COMPREHENSIVE COTTON TESTING TO OBTAIN THE FULL FIBER PROFILE RELEVANT FOR THE PREPARATION PROCESS AND THE YARN QUALITY

D. Messa
Mesdan S.p.A., Puegnago del Garda, Italy
S. Meier
Loepfe Brothers Ltd., Wetzikon, Switzerland

ABSTRACT

The brand new Loepfe LabMaster® series with the instruments FIBERMAP® and YARNMAP® together with Mesdan CONTEST® set a new standard for laboratory measurements. The testing devices integrate the most important measurements into one system in order to complete the fiber profile throughout the whole preparation process of the spinning mill, from bale to finisher sliver. Apart from delivering the standard data known from cotton classification, detailed analysis of process relevant fragments such as neps, seed coat neps, trash and stickiness are integrated. In addition, the test results obtained from the yarn testing instrument YARNMAP® can be directly linked through the data system LabMaster TOP® in order to achieve the most comprehensive analysis as basis for the decisions in the spinning mill. These innovative instruments are the most effective tools to measure the quality of fibers and yarn in the fastest, reliable and economic way. The instruments were presented at ITMA Milan 2015 for the first time.

INTRODUCTION

In order to keep the spinning and preparation process under control, spinning mill managers need to take decisions based on numerous testing instruments every day. However, it can easily become a challenge to harmonize the test results with the requirements of the spinning mill in an efficient and effective way. The integration of several sensors into one instrument as well as a data system that links the data of the test instruments in the most comprehensive way support the management in drawing the right conclusions.

Savio Group: qualified technologies in the textile industry

The Savio group is a network of companies, combining qualified technologies in the textile industry. The Savio group provides among others solutions for winding, electronic yarn clearing, splicing of any type of fibers and yarn as well as quality control laboratory testing equipment.

Loepfe Brothers Inc. stands for innovation in the textile industry over the last six decades. The company, which was founded in 1955, belongs to the Savio group since 2008. The company introduced weft feeders and weft stop motion – the first electronic sensors for looms. Today, Loepfe supplies 50% of yarn clearers worldwide. Already in 1991, Loepfe developed the first yarn clearer, which was able

to detect foreign fibers as well as the first online fault classification in addition to the classic yarn defects.

Mesdan was founded in 1952 and became part of the Savio group in 2013. The company consists of 2 business units:
- Mesdan Yarn Joining Solutions (Jointair® and Aquasplicer® are just a couple of Mesdan's renowned trademarks)
- Mesdan-Lab Laboratory Testing Equipment for fibers, yarns, fabrics and garments started at the beginning of the 90's and expanded further in 2012 with Mesdan-DyeLab QC Dyeing & Finishing Laboratory Machines.

The textile expertise of both companies was brought together some years ago to start the development of an innovative fiber testing and a comprehensive yarn testing instrument. Both instruments were shown to the public for the first time at ITMA 2015 in Milan.

Relationship between fiber parameters and yarn quality

The spinning process is a sequence of various machines that serve to prepare the given fiber material in the best possible way to be able to spin a yarn with the best possible yarn characteristics.
But what are the most relevant parameters for a spinner to make sure that the spinning process is under control and to be able to achieve a good result? According to cotton experts these are: fiber length, short fiber content, neps, Micronaire, maturity, stickiness and color.
These parameters influence the yarn quality and the yarn that can be spun out of the fibers. Some of the relationships are: The length defines the yarn type, the count, the evenness and the hairiness of the yarn. The short fibers influence the evenness, the imperfections, the hairiness, the strength and the appearance. The Micronaire is responsible for the yarn count and the strength. The maturity influences the dye-uptake. The neps and seed coat neps influence the appearance of the yarn and its strength. The color influences the appearance of the fabric. The evenness and the imperfections of the yarn deteriorate due to the problems caused by stickiness. For these reasons, it is very important to control the fiber quality from the very beginning.

Loepfe LabMaster FIBERMAP® and Mesdan CONTEST®

Mesdan and Loepfe developed two instruments that are able to measure all these parameters which are important to evaluate the raw material, control the preparation process and spin a high quality yarn.
The instrument sold by Mesdan is the so-called CONTEST®. The instrument sold by Loepfe is called LabMaster FIBERMAP®. Both instruments use the same platform and technologies to measure neps, seed coat neps, trash, stickiness and Micronaire, maturity, and fineness.
In addition to these properties relevant for processing, Loepfe LabMaster FIBERMAP® measures all the parameters that are known from cotton classification.

These are length, strength, elongation color, and trash. Both instruments are explained in detail in the next slides.

Fig. 1: Mesdan CONTEST®   Fig. 2: Loepfe LabMaster FIBERMAP®

Classification of neps, seed coat neps and trash

A 3.5 gram specimen made of cotton (hand shaped in sliver form) is automatically transformed into a 10 meters thin homogenous web sample by the inbuilt opening group. This web is processed by the Fragment Tester where high definition image analysis of the impurities is performed. More than one hundred reflected images of the web are captured by the video camera during its passage through the Fragment Tester.
These Images are processed by the Fragment Software which identifies, counts and classifies the impurities according to type (trash, seed coats neps, neps) and size classes.

Classification and grading of stickiness

Cotton stickiness
Cotton stickiness is caused by an excess of sugars in the cotton lint:
- from the plant (physiological sugars)
- from insect's secretion (mainly entomological sugars from white-fly and aphid honeydew).
- from oil released from crushed seed coats
- from other sources

For everyone involved in the cotton supply and processing chain, lint stickiness means profit loss (growers, ginners, traders, and spinners). In spinning, cotton stickiness contaminates machines that are used in the transformation process from fiber to yarn increasing the production costs (excessive wear, increase of maintenance cleaning operation, clogging of machinery, production loss).

Cotton stickiness also reduces the quality of the yarn by decreasing the evenness and increasing neps and hairiness. Therefore, it is important to have information on cotton stickiness just as for other fiber parameters (strength, length, color etc.).

Stickiness is a worldwide contamination problem as shown by the International Textile Manufacturers Federation (ITMF) Cotton Contamination Survey. Every other year the ITMF organizes a survey by sending a questionnaire to spinners worldwide about the perception they have on the different cotton contaminations for the main origins of cotton: "The presence of sticky cotton as perceived by the spinning mills increased again in 2013 significantly from 20% in 2011 to 23%. This level is higher than the long-term average. Therefore, stickiness remains a major challenge to the global cotton spinning industry. (….) Seed-coat fragments recorded a noticeable jump, remaining an issue for spinners around the world. 42% of cotton spinners (2011: 38%) claim that they have encountered moderate or significant amounts of seed-coat fragments in the cotton growths consumed."

Fig. 3: ITMF Cotton Contamination Survey, Edition 2013, Stickiness 1989 – 2013

Fig. 4: ITMF Cotton Contamination Survey, Edition 2013, Seed Coat Fragments 1991 – 2013

Stickiness Tester
The thin web is passed through two heated (37°C) drums pressed one against the other at a constant pressure. The sticky particles adhere and deposit on the rollers whereas the web is sucked away and delivered to the next test.
The sticky deposits are optically examined, counted and classified according to the size (variation of the optical signal). At the end of the test, the drums are cleaned by two brushes and knives to prevent repeated counting of sticky deposits.
The stickiness measured for the tested sample is graded by a special algorithm that gives more importance to large deposits.
Therefore at the end of the test the spinner is able to class the cotton bales by Stickiness Grade (from non-sticky to low, moderate and sticky bales) the same as for color, leaf grade, Micronaire , strength, length and uniformity, and take relevant processing decision.

Advantages
One of the biggest advantages of the Stickiness Tester is that it enables accurate and rapid measuring of stickiness thus making it suitable for mass testing of large numbers of samples. The large natural variability of stickiness within bales and samples must be considered. Stickiness and other contaminants (seed coat fragments, trash) present in a 3.5gr/10mt sample are measured in less than 60 seconds, in addition to neps, maturity, and fineness.
But overall, the most important advantage is the ability of the Stickiness Tester to provide practical information on cotton stickiness simulating the passage of the cotton sample through carding drums and rollers: it detects all sticky deposits coming from any source (insects' honeydew, concentration of plant sugars, crush seeds, oil, etc.) that can contaminate the spinning machinery.
In other words, the Stickiness Tester integrated in CONTEST® and FIBERMAP® laboratory instruments is a real working tool for the spinners: it provides practical information that can be used by the spinners to take relevant decisions whether to process the sticky bales (by blending them with non-sticky bales and setting the spinning process accordingly) or discharge them.
Cotton bales can therefore be classified for stickiness grade and not only for the other physical fiber properties.

Micronaire and Maturity by double-compression

Micronaire is measured based on the air permeability of a sample of certain weight and fixed volume. Maturity is measured on the sample by double compression based on the fact that the passage of pressed air is higher through mature fibers than through immature fibers. Fineness in millitex is calculated based on Micronaire.
This high speed measuring system enables to check if cotton bales have a potential for the dye defect before processing and checking formation of neps during the process. One of the effects of immature fibers are the white specks that can degrade fabrics considerably.
The sample is automatically prepared, blended and fed to the tester and then delivered onto an electronic balance for weight control. This testing procedure eliminates operator influence on the results and makes measurement very accurate and precise.

Classification parameters to complete the fiber profile

In addition to the measurement of the fragments stickiness, fiber maturity and fineness, the Loepfe FIBERMAP® integrates a second module that measures the parameters known from the cotton classification, i.e. length, strength, color, and trash.
All these measurements are performed fully automatically and with only one sample that is prepared in a cassette.
The measurement of the color and trash are optical measurements that evaluate the sample for the Rd, +b, Color and Leaf Grade. The trash is specified in Trash area and Trash count. The length evaluation calculates the UHML, UI and SFI based on

the fibrogram taken from the sample. The strength, the elongation and the moisture of the fibers are measured as well.

Needless to say, the instrument is calibrated with international standard cotton from USDA as well as the standard color tiles. Spinning mills can rely on the results and compare them with the classification values of the purchased cotton. FIBERMAP® is the only instrument for mass testing of cotton quality and contamination providing more than 18 measurements in one measuring cycle.

Closing the loop: integration of data

However, the value of the fiber testing instruments must be seen in an overall context for the spinning mill. The results need to be correlated and combined with the yarn quality results in order to have the full benefit and in order to quantify the effect of the fiber preparation on the final product.

The yarn testing instrument LabMaster YARNMAP® measures the yarn automatically for its count, evenness, hairiness and strength in one test cycle. Also, measurement of sliver and roving evenness can be tested simultaneously.

In order to close the loop, all these test results are combined in a data management system called LabMaster TOP®. Comprehensive reports for fiber-to-yarn engineering are available to correlate the results from fiber testing directly to the results from the yarn quality. The quality manager can, for example, analyze the effect of the short fiber content on the evenness or the hairiness of the yarn in one report. The integration of data supports the effort to produce the best yarn quality out of the given raw material.

Fig. 5: Complete laboratory system

Key benefit: integration for a complete fiber profile

Summarizing the benefits of these two new fiber testing instruments, we can say:
- Complete fiber profile measured in only one instrument in the shortest measuring time
- Detailed information about processing relevant parameters: classification of neps, seed coat neps, trash and sticky points
- Integrated, fast and reliable stickiness contamination measurement by number, size, and grade
- Additionally, measurement of parameters known from cotton classification, such as length, strength, color, trash and Micronaire
- Automated testing, easy sample preparation, intuitive instrument operation ensure reproducible results
- Highest efficiency with regard to investment, resources, and maintenance
- Connecting fiber characteristics with yarn quality delivers technological benefit for the spinning process
- Data integration in the management cockpit

Together, Loepfe and Mesdan offer new and comprehensive solutions for laboratory testing that fulfill the needs of quality oriented spinning mills and the challenging requirements of the market.

Thank you very much for your attention!
Daniela Messa & Sandra Meier

REFERENCES

Cotton Contamination Survey, Edition 2013, ITMF