A COMPARISON OF EIB MEASURES TO CURRENT YARN TEST METHODS

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Abstract

The performance characteristics of two yarns as measured on the evenness tester and the EIB System were examined. Results from the evenness tester indicated the yarns could be substituted or interchanged in fabric formation without any negative affects on fabric appearance. Further evaluation of yarn with the EIB System gave contradicting results. EIB appearance boards indicated that one of the yarns would have a significant influence on the appearance of certain width fabrics.

Introduction

Researchers continue to work on instrument systems that might be used to replace subjective indicators with more objective measurements of fiber/yarn/fabric qualities. A number of instruments have been introduced. In the cotton classification system several instruments have been integrated into a system. Thus, the cotton classification system has changed significantly, from a human judgment system, toward a more complete instrument classification system. The high volume instrument (HVI) system is used to measure a number of fiber quality characteristics, including micronaire, reflectance, yellowness, trash, length, length uniformity, strength and elongation. Prior to the HVI system, the human classification system gave subjective measures for grade and staple, with an instrument measure for micronaire. Today, HVI systems are one of the most widely used instrument technologies for measuring the fiber characteristics of cotton for marketing and utilization purposes.

Until recently, yarn appearance grade was a subjective determination. Yarn appearance refers to the relative evenness, smoothness, and freedom from foreign material of the yarn as evaluated by visual comparison of the yarn with the latest ASTM Standards. Yarn specimens, wound on black boards, are compared with photographs of specimens representing the appearance grade.

The appearance of a woven or knitted fabric depends to a large extent on the smoothness, cleanliness, and general appearance of the yarn from which it is manufactured. Since appearance is very important in many types of cotton products, high yarn appearance grades are desirable. The Cotton Testing Service, USDA and ASTM work to maintain a set of quality yarn appearance standards.

Yarn appearance grades have been used in the textile industry for a number of years. As stated previously these have been subjective determinations. Since yarn appearance is one of the most important quality control characteristics spinners have always been keenly aware of its affect on fabric quality. High quality yarns that are consistent over time are preferred in fabric manufacturing. As one would expect, unevenness (thick and thin places) in yarn is directly related to fabric appearance. A high quality yarn is one with a very smooth appearance, no large neps, no long thick places, no long thin places and no foreign matter. A poor quality yarn has an uneven appearance, large neps, long thick places and long thin places. A smooth, imperfection free yarn produces a smooth, imperfection free fabric. Similarly, a poor quality yarn produces a poor quality fabric.

Measuring Yarn Appearance by Instruments

Yarn appearance was such an important yarn quality control measure that instrument technologies were developed to automate yarn evenness testing. All of this in an effort to obtain more precise and less subjective measurements. Harrison has reported that instrument measurements of yarn evenness are made by capacitance method, which has been used in the textile industry since being introduced by the Institute of Textile Technology years ago and which relates to the visual appearance of yarn. These instruments are marketed by several companies and are used by most textile manufacturers to monitor and control the quality characteristics of yarn produced. More specifically, yarn spinners rely on the results from these instruments to improve the quality of their yarn, i. e., produce a smoother more even yarn.

Frequently when objective measurements are compared to subjective determinations different conclusions may be drawn. Quality indicators from yarn evenness measurements might be quite different from those obtained from a visual examination of yarn appearance. Harrison stated that in cases where variations in yarn bulkiness do not coincide with variations in mass, visual perception of yarn evenness is somewhat different from instrument measurements of weight variations.

As stated above, a comparison of instrument measurements and visual interpretations of yarn quality can lead to contradicting and sometimes confusing results. One system might suggest a certain outcome and the other suggest another. This is not only true when comparing instrument measures with visual interpretation, it is also true when comparing different instrument measurements. The purpose of this paper is to present a case for which outputs from different instruments gave contradicting fabric appearance results.

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Capacitance and Optics Measurements

The evenness tester is one of the most used instruments in the textile industry when it comes to evaluating yarn quality. It gives yarn information on neps, thick places, thin places and evenness (CV%). It also gives diagram and spectrogram charts for analyzing weight variation and causes of variation in yarn, respectively. These data provide the spinner with quality information from which he can determine the level of yarn quality produced and it gives an indication of how his yarn will perform in downstream processes, such as weaving and fabric appearance.

Lawson-Hemphill, Inc. recently introduced an instrument for use in determining yarn appearance. The Electronic Inspection Board (EIB) is an image analysis system that is capable of electronically evaluating yarn. The system consist of a video line camera, a lighting system, a yarn transport system for maintaining uniform tension on the yarn as it passes before the camera and computer software for data acquisition and analysis. This technology uses digital optics and its imaging software to analyze yarn faults such as neps, long thick places and long thin places.

The EIB System software calculates the average diameter of the yarn and detects thick and thin places in the yarn. From these data the systems software module can take the digital data and simulate yarn as it would appear on an inspection board. The simulated yarn appearance board is a precise replica of the actual yarn board, showing thick or thin places in the yarn. A unique feature of the EIB System appearance board is the ability to show either thick places or thin places, so that each can be reviewed separately. The simulated appearance board only shows the portions of yarn that are above a certain threshold (thick places) or below a set threshold (thin places). Threshold settings are determined by the user based on yarn counts and quality requirements.

Figure 1 shows an appearance board for thick places as produced by the EIB System software. Clearly, in this example the appearance board looks different from a typical board, one physically wrapped with yarn. On a typical appearance board there would be continuous ends of yarn in the horizontal direction. The viewer would visually inspects these wrapped yarn segments for thick places, thin places, neps, etc. For the EIB generated board in Figure 1 the system maintains a complete yarn profile and as the system simulates wrapping yarn on the appearance board only thick places are visible. Thus, the dotted or broken horizontal lines represent thick places in the yarn; thick places whose diameter has been defined by threshold settings.

Defects in yarn usually are directly related to defects in fabrics. Fabric appearance is often influenced by the number and frequency of thick places in yarn. Uneven streaks or a banding appearance in fabric is a typical problem encountered and can be caused by thick places in yarn. Thus, in evaluating yarn one would like to see a minimum number of dotted or broken lines on the EIB appearance board. However, if dotted or broken lines exist they should be evenly distributed for all boarded yarn. An even distribution of defects would indicate fewer problems in downstream processes.

The capability of the EIB System to show a distribution of defects in fabric is of primary importance to yarn spinners and users. This is even more meaningful since the EIB System software provides an option for examining appearance boards of different widths. Appearance board widths are created to simulate yarn appearance in fabric on different width looms. By changing the width of the appearance board, one can evaluate how a yarn would appear in various widths of fabric on a loom. Spinners and fabric producers can use this EIB option to minimize the influence of yarn defects on fabric appearance.

A Case Study

Recently, a request was made to evaluate two packages of 100 percent cotton, 18s count yarn in the School of Textiles laboratory at Clemson University. Results from these tests were needed by the company to confirm/support findings from their production and lab tests. Both yarns were conditioned and processed the same way on the evenness tester and EIB System.

Table 1 shows the evenness tester results from the standard and experimental yarns. From these data the experimental yarn measurements indicate an overall improvement in yarn quality characteristics - a lower evenness value, a lower number of thick and thin places, and higher neps.
The company obtained similar results from their evaluation. Based on their data the experimental yarn, with a lower CV%, was placed into production. Severe filling band problems were quickly observed in the fabric and the experimental yarn was removed from production.

In the Clemson lab the two yarns were run on the EIB System. Yarn profiles plots were created, Figures 2 and 3, to study variations in yarn diameter. From these figures there does not appear to be a difference in the yarn diameters - they appear to be similar.

To examine these yarns more thoroughly, electronic appearance boards were created. Figures 4 and 5 show 35 cm boards for the standard and experimental yarns. From these figures it can be concluded that the yarns can be substituted/interchanged in a fabric without having any affect on fabric appearance. Figures 6 and 7 show yarns wrapped on 25 cm boards. The standard yarn in Figure 6 show no evidence of a banding problem. However, the experimental yarn in Figure 7 clearly shows a banding problem. Hence, the EIB appearance board provides clear evidence that supports the observed banding problems

encountered in manufacturing with the experimental yarn. Banding occurred with the experimental yarn even though it had a lower evenness measurement.

Summary

From the above it is clear that the electronic appearance board can be very useful in determining the best fabric widths for certain yarns. A number of boards with various widths can be created and studied from one data set. Multiples of board widths are used to simulate fabric widths on the loom. With this information yarns with banding type defects can be directed to fabric widths that minimize their influence on fabric appearance.

References

Annual Book of ASTM Standards. 1993. Vol. 07.01, Textiles (I): D2255-90, pp. 595-599.

Cotton Testing Service. 1982. Cotton Division, AMS, USDA, Agriculture Handbook Number 594, pp. 17-18.

Harrison, Robert E. 1996. Use of Image Analysis to Grade Cotton Yarn. Sixth International Conference on Computers in Agriculture, pp. 795-800.

Table 1. Standard and Experimental Yarn Properties

Yarn	Evenness (CV%)	Thin Places (-50%)	Thick Places (+50%)	Neps (200%)
Standard	14.68	12.56	92.56	49
Experimental	13.74	6.30	80.80	122

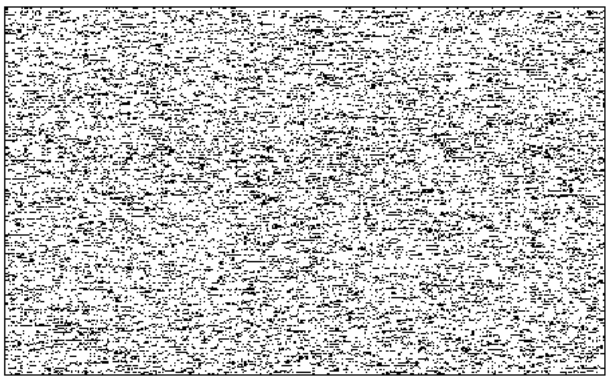

Figure 1. Typical Yarn Appearance on EIB Display Board

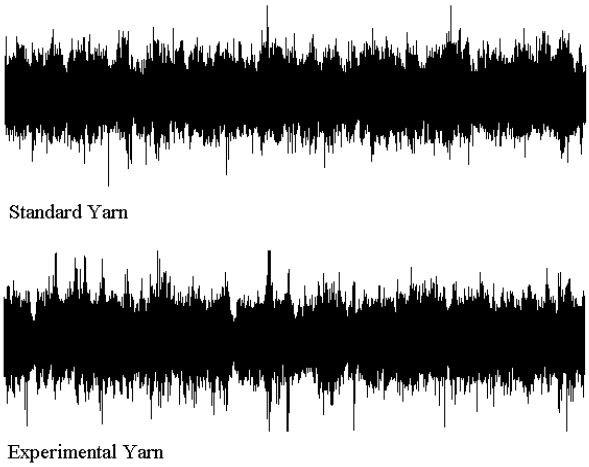

Figure 2. Comparison of Standard and Experimental Yarn Profiles

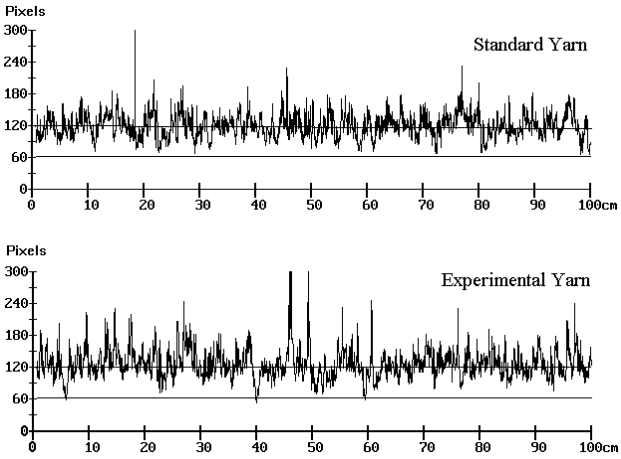

Figure 3. Comparison of Standard and Experimental Yarn Diameters

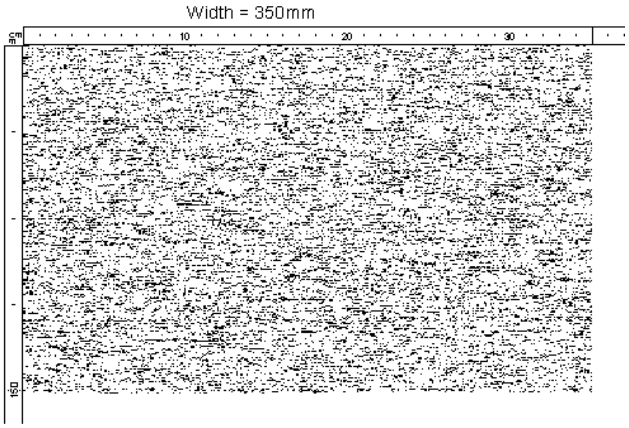

Figure 4. EIB Appearance Board for Standard Yarn (Width = 35cm)

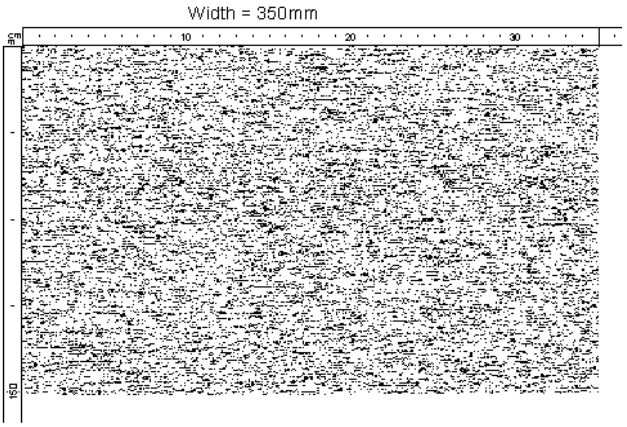

Figure 5. EIB Appearance Board for Experimental Yarn (Width = 35cm)

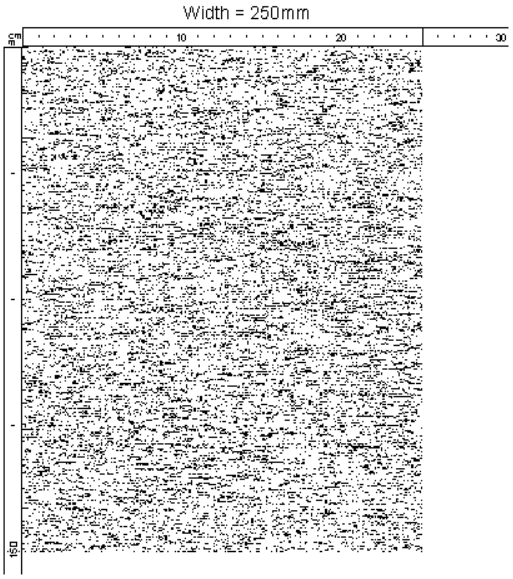

Figure 6. EIB Appearance Board for Standard Yarn (Width = 25cm)

Figure 7. EIB Appearance Board for Experimental Yarn (Width = 25cm)