YARNS QUALITY ASSURANCE DEPENDING ON THE SPINNING SYSTEMS (II)

BY

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Abstract. This paper will deal with two of the leading topics of the yarn quality characteristics: the consistency (by mean of evenness) and the yarn surface integrity (by mean of the hairiness). After Part I states as a rule the yarn evaluation by means of test report and graphics representations, Part II describes the actual USTER® TESTER 4 reports and the available graphics evaluations for 24 Ne (25 Tex) yarn spun from 100% carded cotton, processed using both ring and open end spinning systems and designed for knitwear.

Key words: yarn, ring-spinning, rotor–spinning, evenness, hairiness.

1. Introduction

Major quality problems that have its origin in yarn manufacturing are still available as feedback from the weavers, knitters, traders and retailers. Therefore, in our days, the laboratory still represents the main point in the complete quality management circle (Sivakumar & Soll, 2005). Regarding the spinning system, the consistency (by the evenness and imperfections) and the surface integrity (by the hairiness) testing are

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usefully for the spinning mills because they may allow the improvement of the yarns’ features and a better feedback from the customer (Douglas, 2005; Peters, 2003). The relationship between the agreed yarn quality profile and the currently reached values has frequently caused issues. Therefore, for the processed yarns, the quality must and can be always settled according to the one rule: never exceeding the required quality profile (Shaik, 2007; Adanur, 1995; El Mogahzy, 1995; Bona, 1994).

In Part I was described the overall interpretation of the USTER® TESTER 4 report and available graphical evaluations as a rule, in order to prevent misunderstandings that can result in wrong decisions in knitting.

This paper part reports on the advanced measurement of cotton yarn’s mass variation and hairiness with USTER® TESTER 4 laboratory system and their evaluation according to the end use. For the suppliers and for the customers too, it is important to distinguish if possible, the manner in which those two characteristics can yield supplementary information on the overall evaluation of yarns spun on different spinning systems, but having the same destination-knitting (*Uster, 2002).

2. Experimental Work – Materials and Methods

For this paper purpose were selected two beaches with 24 Ne (25 Tex) yarn spun by both, ring and open-end spinning systems from 100% carded cotton and designed for knitwear.

The raw material was Uzbekistan cotton, with 29 mm average length and base range for Micronaire (4.5 and, respectively 4.6).

The surface integrity evaluation (by yarn hairiness) was performed on USTER®TESTER 4 (UT4) simultaneously with the consistency evaluation (by mean of the yarn evenness and appearance integrity by mean thick places, thin places and neps) in order to assess if the yarns have accomplished the specified characteristics with respect to their destination (*Uster, 2002; Harpa, 2005; Harpa, 2007a; Harpa, 2007b).

In Figs. 1 and 2 are shown the UT4 test reports with all average numerical results of five yarns samples; in these reports (printed in Italian language) are included the usually statistical parameters achieved for the above yarn characteristics (*Uster, 2001).

The headers of the test report contain all the necessary data for identification of the test specimen and also, the specification of the measurement.

In order to produce the foregoing yarns adequately to their destination, the nominal values of the quality characteristics were settled in Qualy Profile, according to supplier-customer agreement.
Fig. 1 – UT 4 test report for carded ring-spun yarn 24 Ne (25 Tex), 100% cotton:

- Header of the test report and statistical parameters;
- Graphic representations (spectrograms and diagrams);
- QualiProfile for the quality assurance;
Fig. 2 – UT 4 test report for rotor-spun yarn 24 Ne (25 Tex), 100% cotton:

a – Header of the test report and statistical parameters;  
b – Graphic representations (spectrograms and diagrams);  
c – QualiProfile for the quality assurance;  
3. Results and Discussions

According to UT4 test reports for 24 Ne (25 Tex) ring-spun yarn (Fig. 1) and respectively rotor-spun yarn (Fig. 2), the quality assessment for the yarns consistency and surface integrity evaluation, come off.

3.1. Statistical Parameters from the Test Reports (Fig. 1a and Fig. 2a)

− Yarn consistency can be evaluated by mean of overall mass variation (referred as unevenness) and was assured at a very good quality level for both yarns: $\text{CVm}_{\text{ring-spun}} = 14.6\%$ (29% USP01) and $\text{CVm}_{\text{rotor-spun}} = 14.21\%$ (20% USP01).

− Irregularity index shows how close the yarn’s actually unevenness to the nominal unevenness is: $I_{\text{ring-spun}} = 1.6$ and $I_{\text{rotor-spun}} = 1.55$; both values means that was assured a medium quality for processing fibers in to the yarns.

− With respect to appearance integrity, that can be evaluated by mean of the amount of yarns’ imperfections and the following values were obtained:
  • for ring–spun yarns: $\Sigma \text{Fini} (\text{Thin places})/1\text{km}_{\text{ring-spun}} = 1.5\%$ (5% USP01), $\Sigma \text{Grossi} (\text{Thick places})/1\text{km}_{\text{ring-spun}} = 165\%$ (44% USP01) and $\Sigma \text{Neps}/1\text{km}_{\text{ring-spun}} = 188.5\%$ (40% USP01);
  • for rotor-spun yarns: $\Sigma \text{Fini} (\text{Thin places})/1\text{km}_{\text{rotor-spun}} = 18.5\%$ (32% USP01), $\Sigma \text{Grossi} (\text{Thick places})/1\text{km}_{\text{rotor-spun}} = 33.5\%$ (5% USP01) and $\Sigma \text{Neps}^*/1\text{km}_{\text{rotor-spun}} = 12.5\%$ (7%USP01);

Comparing the USP01 values with the measured values, it was obtained the quality levels that proved adequate settings for spinning preparation.

− Surface integrity evaluation was carrying out by performing hairiness analysis for both yarns: $H_{\text{ring-spun}} = 6.95$ (24% USP01) and $H_{\text{rotor-spun}} = 4.85$ (52% USP01).That means a good quality level for ring –spun yarn and medium quality level for the rotor-spun yarn; in fact the last one is the agreed one from the customer because the yarn was designed for knit ted fabrics. Comparing these results with values from Table 1 (see Part I of this paper), all samples from the tested yarns (ring and rotor–spun), have the bigger hairiness values that the top ones. In addition, changing of the hairiness within a yarn is considered visible (after the dyeing process), when the difference is more than one hairiness unit; from this point of view, the experimental yarns do not have issues.

− As a measure of hairiness uniformity, standard deviation of hairiness was identified with following values: $\text{sH}_{\text{ring-spun}} = 1.75$ (27% USP01) and $\text{sH}_{\text{rotor-spun}} = 1.24$ (53% USP01). The rotor-spun yarns has a strongly hairiness variations comparatively with the ring–spun yarn, but not so high as to be alarming.

− Usually, the smallest hairiness variation should be the desired goal because the hairiness variations combined with a critical overall hairiness level have a negative effect on knitted fabric appearance, but not for these yarns (having in account the customer specifications).
3.2. Graphical Representations from the Test Reports  
(Fig. 1 b and Fig. 2 b)

− The mass spectrograms for both yarns show periodical faults however the hairiness spectrogram shows periodical faults only for the ring-spun yarn.

− Relationship between the hairiness diagram and the hairiness values it is obviously stand out for both yarns; the width of the diagram is a direct measure of the hairiness variation $s_H$, and for both yarns, hairiness diagram have a few sudden changes of hairiness between even aspects.

3.3. Quality Profiles from the Test Reports  
(Fig. 1 c and Fig. 2 c)

− The circular diagrams Uster QualityProfiles (UQP) contain all the measurement results achieved with USTER® TESTER 4. In this paper, measurement parameters for UQP are the same from test report, namely: CVm, %; ID; Fini /Thin, -50%; Grossi / Thick, +50%; Neps, +200% /280%*; ±; H and sh.

− The pie charts have majority circular sectors with green (different shades) and blue colors for the quality specification agreed by the customer. That means a good yarn who meets the requirements for the properties evaluated in the quality profile. This classification level can be regarded as the good quality to be achieved in both, ring-spun and rotor-spun yarns, for knitted fabrics.

− The yellow spots mean an adequate yarn who still meets the nominal specifications but also, mean to pay attention on foregoing yarns to be produced, for assurance of a long-term quality.

− The red spots are for an immediate correction of the process (for thin places in ring-spun) for avoiding the rejection of yarns batches. In spite of all this, the produced yarns have the consistency and the surface integrity accomplished adequately.

3.3. Knitted Fabric Simulation from the Test Reports  
(Fig. 1 d and Fig. 2 d)

− The USTER® TESTER 4 software allows the fabric simulation as single jersey knitted fabric on the computer screen.

− Size of the knitted fabric on the printer is the following: visible section (320 mm width, 192 mm height), 6 mm yarn length per stitch, stitches (2.4 mm width, 1.2 mm height) and 166 needles.

− From the viewpoint of fabrics’ appearance, both simulated fabrics have a good texture but the one obtained from rotor–spun yarns has visible uneven sectors.
4. Conclusions

For usually quality assurance in spinning mills, the assessment of the yarn quality is based on the numerical values, on the graphic representations (diagrams and spectrograms) and moreover, on the two new instruments: quality profile and the fabric’s simulation.

The agreed levels with respect to the yarn’s features can differ according to quality demands from the customer; it could be quality level 5%USP or 95%USP, but always depending on the agreed yarn quality profile. In this paper, the 50% percentile value was the suitable ranking and so, the rotor –spun yarn is much proper for the customer specifications.

REFERENCES

* * * Uster Technologies, USTER ® LABORATORY SYSTEMS Application Manual (2002).
* * * Uster Technologies, USTER ® STATISTICS (2001).
Lucrarea prezintă două din cele mai importante caracteristici de calitate ale firelor: constanța caracteristicilor (prin uniformitate) și integritatea de suprafață (prin pilozitate). După ce partea I a lucrării a stabilit necesitatea evaluării firelor prin testare și reprezentări grafice, partea a II-a prezintă rapoartele USTER® TESTER 4 și interpretările grafice disponibile, exemplificându-le pentru fire de bumbac 100% cardat, 24 Ne (25 Tex), filat clasic și OE și folosite pentru tricoturi.