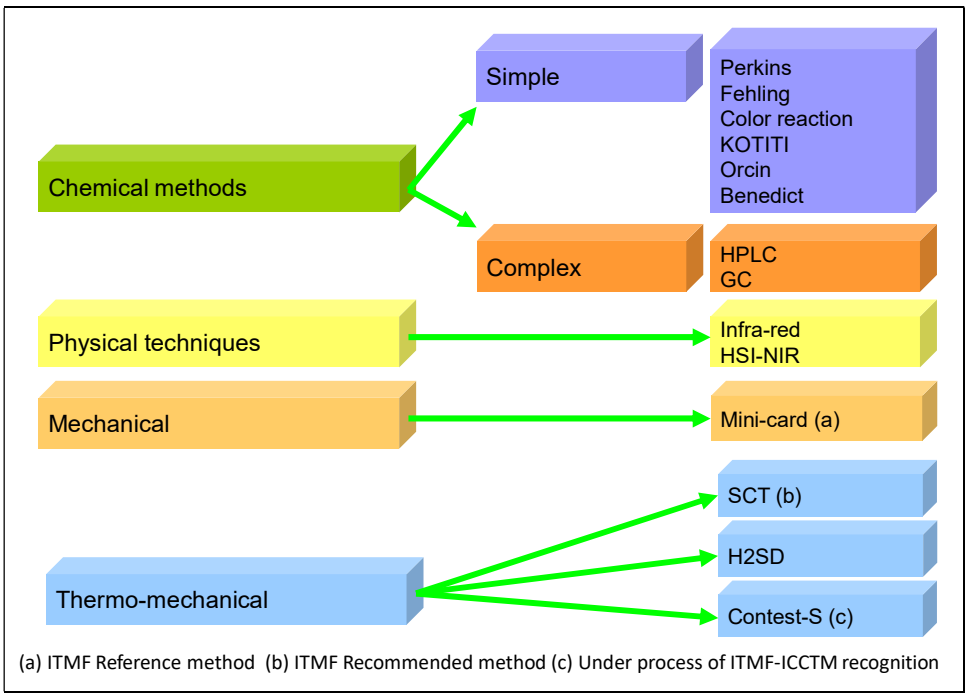


Figure 1: Possible methods to estimate stickiness [Gourlot/Drieling]

Following testing methods typically take part in the Stickiness Round Trial:

- SCT - 11 laboratories
- Caramelization - 4 laboratories
- Contest-Fibermap - 4 laboratories
- H2SD - 4 laboratories
- Minicard - 3 laboratories
- HSI-NIR - 1 laboratory
- KOTITI - 1 laboratory
- Clinitest - 1 laboratory
- Qualitative method - 1 laboratory
- Quantitative method - 1 laboratory
- Reactive Spray - 1 laboratory

[1] The text shows excerpts from the report that was planned to be published by J-P. Gourlot and A. Drieling on the International Cotton Conference Bremen in March 2020. It will now be published in Bremen in March 2021.

Specifically different kinds of sugar (as e.g. glucose, fructose, melezitose, trehalulose) show an extremely different stickiness potential, so that solely the measurement of the sugar content or its chemical reaction in all the given chemical methods is absolutely insufficient. Important for trading is the stickiness potential and not the sugar content.

Physical and complex chemical techniques are not suitably developed for daily testing for trading purpose with its specific questions, and are hence not appropriate. And mini-card as a pure mechanical method is not suitable as well for many reasons (time-consuming, sensitive to the operator and operating conditions, instrument not produced anymore).

Hence, from all given sugar or stickiness test methods, solely thermo-mechanical methods could be suitable for trading purposes and will be regarded in detail. This is:

- SCT
  which is the method recommended by the ITMF and the most common method.
- H2SD
  which is closely related to SCT, but automatic.
- Contest Stickiness
  It was recognized by the ITMF-ICCTM in 2020. The number of worldwide available devices is limited so far. A special table for stickiness is used. Practical experiences with the results must be intensified, although long term experience on the predecessor Lintronics is given.

In addition, although not suitable for trading, these methods have to be kept in mind:

- The mini-card is still the ITMF reference test method and hence an important comparison.
- HPLC is a very good scientific background, as only this method can divide between sugar types and hence an evaluation of each sugar type is possible. HPLC will be included in the planned future research on stickiness testing.

Ability to predict the impact of stickiness on spinning

Results from micro-spinning tests in 2016 [CIRAD][2] show the correlation between stickiness test results and the spinning behavior for different methods. For in sum 36 evaluated cotton processing and yarn criteria, the mechanical and thermo-mechanical methods show the best correlation to processing behaviour and yarn quality (28 to 29 suitable correlations), and chemical methods show worse correlations. This work is currently continued by CIRAD on Stickiness Round Trial samples.

Variation in stickiness test results

Variation of stickiness test results can in a first view be divided into:

- Variation of test results within a sample
- Variation of test results within a bale / within a lot (same method, same lab)
- Variation of test results between different instruments (same method)
- Systematic deviations between test results – correlation between different methods.

The variation of test results within a sample can be taken into account by the number of tests per sample and the sample preparation, and is mostly a problem of efficiency.

The first and very important problem in stickiness testing is the variation of stickiness within a bale or within a lot. As there is "nests" of stickiness on the fields and consequently in the bales, a sample cannot be fully representative for the complete bale, which is a problem for sampling. An example for the variation is shown in figure 2. The variation of results within the bale has to be considered when developing trade rules for stickiness, especially when looking at re-testing, complaints and arbitration.

[2] J.P. Gourlot, reported at ITMF ICCTM, Bremen 2016

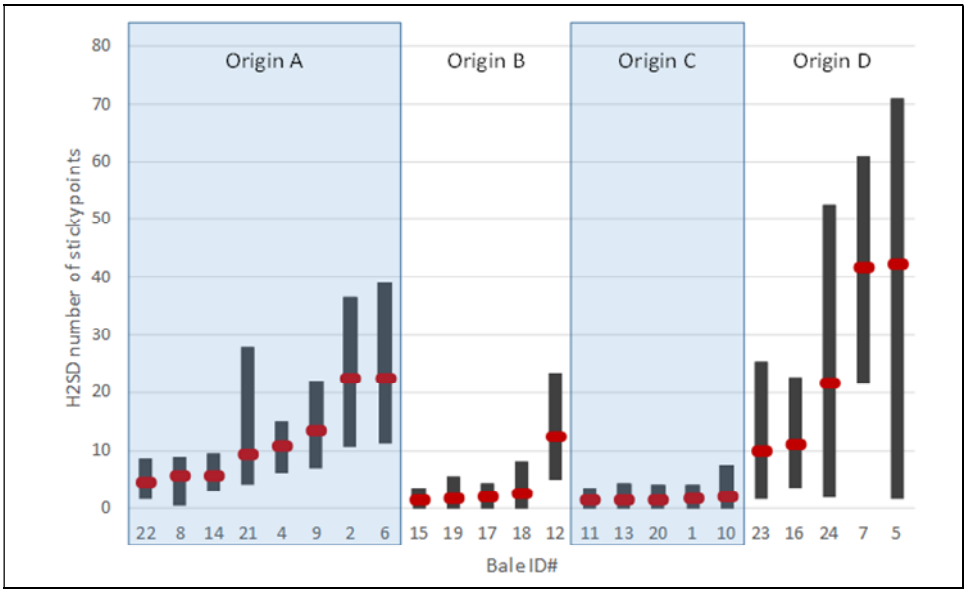


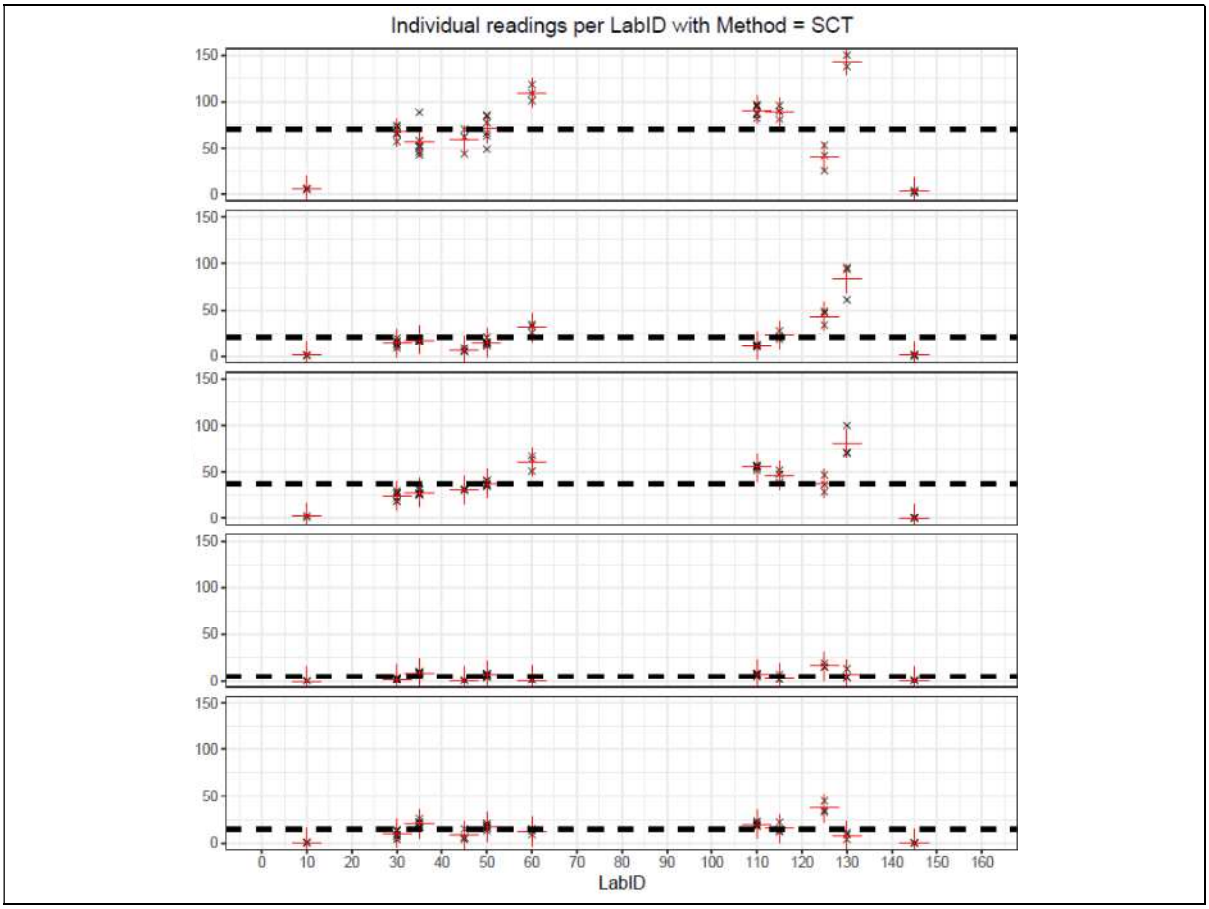
Figure 2: Min, max and mean numbers of sticky points as measured by H2SD on 32 samples per bale from 24 bales from various origins [Frydrych et al. 2004]

From 2017 to 2019 (and continued at least in 2020), several Stickiness Round Trials have been conducted in cooperation between Faserinstitut Bremen, CIRAD and ICA Bremen. They provide the best basis for analyzing:

- The variation of test results within a method
- The correlation of test results between methods

Figure 3 shows for the example of SCT (for 5 samples in one Round Trial) the variation of single test results within single laboratories (each number on the x-axis is one laboratory), and the variation between the laboratories (each red cross is the mean value for one laboratory, the dotted line is the inter-laboratory average). It can be seen that the variation between laboratories is, even for this long given test methods and for laboratories with a long participation in the Stickiness Round Trials, very high. For Round Trial 2019-2, the inter-laboratory CV% is for the 5 samples:

- For SCT between 52 and 99%
- For H2SD between 39 and 95%
- For Contest-S between 18 and 48%



Extract from the RT2019-2 report: SCT results for five cottons A to E by various laboratories.

Correlation between the different test methods

Figure 3 shows the correlation between the different mechanical and thermo-mechanical test methods. For all but one correlation, r is higher than 0.8. In comparison, the caramelization method as a typical indirect sugar-detecting method shows extremely poor correlations (r between 0.18 and 0.26). The conclusion based on analyzing 12 different stickiness test methods is:

- Solely mechanical / thermo-mechanical test methods should be used.
- A suitable correlation between all three thermo-mechanical methods is given. There is no thermo-mechanical test method that should be prioritized due to better correlations or excluded due to worse correlations.
- A suitable correlation between the thermo-mechanical test methods and the Mini-card as the ITMF reference method is given, too (r from 0.72 to 0.88).

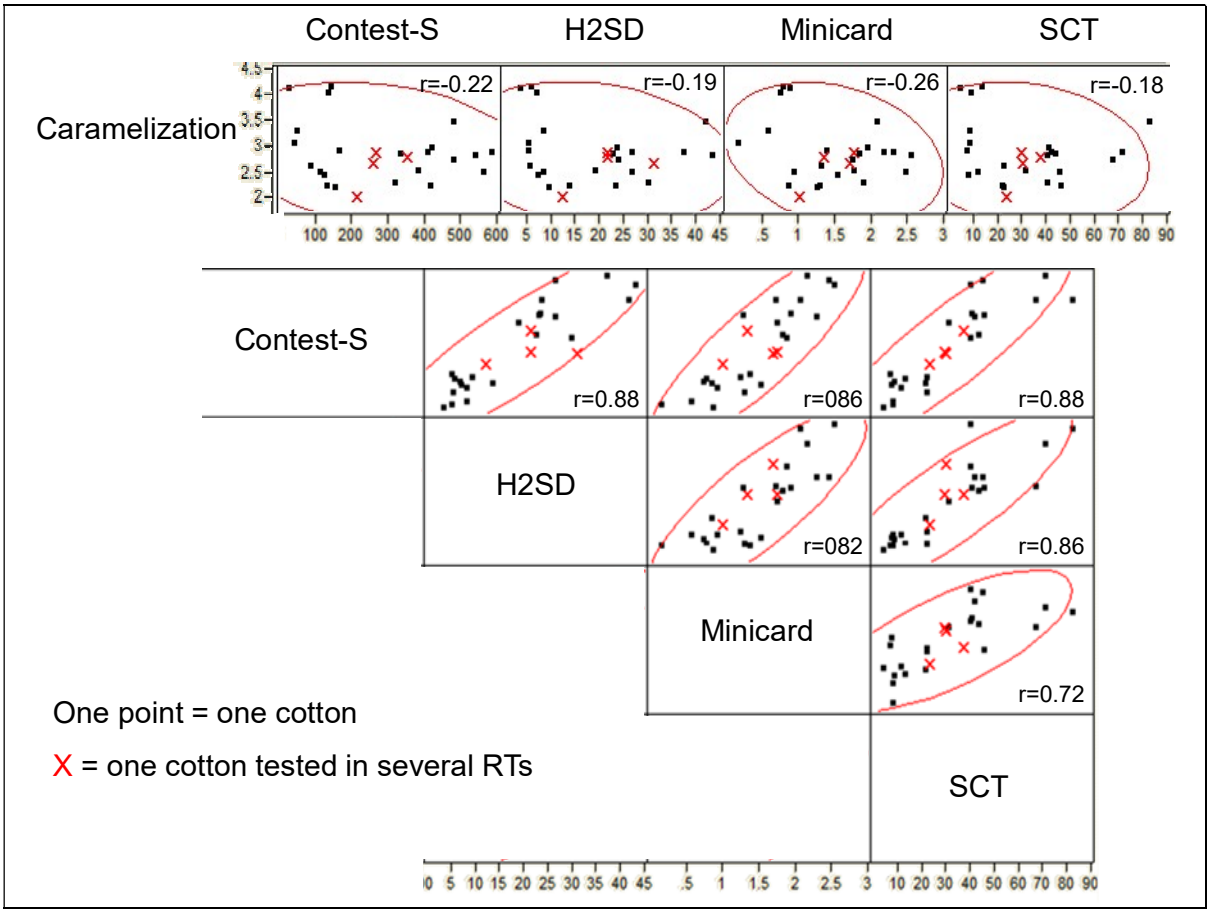


Figure 3: Correlation between the different mechanical and thermo-mechanical stickiness testing methods, based on 26 cotton samples in 6 Stickiness Round Trials

Choice of suitable test methods

Based on

a) the actual testing of stickiness rather than sugar content
b) the ability to predict the impact on spinning and
c) the suitable correlation between the test methods,

three suitable test methods are found with SCT and H2SD and Contest S.

SCT is the method with most users worldwide. H2SD is an improved and automated version of the SCT. And Contest Stickiness bases on Lintronics developments known in several labs, again improved by Mesdan during the recent years. Each method got its specific advantages and disadvantages. Choosing only one would either exclude most laboratories or disturb the current important technical improvements that have been desired by all.

Next steps

Unfortunately, as the methods are differing from each other, they got different scales, which cannot be directly compared to each other. Hence, we are currently looking at different ways of developing a

- Common Stickiness Scale.

With a Common Stickiness Scale, the results of each method will be translated to the common scale, so that all three methods can be chosen and still the same scale is given. As the limits for getting problems in spinning are different for each spinning mill, it will not be suitable to just define a limit for comparison (sticky ←→ non sticky), but a continuous scale has to be givne. The continuation of the Stickiness Round Trials will help to develop and maintain the Common Stickiness Scale.

In addition, it is extremely important that laboratories that are included in cotton trading are

- regularly checked in comparison to other laboratories,

so that deviations from the typical test level and hence the common scale can be seen. Again, this can be done with the continued Stickiness Round Trials.

Trade rules for sampling of bales for testing and regulations for measurements will have to consider the specific problems of stickiness, especially the high variation of stickiness test results within a bale.

Besides, there is several additional important topics and activities:

- Continuation of tests for the relationship between stickiness test results and stickiness in spinning practice
- Try to find thresholds for stickiness impact on spinning
- Analyze sources of result variabilities and systematic deviations
- Research for the development of suitable stickiness calibration material
- Development of a stickiness testing guideline.

Authors / organizers

Axel Drieling, Faserinstitut Bremen / Bremen Fibre Institute, Bremen, Germany
Jean-Paul Gourlot, Cirad, UPR AIDA, Montpellier / AIDA, Univ Montpellier, Cirad, Montpellier, France
Karsten Froese, ICA Bremen, Bremen, Germany

A full report was planned to be published by J-P. Gourlot and A. Drieling on the International Cotton Conference Bremen in March 2020. It will now be published in Bremen in March 2021.