TRC

TEXTILE TOPICS

INTERNATIONAL CENTER FOR TEXTILE RESEARCH AND DEVELOPMENT
TEXAS TECH UNIVERSITY / LUBBOCK, TEXAS / U. S. A.

Volume XVIII, No. 3 November 1989

STUDIES IN FIBER LENGTH UNIFORMITY: Part I

During the past year we conducted an investigation of the influence of cotton fiber length uniformity on spinning performance and yarn quality. This was done as part of a research program sponsored by the Texas Food and Fibers Commission, and the findings have already been reported to that agency. We found this quite interesting, and we believe that certain parts of the report might be of interest to the readers of *Textile Topics*. Therefore, we are excerpting portions for publication in this bulletin. The full report covered 54 pages and is too long to carry in *Topics*.

The objective of the study was to determine the influence of different measures of cotton fiber length uniformity on spinning performance and yarn quality. It is recognized that most cotton spinners are aware that irregular fiber length -- either as a measurement of length uniformity or short fiber content -- has some influence on these parameters. It seems to us there is more emphasis at this time on short fiber content than on length uniformity, and one phase of this study was to determine which of these would be more useful in selecting cottons for good spinning and the production of quality yarns. Actually, it has already been shown that the two parameters are closely related in an inverse manner, for as length uniformity increases, short fiber content usually decreases.

Some fiber technologists have argued that the uniformity measurement is equally as important as short fiber content in describing the variability in length, and it has been suggested that length uniformity might be better than short fiber content when predicting yarn quality. However, it was pointed out in one case that when yarn quality is being estimated from fiber properties, including length, strength and fineness, the influence of length uniformity was minimal.

Whatever the case, we think it appropriate at this time to present some of the results of our studies dealing with the influence of irregular fiber length. The following sections are taken directly from a report prepared by John B. Price, assistant director of the International Center for Textile Research.

*** *** *** *** *** *** ***

"Short fibers are indicative of mechanical damage. There has been increasing criticism, particularly from Europe, that the short fiber proportion within US cottons continues to rise. Increasing the number of short fibers increases processing waste. It is also likely to produce less even yarns, particularly when ring spinning.

"The proportion of short fibers or, more generally, the uniformity of fiber length, can be expressed in several ways. The most popular are:

a) coefficient of variation of length;
b) short fiber content (proportion of fibers less than 0.5 inches in length);
c) uniformity ratio (ratio of 50% span length to 2.5% span length, as a percentage);
d) uniformity index (ratio of mean length to upper half mean length, as a percentage).

"Some other less-frequently encountered measures are:

e) dispersion (interquartile range expressed as a percentage of the effective length);
f) percentage short fiber (proportion of the fibers which are less than half of the effective length).

"Most of the above statistics may be obtained from the cumulative frequency diagrams of cotton fiber length. Probably for convenience, the high volume instruments merely record uniformity index (d). Questions have been raised regarding the applicability of these measures. Traditionally, short fiber content (b) is the statistic which commands most attention, and there are apparent difficulties in accepting the newer measure, uniformity index.

"Thirty-six cottons, grown primarily in Texas, had been thoroughly characterized by HVI testing, individual instrument testing, spinning and yarn testing, and also by dyeing and measurement of the resultant color. Further testing was also performed with bale samples by means of the comb sorter to provide a fiber array, as well as by the use of the Peyer AL-101 instrument.

"Rather than rely on correlation analyses to

assess how well different length measuring techniques relate to each other, it was decided to judge the different sets of length data provided by the instruments in terms of their ability to appear in regression equations derived for major yarn properties. In this way their true importance could be determined, in the practical terms of the ability of each instrument's data to estimate yarn strength, evenness and spinning performance. Thus the different length uniformity parameters were to be judged in conjunction with the different length values provided by the Digital Fibrograph, Peyer AL-101, comb sorter method and the two HVI systems (Motion Control Inc. and Spinlab Inc.).

"1. Correlations Between Length Data

"1.1. Distribution data

"Table I shows the distribution data for the different statistics which were obtained from the thirty-six cottons.

"All upper length values were similar in average level, except for the Suter-Webb array data which were noticeably higher. The data indicating the spread of the length were all similar. This is indicated by the coefficients of variation which were about 10%.

"All uniformity ratio or index data had low standard deviations and low coefficients of variation (2% to 5%). The relative spread of data was lowest for the Motion Control Inc. HVI statistic.

"The distribution data for the coefficient of length measurements were similar although the comb sorter method tended to give higher values.

"Amongst the short fiber content measurements, higher levels and standard deviations were obtained with Suter-Webb and Peyer data than with the Digital Fibograph data. However, coefficients of variation of the distributions of the short fiber content measurements were of similar order.

"1.2. Correlations

"The correlation coefficients between the upper length statistics were all 0.975 or better. These are presented in Table II. Correlations between mean length data were slightly inferior. In particular, correlation coefficients were worse when the Digital Fibrograph's mean length was used.

"Table III provides the correlation coefficients for the associations between estimates of non-uniformity of length. 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."

*** *** *** *** *** *** ***

This is the first part of the report. Tables mentioned in the preceding section are given below and on the facing page. The remainder of the report will be presented in the next issue of *Textile Topics*.

TABLE I
LENGTH DISTRIBUTION DATA

(Bale Samples)

Instrument-	Property	Mean	Range		Standard Deviation	Coefficient of Variation
			min	max		
Suter-Webb Comb Sorter	Upper Quartile Length (in)	1.126	0.892	1.350	0.118	10.4
	Mean Length (in)	0.871	0.667	1.140	0.098	11.3
	CV% of Length	38.3	27.9	47.1	4.2	11.0
	Short Fiber Content (%)	17.5	6.6	31.5	4.9	27.8
Peyer AL 101 (wt. biassed)	Upper Quartile Length (in)	1.038	0.85	1.24	0.103	9.9
	Mean Length (in)	0.818	0.68	1.05	0.086	10.6
	CV% of Length	35.1	24.0	42.9	4.12	11.7
	Short Fiber Content (%)	17.8	2.7	32.6	6.02	33.7
MCI HVI 3000	Length (in)	1.046	0.87	1.24	0.10	9.3
	Uniformity Index (%)	79.5	75.5	84.5	1.7	2.1
Digital Fibro-graph	2.5% Span Length (in)	1.020	0.885	1.228	0.092	9.0
	Uniformity Ratio (%)	43.85	39.7	48.7	2.0	4.6
	Short Fiber Content (%)	7.96	0.30	15.0	3.2	40.4
Spinlab 800	Length (in)	1.030	0.87	1.22	0.09	8.8
	Uniformity Index (%)	75.4	66	83	3.9	5.2

TABLE II

CORRELATION MATRICES

2.1. Between Upper Length Statistics

		Upper Quartile Length		HVI Length	
		Peyer	Suter-Webb	MCI	Spinlab
2.5% Span	Fibrograph	0.9758	0.9755	0.9826	0.9830
	Peyer		0.9763	0.9824	0.9752
Upper Quartile	Suter-Webb			0.9854	0.9818
HVI Length	MCI				0.9805

2.2. Between Mean Length Statistics

		Mean Length	
		Peyer	Suter-Webb
50% Span	Fibrograph	0.9226	0.9275
Mean Length	Peyer		0.9619

TABLE III

CORRELATION MATRIX BETWEEN ESTIMATES OF NON-UNIFORMITY OF LENGTH

	Short Fib. Content (Fibrograph)	CV% of Length (Peyer)	Short Fiber Content (Peyer)	CV% of Length (Suter-Webb)	Short Fiber Content (Suter-Webb)	Uniformity Ratio	
						MCI	Spinlab
Uniformity Ratio (Fibrograph)	-0.8719	-0.8469	-0.3979	-0.8064	-0.5349	0.6176	0.8507
Short Fiber Content (Fibrograph)		0.9113	0.6960	0.7917	0.7174	-0.7936	-0.7609
CV% of Length (Peyer)			0.7650	0.8653	0.7872	-0.7951	-0.7252
Short Fiber Content (Peyer)				0.6291	0.8757	-0.7841	-0.3551
CV% of Length (Suter-Webb)					0.8651	-0.7902	-0.7683
Short Fiber Content (Suter-Webb)						-0.8442	-0.5641
Uniformity Ratio (MCI)							0.6754

DONATION FROM TEXTUBE

The Textube Corporation of Greer, South Carolina, recently donated a substantial supply of plastic cores for use on our rotor spinning machines. This donation was very timely, for our research and educational programs had virtually consumed all the spinning tubes we had in stock. We are very pleased to have these particular cores for we have found them to be extremely durable, which permits their reuse many times.

We want to use this opportunity to express our gratitude to Textube Corporation for their contribution to our activities.

VISITORS

November visitors to the International Center included Roger Bolick, Allied Fibers, Hopewell, VA; Kenny Messer, Milliken Chemical, Inman, SC; Jonathan Krebs and Greg Boggs, Southwestern Public Service Co., Amarillo, TX; Randy Goldsmith, Texas A&M University, College Station, TX; Rose Matic, Clemson University, Clemson, SC; Siegfried Prueckel, Schlafhorst Inc., Charlotte, NC; Fred Spitzka and A. E. Brunner, Rieter Corporation, Spartanburg, SC; Al Probst, Pioneer Textiles, Sanford, NC; Harvey Campbell, Bakersfield, CA; George Overton, Crosrol, Inc., Greenville, SC; Carl Cox,

Texas Food and Fibers Commission, Dallas, TX; R. Eric VonWiller, American Truetzchler, Inc., Charlotte, NC; John Eckert, Wool Bureau, Woodbury, NY; and Percy Lee, International Wool Secretariat, Ilkley, England.

Visiting groups included eight students from the Clothing and Textiles Department, Eastern New Mexico University, Portales, NM; 15 members of the Historical Custume Committee, Texas Tech University Museum; 25 members of the South Plains Quilters Guild; 13 high school students and 46 elementary students from area schools.