USTER® *TESTER 5*

Application Report

Comparison of the capacitive and optical measuring methods to determine evenness

Textile Technology / 2000 / Edition 2: July 2008 / SE 564

USTER®
Think quality

veronesi\TT\Application Reports\USTER TESTER 5 / SE_564_Comparison of the capacitive and optical measuring ... .doc

Contents

1 State of the art

Since the introduction of the first yarn evenness testing unit in 1948, the textile industry has made great strides in the yarn production technology with regard to increased productivity and quality improvement through optimum use and utilization of raw materials and with the introduction of new spinning technologies. The intelligent development of testing methods which lead to these advances in the field of evenness testing was also successful in the field of quality control and opened up new possibilities with the introduction of the automated fiber testing.

However, the central issue is still the quality of the respective textile end product, which in the spinning process is clearly represented by the finished yarn. In the textile language, the yarn is defined as a „line-shaped structure", whereby the attention with respect to the yarn quality is focused on a homogeneous, even distribution of fibers in the cross-section over the entire yarn length of the production. The capacitive measurement of the yarn mass with the help of a testing instrument was made possible for the first time in 1948 with the yarn evenness testing unit GGP and allowed a direct influencing control over the improvement of the yarn evenness. Since then, Uster Technologies has further developed the capacitive measuring system and now presents it in the fourth generation of yarn evenness testing units as the basis of every USTER® *TESTER 5.*

With the above-mentioned introduction of new spinning methods, other quality parameters besides the pure yarn evenness monitoring with regard to a constant mass flow have become more important. Worth mentioning at this point are certainly the yarn hairiness and the optical unevenness or diameter variation of yarns. Parameters such as the yarn strength and elongation or the yarn twist will be ignored at this point because they involve destructive quality tests. Regarding the determination of the fineness of slivers/rovings and yarns, there are special testing units available on the market today, all of which involve the use of a scale. The USTER® *TESTER 5-S800* offers the optional possibility of determining the fineness of yarns simultaneously with the evenness, hairiness and diameter measurements.

The introduction of new possibilities of determining the yarn diameter and the surface structure of yarns has in the past repeatedly led to discussions about the inadequacies of a capacitive determination of the yarn evenness. This has prompted Uster Technologies to prepare a tabular summary of the advantages and disadvantages of the respective testing methods from an objective point of view, because Uster Technologies today offers the possibility of determining all of the above quality parameters in one test run. After many years of experience with the capacitive measuring principle and the resulting standards, which are accepted worldwide, Uster Technologies is still convinced of the capacitive evenness testing and will continue to be behind it and make it an integral part of every future USTER® *TESTER.*

2 Area of application of the capacitive and optical sensors

The following table gives a good description of where the capacitive sensors can be applied

Testing of	Capacitive sensor	Optical sensor one-dimensional	Optical sensor two-dimensional
Yarns up to 200 tex	Yes	Yes	Yes
Slivers	Yes	**No**	**No**
Rovings	Yes	**No**	**No**
Yarns > 200 tex	Yes	**No**	**No**

3 Determination of faults with capacitive and optical sensors

The following table shows the frequently yarn faults and how to record by the various measuring methods.

Type of yarn faults	Capacitive sensor	Optical sensor one-dimensional	Optical sensor two-dimensional
Periodic fault caused by damaged roller surfaces, belts or gear wheels	This type of faults always results in a change in the number of fibers of the cross-section => true change of mass => **always detected**	A change in the number of fibers of the cross-section can, but doesn't have to, result in an increase or a decrease of the diameter => **possibly detected**	A change in the number of fibers of the cross-section can, but doesn't have to, result in an increase or a decrease of the diameter => **possibly detected**
Nearly periodic fault caused by incorrectly set drafting zones (floating or torn fibers)	This type of faults always results in a change in the number of fibers of the cross-section => true change of mass => **always detected**	A change in the number of fibers of the cross-section can, but doesn't have to, result in an increase or a decrease of the diameter => **possibly detected**	A change in the number of fibers of the cross-section can, but doesn't have to, result in an increase or a decrease of the diameter => **possibly detected**
Yarn roundness	Cannot be measured	Unroundness can distort the CV and result in errors in the counting of thick and thin places	The observation of the yarn body from two directions allows the determination of the roundness

Type of yarn faults	Capacitive sensor	Optical sensor one-dimensional	Optical sensor two-dimensional
Accidental evenness (CV)	The spinner's goal is to provide the same number of fibers in the cross-section at every stage of the process, and this means a constant mass, which is best determined with a capacitive sensor	The variation of the diameter does not provide any information about the control of the drafting processes. It is more suitable for determining the future visual appearance of the yarn	The variation of the diameter does not provide any information about the control of the drafting processes. It is more suitable for determining the future visual appearance of the yarn
Thick places	Yarn thick places in the end product are always considered disturbing if these are caused by an increase in the number of fibers of the cross-section and therefore result in a true mass increase	Thick places caused by an increase in volume can usually be equalized in subsequent processing. One-dim. measurement can result in errors[1]	Thick places caused by an increase in volume can usually be equalized in subsequent processing[1]
Chance of the amount of fibers in cross section without increase of the diameter	Mass faults which are not visible in the yarn and on raw-white fabrics are determined but as a result of the higher amount of fibers in cross section, they will change their color at a later processing stages.	Cannot be measured	Cannot be measured
Thin places	Thin places with an actual decrease in the number of fibers of the cross-section have a disturbing effect on the subsequent processing	A decrease in the diameter with the same number of fibers in the cross-section indicates twist variations, which is more a long-wave event. One-dim. measurement can result in errors[1]	A decrease in the diameter with the same number of fibers in the cross-section indicates twist variations, which is more a long-wave event[1]

[1] For the present no determination of IPI-values with the sensor OM

Type of yarn faults	Capacitive sensor	Optical sensor one-dimensional	Optical sensor two-dimensional
Neps	Actual, short-wave mass increase in the form of fiber neps, seed coat fragments or trash particles and, with very fine yarns, also loose accumulations of fibers	Because of the short measuring field length, actual, short-wave variations can easily be detected, whereby protruding fibers and loose accumulations of fibers are also included in this category. One-dim. measurement can result in errors[1]	Because of the short measuring field length, actual, short-wave variations can easily be detected, whereby protruding fibers and loose accumulations of fibers are also included in this category[1]

4 Other quality characteristics

In addition to above parameters, the textile user will find the following parameters also helpful for the evaluation of the spinning process and consequent processes.

Miscellaneous	Capacitive sensor	Optical sensor one-dimensional	Optical sensor two-dimensional
Yarn index	With the knowledge of the fiber fineness, it is possible to compare the spun quality with the quality of a yarn which, according to mathematical assumptions[2], is ideal	Not possible	Not possible
Determination of the diameter	Not possible	Determination of the diameter is possible, but slightly distorted due to the one-dimensional measurement	The two-dimensional determination of the diameter provides information on short- and long-wave twist variations
Determination of the density	Not possible	Possible with help of the nominal count, but unreliable because of the inadequate determination of the diameter	Possible with the help of the nominal count and the actual, two-dimensional determination of the mean yarn diameter

[2] J.G. Martindale, Irregularity in worsted rovings and yarns, WIRA report, September 1943

5 Other factors of influence

Quality standards, process control as soon as raw material- and ambient conditions may cause different reactions by the different principle of measurements.

Miscellaneous	**Capacitive sensor**	**Optical sensor one-dimensional**	**Optical sensor two-dimensional**
Influence of the climatic conditions such as humidity and temperature	Test results can only be compared if the respective ambient conditions are the same => standard climatic conditions!	Relatively independent of climatic conditions	Relatively independent of climatic conditions
Process control	Optimum monitoring of the spinning process from the card all the way to the yarn	Difficult, because only yarn testing is possible	Difficult, because only yarn testing is possible
Conductive fibers	Signal error because of different dielectrical constants	No influence concerning the measurements	No influence concerning the measurements
Standards and reference values	Internationally recognized standards based on the testing of the yarn quality produced worldwide under defined testing conditions allow the producer to compare his own yarn quality with the yarn quality produced worldwide	Not available	Not available

A quick look at this comparison of the different measuring principles – the capacitive detection of the mass variation and the optical determination of the yarn diameter – shows quite clearly that both systems have advantages and disadvantages. The capacitive measuring method has its strong points in the determination of the production parameters which are essential for the spinning machine settings, and this makes it indispensable for every spinning mill. On the other hand, it shows that the optical – opto-electronic – measuring methods have advantages with regard to the visual appearance of the yarn, especially on yarn boards and in knittings. At this point, it should be noted that the one-dimensional observation comes very close to that of the human eye. A two-dimensional, optical observation of the yarn body, on the other hand, offers advantages for the determination of the roundness and the density of a yarn.

Uster Technologies AG
Sonnenbergstrasse 10
CH-8610 Uster / Switzerland

Phone +41 43 366 36 36
Fax +41 43 366 36 37

www.uster.com
textile.technology@uster.com