



## STUDIES IN FIBER LENGTH UNIFORMITY: Part II

In last month's *Textile Topics* we carried excerpts from a report on different measures of cotton fiber length uniformity. This month we continue the serialization of that report. For continuity, we are beginning Part II by repeating part of the last paragraph of the material presented previously.

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"... All correlations involving uniformity ratio with either short fiber content or the coefficient of variation of length were negative, implying that an increase in uniformity ratio or index involved a reduction in length variation or short fiber content, as expected by definition. For ease of interpretation, the data within Table IV have been broken into smaller matrices.

"For short fiber content, there was a high correlation (0.88) between Suter-Webb and Peyer deter-

minations. The correlation coefficient between Suter-Webb and Peyer estimates of the coefficient of variation was also high at 0.87. Correlations involving Fibrograph data were inferior, having coefficients of about 0.70.

"Among uniformity ratios and indices, the Fibrograph and Spinlab HVT data were well correlated at 0.85. Utilizing the MCI-determined statistic caused a reduction in correlation coefficient to about 0.65.

"Correlations between the coefficient of length variation and the short fiber content are shown in Table IV. The worst correlations involved the Peyer short fiber content values with those of the Digital Fibrograph and also the coefficient of variation of fiber length as determined by the Suter-Webb comb sorter method. The highest correlation coefficient was obtained between the Peyer estimate of coefficient of length variation and the Digital Fibrograph's short fiber content.

"Between uniformity ratio/index and coefficient of length variation data, the best correlation observed was between the uniformity ratio of the Digital Fibrograph and the Peyer instrument's coefficient of length variation. The worst associations involved the Spinlab uniformity index.

"As might be expected, there was a high correlation between Digital Fibrograph variability data, as shown in Table IV, but the Fibrograph's short fiber content estimate had a poor association with Suter-Webb or Peyer short fiber content estimates. Similar behaviour was observed for the Spinlab HVT data. The most consistent correlations with short fiber content were obtained with the Motion Control Inc.'s HVI estimate of uniformity ratio.

"The general impression gleaned from these data is that the measurement of the upper length statistics is consistent between instruments both in terms of level and accuracy. This

TABLE IV  
SMALLER CORRELATION MATRICES

### 4.1 Short Fiber Contents

	Peyer	Suter-Webb
Fibrograph	0.6960	0.7174
Peyer		0.8757

### 4.2 Uniformity Ratios/Indices

	MCI	Spinlab
Fibrograph	0.6176	0.8507
MCI		0.6754

### 4.3 CV% Length/Short Fiber Content

	CV%		SFC	
	Peyer	Suter-Webb	Peyer	Suter-Webb
Fibrograph	0.9113	0.7917	0.6960	0.7174
CV% - Peyer		0.8653	0.7650	0.7872
CV% - S.W.			0.6291	0.8651
SFC - Peyer				0.8757

### 4.4 Uniformity Ratio/CV%

	CV%	
	Peyer	Suter-Webb
Fibrograph	-0.8469	-0.8064
MCI	-0.7951	-0.7902
Spinlab	-0.7252	-0.7683

### 5 Uniformity Ratio/SFC

	SFC		
	Fibrograph	Peyer	Suter-Webb
Fibrograph	-0.8719	-0.3979	-0.5349
MCI	-0.7936	-0.7841	-0.8142
Spinlab	-0.7609	-0.3551	-0.5641

cannot be said for statistics purported to be descriptive of the variability of length. As might be expected, Suter-Webb comb sorter array and Peyer AL-101 data were most alike."

[At this point we are omitting several sections of the report referring mostly to regression equations.]

### 5. Analysis of Uster Imperfection Data

"Since length uniformity data had failed to consistently enter equations to explain yarn strength, non-uniformity and spinning performance, it was decided to extend the analysis to include Uster imperfection data, namely, thin places, thick places and neps. It was felt that such short term defects should be explained to a significant degree by fiber length variability, rather than necessarily influence the all-embracing evenness statistic, the coefficient of variation (non-uniformity).

"The data used as dependent variables were the imperfection data from  $N_e$  16 rotor and ring yarns. Stepwise regression was used to derive the equations having the most terms which were significant in their explanation of the independent variable, just as in previous analyses. In addition, simple correlation data were obtained with each instrument's length data.

#### 5.1. Correlations between fiber length data and Uster imperfections

"The correlation coefficients are shown in Table V.

TABLE V  
CORRELATION MATRIX  
FIBER PROPERTIES AND YARN IMPERFECTIONS

Fiber Length Characteristic	Rotor ( $N_e$ 16)			Ring ( $N_e$ 16)		
	Thin	Thick	Neps	Thin	Thick	Neps
<u>Digital Fibrograph</u>						
2.5% Span Length	-0.7083	-0.6837	-0.5333	-0.7929	-0.5924	0.3546
50% Span Length	-0.4906	-0.4941	-0.4766	-0.7288	-0.6632	0.3428
Uniformity Ratio	0.4201	0.3526	0.0823	0.0569	-0.2036	0.0009
Short Fiber Content	-0.1561	-0.1041	0.1090	0.2535	0.4024	-0.1750
<u>Peyer AL-101 Almeter</u>						
Upper Quartile Length	-0.6926	-0.6816	-0.5004	-0.7348	-0.5230	0.3745
Mean Length	-0.6098	-0.6138	-0.5216	-0.7589	-0.6143	0.3634
CV% of Length	-0.1549	-0.0623	0.2157	0.2831	0.4438	-0.0442
Short Fiber Content	0.3660	0.3953	0.5032	0.7404	0.7007	-0.2509
<u>Suter-Webb Array</u>						
Upper Quartile Length	-0.6865	-0.6920	-0.5664	-0.7978	-0.5516	0.3147
Mean Length	-0.5357	-0.5848	-0.5689	-0.7898	-0.6141	0.2995
CV% of Length	-0.2797	-0.0953	0.2138	0.2271	0.3067	0.0074
Short Fiber Content	0.1086	0.2547	0.4783	0.6285	0.5440	-0.1128
<u>Motion Control</u>						
Length	-0.7083	-0.7050	-0.5670	-0.7833	-0.5493	0.3037
Uniformity Index	-0.0607	-0.2088	-0.4113	-0.4542	-0.3918	0.1467
<u>Spinlab</u>						
Length	-0.6976	-0.6811	-0.5419	-0.8045	-0.5772	0.3379
Uniformity Index	0.3632	0.3001	0.0370	-0.0104	-0.1203	0.0641

#### 5.1.1. Thin places (rotor yarns)

"Thin places in the yarns were most highly associated with an upper length statistic. Correlation coefficients were of the order of 0.70. The next highest correlation was given by a central length parameter. Correlations with measures of length uniformity were poor and insignificant in some cases.

#### 5.1.2. Thick places (rotor yarns)

"As [in] the case of the incidence of thin places in rotor yarns, an upper length statistic correlated best (typically 0.68) followed by mean length. The remaining statistics correlated poorly.

#### 5.1.3. Neps (rotor yarns)

"Length statistics correlated best with the frequency of neps in rotor yarns. A central length statistic tended to be better than an upper length statistic in this regard. Fair correlations were noted with short fiber content data provided by Peyer or comb-sorter methods, and with the Motion Control uniformity index.

#### 5.1.4. Thin places (ring yarns)

"As in rotor yarns, the number of thin places was best associated with a length statistic, most often the upper length statistic. Correlation coefficients were of the order of 0.76. Short fiber content from Almeter and array methods provided high correlation, also.

#### 5.1.5. Thick places (ring yarns)

"Ring-spun yarns' thick places were best estimated by a central length parameter, correlation coefficients being of the order of 0.63. Short fiber content tended to correlate with statistical significance, also.

#### 5.1.6. Neps (ring yarns)

"All correlations were poor. Most were not statistically significant at the 5% level.

#### 5.1.7. Discussion

"For the most part, the frequency of Uster imperfections was associated with length statistics rather than parameters descriptive of fiber length uniformity. Perhaps thin and thick places in rotor yarns were associated more with an upper length statistic, whereas similar defects in ring yarns were probably explained by a central length statistic.

"Short fiber content appeared to have higher correlation with yarn imperfections than other length uniformity data, particularly when using data from the Almeter or Suter-Webb array. A possible reason for this is . . . that short fiber content was more highly correlated with length statistics than other data; in other words, short fiber content is not independent of fiber length itself, and will tend, therefore, to imitate length statistics in associations with other parameters.

"One would also expect that a reduction in length uniformity (i.e. a reduction in indices or ratios of uniformity, or an increase in short fiber content or coefficient of variation in length) would produce an increase in imperfections. Correlations with uniformity ratios or indices should be negative, whereas those between other length uniformity statistics and imperfections ought to be positive. In many cases, contrary correlations were observed, indicating how poorly (statistically insignificantly) length uniformity data explained yarn imperfections."

[Here again, we are omitting a section concerned with regression equations.]

## "CONCLUSIONS:

- "1. Yarn properties and performance are determined primarily by the major fiber properties such as strength, length and micronaire value. Parameters descriptive of variation of length have lesser influence as indicated by lower correlation coefficients and delayed entry into regression equations formed by the stepwise technique.
- "2. Because little variation remains to be explained and/or because correlations are relatively weak, then it is very difficult to rank the different length variation parameters in terms of their ability to explain yarn properties and performance. This is demonstrated in subsequent conclusions which are more specific in nature.
- "3. Between length-measuring instruments, upper length statistics are consistent in approximate level and accuracy.
- "4. Statistics descriptive of length variation showed poor to good correlation between the various instruments. Suter-Webb comb sorter array and Peyer AL-101 data were most alike. Short fiber content (Fibrograph) was very highly correlated with the coefficient of length variation of the Peyer instrument. There was poor associa-

tion between high volume instrument uniformity indices.

- "5. Rotor yarn strength was adequately explained by fiber tenacity, an upper length statistic and micronaire value. Length variability estimates generally entered when mean length data were used instead of upper length statistics, tending to provide an approximation to the upper length statistic.
- "6. Ring yarn strength was explained mostly by fiber tenacity, a length statistic, and a parameter closely correlated with micronaire value, namely, elongation, short fiber content or uniformity ratio. Mean length may be more descriptive of yarn strength than an upper length statistic.
- "7. Parameters describing length variation entered equations for ring yarn strength more frequently than for rotor yarn strength. There were no consistent trends to indicate that one measure of length variability was better than another.
- "8. Rotor yarn evenness was explained primarily by fiber length and micronaire value with statistics emanating from either of the array methods; fiber tenacity also qualified for entry when upper quartile length was present. Use of mean length data may provide superior description.
- "9. Estimation equations for ring yarn non-uniformity frequently contained fiber tenacity in addition to fiber length. Fiber tenacity is highly correlated with fiber length and its presence may be spurious. Short fiber content, also correlated to fiber length by definition, tended to qualify for entry into such equations.
- "10. Spinning performance was determined mainly by fiber length and micronaire value.
- "11. For rotor yarns:
  - 11.1. Thin places were estimated best by micronaire value and a length statistic, preferably an upper length value.
  - "11.2. Thick places were described primarily by fiber length, preferably the upper length values.
  - "11.3. Neps were best explained by the 2.5% span

*length provided by the Digital Fibrograph, and mean length data from array methods of length determination.*

**"12. For ring varns:**

- "12.1. *Thin places were explained mainly by an upper length statistic. Among data supplied by either array method, short fiber content qualified for entry.*
- "12.2. *Thick places were described mainly by fiber length and trash content. Length uniformity parameters frequently entered also, short fiber content possibly being favoured in terms of improved correlation.*
- "12.3. *Neps were explained by non-lint content. Length data appear to have little or no ability to explain their presence."*

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This concludes the portion of this study selected for reprinting in *Textile Topics*. This research was sponsored by the Texas Food and Fibers Commission and conducted under the supervision of John B. Price, assistant director of the International Center for Textile Research and Development.

## **VISITORS**

December visitors to the International Center included Robert D. Mackey, Burckhardt America Inc., Greensboro, NC; Sterling Weaver, Rieter Corp., Spartanburg, SC; Carson Gilmer, UDP Inc., San Antonio, TX; Supaporn Prajuabpansri, Metro Spinning Co., Ltd., Bangkok, Thailand; John S. Marquez-Lim, Litton Mills, Inc., Manila, the Philippines; Holger Ostermann and Adrian Gottmers, Cargo Control KG, Bremen, West Germany; Jack Watt, Wool Research Organization of New Zealand, Christchurch, New Zealand; and Per Ola Olsson, Iro AB, Ulricehamn, Sweden.

Visiting groups included 25 high school students from Australia, here on an exchange study program; 15 students from Plainview High School, Plainview, TX; and 45 elementary students from area schools.