"The Measurement of Short Fiber Content and Its Effect On Mill Performance and Quality"

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Short fiber in raw cotton refers to fibers that are shorter than 1/2-inch in length. Work In Europe has shown that on a non-ginned cotton seed the short fiber content is less than 1%, by weight, of the total fiber on the seed. After ginning, the short fiber content increases to the present U.S. average short fiber content level of 14%. Taking Texas short cotton out of this value brings the level down to between 9 and 10% for the combined Delta, Estern and Far Western growth areas. For many years the cotton spinning industry has known that as the percentage of short fiber increases in the fiber shock being processed, the poorer the manufacturing performance and the lower the yarn and fabric quality. Knowing this fact has down little to help our plants keep short fiber form entering the manufacturing unit in cotton raw material. The primary reason for this is that there has been up to now, no fast, reliable way to measure short fiber content. The referee Suter-Webb Array can take up to three hours to perform two determinations on one bale sample. The Peyer AL-101 takes about 15 minutes to do two determinations per sample. Within the recent past, Zellweger Uster has been marketing their AFIS L&D unit for measuring fiber length and length distribution, and diameter or fineness. The AFIS L&D takes about three minutes to do three determinations per bale sample. All three of these tests are satisfactory by themselves, but as you can see they are a far cry from the HVI speed we need if we are going to get serious about

controlling short fiber content in cotton mixes. Some in or industry are suggesting that the HVI mean length over upper half mean length Uniformity Index value can be used as a measure of short fiber content in cotton.

In an effort to shed length on the various methods for measuring short fiber content in cotton since the inception of the Suter-Webb array, researchers at the Institute have just recently completed a study of the Array, the Peyer AL-101, the AFIS L&D, and the measure Uniformity Index form both fiber content. On cottons having a wide range in Suter-Webb Array upper quartile length, from 1.08 to 1.53 inches, in mean length from 0.89to 1.33, and in short fiber percentage less than 1/2-inch, from 1.95 to 11.30%, the identical samples were multiple tested on both a Peyer AL0101 with Fibroliner, and the AFIS L&D. the results of this work showed the following R square values.

Correlations, R^2, for Three Different Fiber Length and

Length Distribution Tests on cotton Samples, by Weight

	Suter-Webb UQL, in	Peyer Al-101 25% point, in.
Peyer AL-101, 25% point, in.	0.91	---
AFIS L & D, UQL, in.	0.96	0.97

	Suter-Webb Mean Length, in.	Peyer AL-101 Mean Length, in.
Peyer AL-101, Mean Length, in.	0.93	---
AFIS L & D, Mean Length, in.	0.97	0.97

	Suter-Webb <1/2-inch (%)	Peyer AL-101 <1/2-inch (%)
Peyer AL-101, <1/2-inch(%)	0.95	---
AFIS L & D, <1/2-inch (%)	0.90	0.84

It is immediately observed that there are exceptionally good correlations between like length properties from all three units tested. Although the correlations are exceptional, one immediately notices that the three units of measurement are on different levels. By weight, the Suter-Webb Array produces a longer upper quartile and mean length, and a lower percentage of fiber less than 1/2-inch compared to the Peyer AL0101 and AFIS L&D. The Peyer AL-101, by weight, on average, reads 0.164 inches shorter at the 25% Point and 0.159 inches shorter at the mean length than the Array. Too, the short fiber content value is higher by 2.58 percentage points, more than likely as a result of the sample preparation technique necessary for the AL-101. The AFIS L&D, by weight, is more like the Array than the Peyer LA-101. Again though, there Is a shortening of the upper quartile length and mean length compared to the Array. These values average 0.128 inches and 0.127 inches shorter, respectively. The Peyer AL-101 and AFIS L&D , by weight, differ at the upper quartile length/25% point by 0.036 inches, and at the mean length by 0.032 inches. The short fiber percentages differ by 1.69 percentage points with the Peyer AL-101 having a higher level than the AFIS L&D. The difference between the AFIS L&D and the Array can also be attributed to the sample preparation in the AFIS instrument itself.

What about the HVI Uniformity Index in its relationship to short fiber content? In a test concerning 157 cotton samples having a wide range of upper half mean length and Uniformity Index values, as determined from both a Motion Control and a Zellweger Uster HVI, and short fiber content as determined by a Peyer AL-101, the correlation coefficient, R, between Uniformity Index and short fiber content was -0.518. This means that as the uniformity Index went up the short fiber content went down, and that 26.8% of the variation in Uniformity Index was associated with the variability in short

fiber content. This correlation does not suggest that Uniformity Index can be used as a measure of short fiber content less than 1/2-inch.

In repeat work on cottons of widely measured length and short fiber content properties, after multiple testing on an AL-101 and a Motion Control HVI, the correlation coefficient, R, was found to be -0.74. In this series of tests, 54.7% of the variation found in the Uniformity Index value can be associated with the variation in short fiber content. This improved correlation can be attributed to testing each sample 20 times on the Peyer AL-101 and the Motion Control HVI to get a more accurate value for both short fiber content and Uniformity Index. to get even this mediocre correlation, far too much testing must be performed: an amount not conducive to using HVI to test for short fiber. I want to make it clear here, the Institute is not saying that Uniformity Index should not be taken seriously. We are saying that it is not a good indication of short fiber content, but we know that the higher the Uniformity Index value the better the plant's performance and quality. A quite comprehensive study is planned between the Institute, Cotton Incorporated, and the International Center for Textile Research and Development in Lubbock, Texas to answer the questions industry has about Uniformity Index. This work should be completed during this calendar year.

Well, enough about measuring short fiber content. For those working on a fast, HVI speed tester, our industry wishes you speedy good luck. We need an accurate reproducible device quickly.

Our researchers have performed a number of large and small experiments or trials in our member plants to determine the effect short fiber has on plant performance and product quality. One of the more interesting was one we did looking at a number of things related to laying down a mix. We were interested in the effect reducing the bale-

to-bale variability of 2.55 span length and micronaire, while maintaining the same average, had on processability and quality. With that we had different levels of short fiber content as measured at finisher drawing, and two levels of number of bales in a mix. Since we are concerned here this morning with short fiber content and its effect, let's only look at the results form that standpoint, and from the largest mix studied.

The yarn produced in this experiment was a 22.5/1, 100% combed cotton knit yarn. Two different 25 bale laydowns were processed on the identical plant machinery organization, and the bales in each laydown were carefully chosen to give similar properties as determined by a High Volume test line, except for the percent fiber less than 1/2-inch. Lot A had a short fiber content, as measured with the Peyer AL-101 on finisher sliver, of 8.6%, and Lot B had a short fiber content of 11.6%; a difference of 3.0 percentage points in the finisher sliver produced from the two laydowns. As mentioned earlier all the other cotton properties were essentially the same.

Sufficient poundage was processed form each laydown to allow frequency checks amounting to 11.520 spindle hours of spinning. Resulting ends-down rates are shown as follows:

	Ends-Down/1000 Spindle Hours
Lot A (8.6% Short Fiber)	7.9
Lot B (11.6% Short Fiber)	12.8

The difference between 7.9 and 12.8 ends-down per 1000 spindle hours was statistically significant at the 95f% Confidence Level.

The results of our laboratory tests on yarn samples comparing Lots A and B are given below.

Results of Yarn Quality Tests

Item Tested	Lot A (8.6% Short Fiber)	Lot B (11.6% Short Fiber)
* Cotton Count	22.32	22.97
* Skein Strength (1b)	108.13	97.43
* Adjusted Break Factor	2399	2238
* Single-End Strength		
Grams	394.8	372.0
Grams/tex	15.0	14.5
* Single-End Elongation (%)	6.22	5.44
* Appearance Grade	B/B-	C
* Appearance Index	106	89
* Uster Evenness (%CV)	16.0	17.3
Uster Imperfection Count		
* Thin Places	15	36
* Thick Places	229	364
Neps	61	67
Classimat		
Majors	3	3
* Minors	312	389
* Long Thin Places	160	247

* Different at 95 Confidence Level

The results of this mill study clearly show that an increase of short fiber content in

cotton is detrimental to both process efficiency and product quality. It would be well for the processors of cotton fiber to measure and control the quality of short fiber on the mixes being process into yarn.

Of course, this can only be done efficiently and effectively when a fast and accurate tool is in our hands for every bale measurement of short fiber content, and intelligent use of this information incorporated into the Cotton Incorporated EFS System. Categorizing bales by short fiber content level, and mix control considering short fiber along with other important fiber properties will, without a doubt, move many of our plants from being marginal producers to ones taking steps to become Would Class operations.