

FiberLab – New Developments And Studies As A Multi-Parameters Fiber Quality Tester

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To be presented at the plenary session 27th Bremen conference

Introduction:

When looking at the history of the progress of fiber testing instruments for cotton, it becomes apparent that the process follows the development of new spinning technologies. The need for better, faster and more complete sets of parameters is vital if the cotton industry is to survive the ever growing competition with man made fibers. FiberLab provides the solution for most of the current, and future needs by utilizing a combination of all the parameters which can be tested in one high speed instrument.

The need to evaluate parameters such as neps, seed coat Fragments, Maturity, and Stickiness as a part of the current and future trading standards is well covered by different speakers at international conferences. Therefore, it is the aim of this presentation to introduce the new development, the FiberLab, as a leading high volume tester that covers not only the HVI parameters but also all cotton fiber characteristics that are known to be important to the textile industry of today and tomorrow.

A few general questions can be asked; what are the advantages of testing all parameters in one instrument? What is the most appropriate place for cotton testing within the cotton/textile industrial chain? Is it the gin, the classing office, the first stage of spinning, or maybe even a combination of all? This presentation will illuminate some of these issues by showing the uniqueness of the technology. It will present the latest studies made by customers and research bodies in regards to the FiberLab, as an exclusive instrument, or as a part of a comparison to others.

The Pioneering technology of the FiberLab:

FiberLab combines well established, old technologies such as Micronaire, optical based length using fibro-graph, and double compression for maturity testing, with new technologies for testing stickiness and neps. The following spec has been given to the basic design:

- The complete set of tests must bare results in no more then 60 seconds.
- All Tests must be made on the same sample for every parameter.
- Length/Strength measurements must allow the option to perform more then one repetition per sample.
- Cotton color must meet the current standard for cotton.(Rd, +b)
- Maturity test must to be made on a blended sample.
- Trash has to be tested in a way that has the potential to separate the trash level from the color measurements.
- Stickiness tests has include the entire tested sample in order to ensure that no sticky point will be excluded from the test at a temperature known to be used in the textile industry.
- The instrument's design has to be modular in order to meet different needs of the textile chain.

As per the third year of commercialization of the FiberLab, all its initial goals have been achieved and the FiberLab meets the above mentioned specifications.

Figure No. 1 shows a general view of the FiberLab, including its two sub-samples that were split from the same one. The largest one (~ 25 gr.) is laid within a metal frame and is used for two cycles of a fully automatic **color/ length/ strength measurement**, based upon a beard of fibers combed to standard fiber-gram based techniques requirements.(figure 2) The calculated parameters, **UI, SFI, Elo, and cotton grading** are all a part of this unit. In parallel to the 25 gr. sample the other sub-sample at a weight of ~ 3.5 gr. is converted into a sliver type sample and is fed through a feeder belt into the Micro-carding device (figure 3). This device converts the sliver type into a fiber web (figure 4) on which the **Neps Trash and seed coat fragments** are tested using Image analysis (figure 5). The same thin web is used for laser based **stickiness** testing using signal analysis tested on two smooth crush rolls (figure 6). At the end of the above mentioned process, the fiber web is automatically re-collected into a condenser. The collected and fully blended material is used for **Micronaire and Maturity tests**. The data is summarized into a Windows based operation software, which stores the information in a database, reports the data, and generates useful statistics by lots, gins, reigns, countries etc. according to the customer's needs.

Major Studies conducted using FiberLab participation:

The influence of the higher cotton bolls on the neps formation:

Neps and seed coat fragments (SCF) in cotton fibers are considered a major problem for most spun yarns, especially for the ring spun yarns. This presented study has been conducted for two cotton seasons, in Israel, using field treatments followed by quality measurements tested on the FiberLab. The samples were examined after manual picking and ginning. The statistical hypothesis assumed that the higher fruiting bodies are responsible for the higher amount of neps in the fibers due to immaturity. The results of this study are shown in figures 7-10. It is apparent that the basic hypothesis is true. The 2001 season yielded less mature bolls at the higher nodes. These higher bolls consist of tremendous amounts of neps due to the weather conditions. (figure 7) In contrast, season 2002 weather condition aloud normal cotton development, yielded more mature bolls which reflected in much less nep count.

The possibility to predict white specs in fabrics by evaluating different fiber parameters as tested on the FiberLab:

A significant study targeted the relations between the old and high cost problem of White Specs in fabrics vs. its original raw material used for spinning, was conducted during the year 2003 . This study was performed by the USDA ARRS in New Orleans by selecting different cotton bales suspected to have different maturity and neps levels. The ongoing study is aimed to find the best tool, or set of fiber characteristics, that has the potential to predict the tendency or even the amount of expected white specs. The study is based on selected commercial bales that were tested, spun, dyed and tested for the amount of white specs after the dyeing process. Four different instruments (FiberLab, FMT, HVI, and AFIS) were used in order to determine the proper combination of fiber testing parameters that are capable of predicting the white specs phenomenon in the best way possible. Figures 11- 14 shows the correlation between white spec in fabrics, and the predicted % white based on the different instruments. The table bellow summarized the R² values for the different instruments:

Instruments	R ² US study 2001	R ² All studies
FiberLab	0.92	0.8
FMT	0.89	0.42
HVI	0.87	0.52
AFIS	0.83, 0.74, 0.94	0.61

It has been shown above that the FiberLab predicts white specs well for both the 2001 study (limited sample number) and the large scale study, where other instruments did not maintain their prediction when more varieties were introduced to the study.

It can be explained by the multi-parameters prediction made by a combination of the Maturity level, the Micronaire, neps and seed coats – all the factors that are tested by the same instrument and on the same sample.

With the statistical connection between raw material fiber characteristics and white specs, and the testing of raw material prior to the spinning process, a future prediction can be made in regards to the occurrence of white specs. The FiberLab was a part of this study and was found to be the best predictor of white specs among all instruments that participated in this study.

In the current situation samples are tested by more than one instrument in order to complete a set of data that might predict white specs. This increases the statistical error involved in the study. On the contrary, the use of only one instrument reduces the error and by that improves the prediction.

Round tests for stickiness:

In the year 2000 FiberLab/FCT was considered a candidate for recommended instrument for stickiness. A round test was requested by the ITMF in order to define its inherent statistics. During the year 2002 and 2003, two round tests has been conducted and their results are shown in figure 15. In the beginning of year 2003, in addition to the round test, a new commercial stickiness grading has been suggested by FiberLab/FCT users (spinners and traders) in order to adjust the needs of the spinners for a good stickiness predictor as well the need of the trader to have a workable scale.

The 5 grade scale has been modified into a simpler 4 grades scale of the following terminology:

Grade Terminology:	Amount Of Sticky Deposits
No sticky	0-60
Low sticky	61-100
Moderate stickiness	101-200
Sticky	200 +

The new grading scale and the round tests can demonstrate the level of commercial maturity reached by the FCT/FiberLab user, defining the usable grades as well as its statistical definitions.

Classing all parameters at the gin and the mill:

During 2002, some articles have been published about a possibility to class the cotton during ginning. While this discussion was just raised and its operational questions are just opened, the first ginnerers made their move toward classing at the gin. A few more years are needed toward a complete on-line automatic mode of automatic testing and conditioning, but the classing of full parameters by FiberLab became a commercial fact in the season of 2002-2003 for different part of the world. Figure 16 demonstrate such operation.

Discussion and Conclusions:

At the time of the previous presentation by the author, given in the year 2000, testing all parameters in one simple instrument was just an ongoing development. Four years later it became a commercial reality that was accepted warmly by the industry. Having this new instrument opens new scientific horizons by providing the opportunity to test known contradictory parameters on the same sample. (neps vs. maturity, neps vs. stickiness, maturity vs. Seed Coat fragments etc.) Successful prediction of white specs using a new combination of fiber testing parameters, as shown above, is the best evidence for the advantage of testing all parameters using one instrument. White specs correlation to maturity and neps tests is just the tip of the iceberg in many other possible relations provided by the FiberLab.

Summery:

The idea of developing fiber testing instrument that measures all needed parameters was driven mainly by the spinning industry that demand more complete set of fiber testing parameters rather than HVI oriented ones. FiberLab is the first instrument to be commercialized and warmly accepted by all sectors such as the spinning, trading, and ginning industries.

The studies presented in this treatise show the huge potential inherently embedded in the testing of all parameters, on one sample, using one instrument, during the same run. The higher efficiency of such instrument is obvious but the ability to predict phenomena such white specs based on multi parameters are scientifically and commercially significant.

The sequential round tests made in 2002-2003 by the Italian customers proves that FCT/FiberLab, after 7 years of commercialization, is a proven tool for the prediction of stickiness in the textile industry.

The successful acceptance of the FiberLab in all sectors paves the way to the next step of gin based classing and the new age of quality control at the gin site. It will be used also for more complete layout planning at spinning mill opening rooms.