FALL 1996

INTERNATIONAL TEXTILE CENTER ITC

TEXTILE TOPICS

INTERNATIONAL TEXTILE CENTER • TEXAS TECH UNIVERSITY
LUBBOCK, TEXAS USA

Sharing current research information and trends in the cotton and textile industries.

COTTON INCORPORATED FUNDS NEW PROJECTS

The relationship between stickiness, dust, abrasion, and machine wear is the topic of a recently funded project for Cotton Incorporated (CI). The ITC is working closely with the Plains Cotton Co-operative Association (PCCA) and Farmers Co-op Compress in planning and executing the project. Both PCCA and the Farmers Co-op Compress are making in-kind contributions.

Agreement has also been reached with CI to undertake an exploratory project assessing the feasibility of a computerized analytical system to develop decision rules that optimize the frequency of calibration for HVI's. A report on this phase of the research will be delivered by March, 1997, then a second phase may follow if results are encouraging.

Cotton Incorporated has recently released a video, "A Video Guide to Mill Nep Control and Management" which is now available from Textile Processing Research of Cotton Incorporated in Raleigh, NC. The ITC has been awarded a project to produce a companion video entitled, "Covering Neps in Woven and Knitted Fabrics", which is now in the scripting stage. It will be available from Textile Processing Research of Cotton Incorporated in late spring of 1997.

NEW ROOF FOR ITC

The roof covering the 110,000 square feet of floor space of the ITC building has become too deteriorated to repair. Therefore, Texas Tech University has allocated Higher Education Assistance Funds (HEAF) to replace it. Work will begin this fall. The current roof will be removed and replaced with a completely different design. The life expectancy of the new roof is at least 20 years. After the roof is finished, some painting and refurbishing will be done in interior areas.

HPLC IS COMING TO ANALYZE SUGARS

A High Pressure Liquid Chromatography instrument is being ordered for the ITC. It will enable identification and molecular analysis of sugars on cotton fibers. It is needed both for research currently underway and planned for the future. A contract to purchase the instrument will be signed in October. It should be installed and operational before the end of 1996.

TRAVELING NEWS

Dr. Dean Ethridge addressed the Calcot 1996 Classing and Marketing School in Bakersfield, CA in August. His presentation was about the ITC and its research efforts.

Dr. R.D. Mehta presented a poster at the American Association of Textile Chemists and Colorists International Conference in Nashville, TN, September 15-18. His presentation was entitled, "Coverage of Immature Cotton Neps in the Dyed Fabrics by Using Chitosan as an After Treatment".

FIBER MEASUREMENT ANOMALIES FROM BLENDING WITH RECLAIMED COTTON FIBERS

M. Dean Ethridge, Director
Reiyao Zhu, Head of Fibers Research

Introduction

Interest is increasing in the re-use of garnetted cotton fibers by blending them with raw cotton fibers. The destructive force necessary to reduce cotton fabric back to separate fibers assures that the quality of the reclaimed fibers will be greatly harmed. Furthermore, the distributional aspects of fiber properties will be greatly altered from the raw state. This raises complex issues of measurement and meaning of measures taken on blends of raw and reclaimed fibers. This report examines some of these issues and offers some guidance on how to interpret and utilize these measurements in predicting yarn quality.

Objectives and Procedures

Based on a range of alternative blend levels of reclaimed cotton fibers with raw cotton fibers, the "derived" properties of the blended fibers are compared with direct measures of fiber properties for each blend. Then these alternative indicators of fiber properties are compared with the yarn properties which result from open-end rotor spinning, in order to draw implications about the meaning and the usefulness of measured fiber properties. Rotor spinning was deemed to be the appropriate spinning technology because the short fiber content of reclaimed fibers is too detrimental to performance on ring spinning systems.

Of course the process must be started by measurement of each class of fibers — raw versus reclaimed cotton. Measurements from the High Volume Instrument (HVI) system and from the Advanced Fiber Information System (AFIS) are summarized in Exhibit 1. It is apparent that:

- Both the length and the length uniformity of the fibers are damaged by the garnetting process.
- The short fiber content of the reclaimed fibers is greatly elevated.
- The trash content of the reclaimed fibers is relatively low.
- The nep count of the reclaimed fibers is relatively high.

The uncertainties of the two sets of measurements that deserve emphasis include the following:

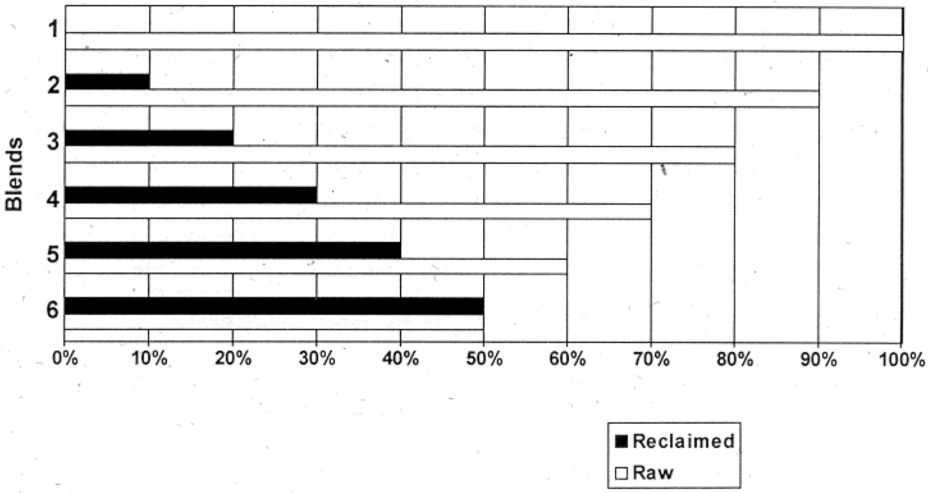
- The impact of garnetting on micronaire, strength, and elongation is not known, because the original measurements for these are not known.
- While it is expected that the elongation of reclaimed fibers is less than it was in the raw state, it is unknown how much of the reduction is due to mechanical straightening of the fibers and how much is due to weakening of the fibers.

Exhibit 1. Measurement of Fiber Properties, Raw Versus Reclaimed Cotton

Measurements	*Raw Fibers*	*Reclaimed Fibers*
HVI		
Strength (g/tex)	29.4	27.6
Micronaire	4.1	4.6
Length (in)	1.06	0.86
Length Uniformity Index	80.3	74.0
Elongation (%)	5.2	4.9
AFIS		
Average Length (in)	0.87	0.62
Upper Quartile Length (in)	1.07	0.78
Short Fiber Content (%)	10.9	34.5
Trash (no/g)	308	53
Neps (no/g)	413	755

In addition to spinning yarn from 100% raw cotton, five blend levels of reclaimed fibers were tested; i.e., 10%, 20%, 30%, 40% and 50%. The result was six separate tests, as summarized in Exhibit 2.

Exhibit 2. Blend Levels of Raw and Reclaimed Cotton Fibers



After the fibers were intimately blended in the opening process, fiber samples were collected from the chute feeder of the carding machine and tested again. Results of these tests are summarized in Exhibit 3, where a substantial amount of variation is apparent in the values obtained from both the HVI and the AFIS. Most of this variation is random error. Of course the measurements taken on the unblended fiber samples (Exhibit 1) also contain random error, which results from both sampling error and measurement error. But the error for the measurements on the blended samples is likely to be magnified by at least two factors:

1. The instruments were developed and calibrated for raw, virgin fibers; therefore, the measurement error should be greater on this artificial blend of raw and reclaimed fibers. The distributions of some of the properties will change substantially, which may alter the meaning of measurements in unknown ways. This is especially pertinent for the HVI measurements, since they are all taken on fiber bundles.

2. Blending at the card chute will not be "perfect," which also increases the sampling error. Successive passes through drawing frames will improve the blending somewhat, but the slivers that come out of drawing frames do not lend themselves to getting typical fiber bundles as are commonly used for measurement, especially in the HVI system.

One result that looks somewhat paradoxical in Exhibit 3 is the up-trend in the trash content with higher levels of reclaimed fibers. Since, the reclaimed fibers are much cleaner than the raw fibers, the question arises as to why the increasing blend levels do not result in decreasing trash levels. The answer lies in the fact that the small amount of trash with the reclaimed fibers is very tightly

Exhibit 3: Measurement of Fiber Properties from Blends Sampled at Chute Feeder

Measurements	*Blends*					
	1	*2*	*3*	*4*	*5*	*6*
HVI						
Strength (g/tex)	29.4	29.0	27.5	28.4	26.7	27.2
Micronaire	4.1	4.3	4.3	4.1	4.6	4.5
Length (in)	1.06	1.05	1.03	1.02	1.00	0.94
Length Uniformity Index	80.3	79.8	78.2	76.4	75.8	76.4
Elongation (%)	5.2	5.3	5.3	5.3	5.5	4.8
AFIS						
Average Length (in)	0.88	0.81	0.81	0.78	0.76	0.76
Upper Quartile Length (in)	1.07	1.02	1.03	1.00	0.97	0.97
Short Fiber Content (%)	10.4	17.2	17.8	20.0	22.0	22.6
Trash (no/g)	24	44	51	41	56	60
Neps (no/g)	563	568	597	595	618	646

held and is not removed by the opening/cleaning line; therefore, successive additions of reclaimed fibers slightly elevates the trash content.

An obvious alternative to measuring newly drawn samples of the blended fibers is to use the original measurements taken on the unblended fibers to derive estimates of the targeted fiber properties. This requires taking a weighted average of each of the original measurements based on the alternative blending levels. Not all of these weighted averages can be taken as linear combinations; in particular, the micronaire values are clearly non-linear in nature and must be averaged in a non-linear fashion. For other measurements, it is possible that non-linear averaging would be superior, if only the interactions of blending levels and instruments were better understood. Nevertheless, a linear treatment of these should suffice for most purposes.

Calculations of blended fiber property measurements from the original, unblended measurements are summarized in Exhibit 4. Of course these are very well behaved, in the sense that they trend consistently up or down with the increased proportions of reclaimed fibers

Exhibit 4: Derived Measurements of Fiber Properties

Measurements	*Blends*					
	1	*2*	*3*	*4*	*5*	*6*
HVI						
Strength (g/tex)	29.4	29.22	27.5	28.4	26.7	27.2
Micronaire	4.1	4.15	4.3	4.1	4.6	4.5
Length (in)	1.06	1.04	1.03	1.02	1.00	0.94
Length Uniformity Index	80.3	79.6	78.2	76.4	75.8	76.4
Elongation (%)	5.2	5.17	5.3	5.3	5.5	4.8
AFIS						
Average Length (in)	0.88	0.845	0.81	0.78	0.76	0.76
Upper Quartile Length (in)	1.07	1.04	1.03	1.00	0.97	0.97
Short Fiber Content (%)	10.9	13.3	17.8	20.0	22.0	22.6
Trash (no/g)	308	282	257	231	206	180
Neps (no/g)	413	447	481	515	549	584

Exhibit 5: Yarn Property Measurements

Measurements	*Blends*					
	1	*2*	*3*	*4*	*5*	*6*
10 Ne Yarn						
Count-Strength Product (CSP)	2298	2220	2094	2035	1920	1800
Tenacity (g/tex)	14.2	13.5	12.9	12.3	11.9	11.0
Elongation (%)	6.4	6.4	6.3	6.1	5.9	5.7
Irregularity (CV%)	13.8	14.2	15.0	15.3	15.7	16.7
Thin Places / 1000 yd	4	8	6	12	16	32
Thick Places / 1000 yd	69	84	125	127	150	195
Neps / 1000 yd	84	124	176	222	298	376
Hairiness	6.3	6.5	6.7	6.9	7.1	7.5
16 Ne Yarn						
Count-Strength Product (CSP)	2275	2196	2131	2009	1909	1764
Tenacity (g/tex)	14.1	13.4	12.8	12.1	11.3	10.9
Elongation (%)	5.9	5.8	5.7	5.5	5.2	5.2
Irregularity (CV%)	14.3	14.3	14.6	14.5	14.9	15.5
Thin Places / 1000 yd	10	6	9	6	10	12
Thick Places / 1000 yd	80	88	97	91	101	133
Neps / 1000 yd	207	206	242	250	313	434
Hairiness	5.6	5.7	5.8	5.9	6.1	6.2

that are put in the blends.

It is noteworthy that (1) the trash measurements are much higher for the derived data than they are for the chute-sampled data, while (2) the nep measurements are substantially lower for the derived data (Exhibit 4 vs. Exhibit 3). These are expected results, because the opening line cleans out much of the trash from the raw cotton, but the mechanical actions necessary to do this increases the neps.

Results

Two yarn counts, 10 Ne and 16 Ne, were spun on the rotor spinning system for each of the six blending levels used. Yarn properties that resulted for each of these are reported in Exhibit 5. These properties are quite well behaved; i.e., they move in a smooth, continuous fashion in the directions that fulfill expectations.

Such results immediately lead to the expectation that the "smooth" measurements provided by the derived fiber properties in Exhibit 4 are likely to enable superior prediction of changes in yarn properties that accompany changes in blend levels of the reclaimed fibers. This is corroborated by statistical analysis. Exhibits 6 and 7 summarize the correlation coefficients between the two sets of yarn property measurements and the fiber property measurements; Exhibit 6 is for the 10 Ne yarn and Exhibit 7 treats the 16 Ne yarn. In each exhibit, the upper correlation matrix pertains to the measured fiber properties and the lower matrix pertains to the derived properties. The correlation coefficients are generally higher, and significantly so, with the derived properties. Therefore, the explanatory power of the derived fiber property measurements is judged to be substantially greater than fiber property measurements taken after the reclaimed fibers are blended.

Exhibit 6: Correlation Coefficients: 10 Ne Yarn Properties Versus Fiber Properties

Yarn Properties	*Fiber Properties* — *HVI Measurements*: Strength	Micronaire	Length	Uniformity	Elongation	*AFIS Measurements*: Short Fiber	Trash	Neps
			Fiber Properties Measured at Chute after Blending					
CSP	0.867	-0.724	0.958	0.907	0.364	-0.912	-0.862	-0.986
Tenacity	0.825	-0.677	0.954	0.908	0.382	-0.931	-0.855	-0.969
Elongation	0.778	-0.693	0.961	0.867	0.426	-0.824	-0.743	-0.959
CV%	-0.834	0.673	-0.972	-0.880	-0.444	0.892	0.848	0.989
Thin Places	-0.614	0.640	-0.975	-0.677	-0.667	0.751	0.716	0.907
Thick Places	-0.853	0.696	-0.974	-0.856	-0.459	0.874	0.863	0.996
Neps	-0.837	0.735	-0.971	-0.885	-0.403	0.891	0.838	0.983
Hairiness	-0.810	0.696	-0.979	-0.874	-0.449	0.896	0.839	0.981
			Fiber Properties Derived from Unblended Measures					
CSP	0.996	-0.996	0.996	0.996	0.996	-0.996	0.996	-0.996
Tenacity	0.996	-0.996	0.996	0.998	0.996	-0.996	0.996	-0.996
Elongation	0.967	-0.965	0.967	0.964	0.967	-0.967	0.967	-0.967
CV%	-0.987	0.986	-0.987	-0.988	-0.987	0.987	-0.986	0.987
Thin Places	-0.886	0.881	-0.886	-0.892	-0.886	0.886	-0.887	0.888
Thick Places	-0.975	0.975	-0.975	-0.978	-0.975	0.975	-0.975	0.976
Neps	-0.991	0.990	-0.991	-0.991	-0.991	0.991	-0.991	0.992
Hairiness	-0.990	0.989	-0.990	-0.992	-0.990	0.990	-0.990	0.990

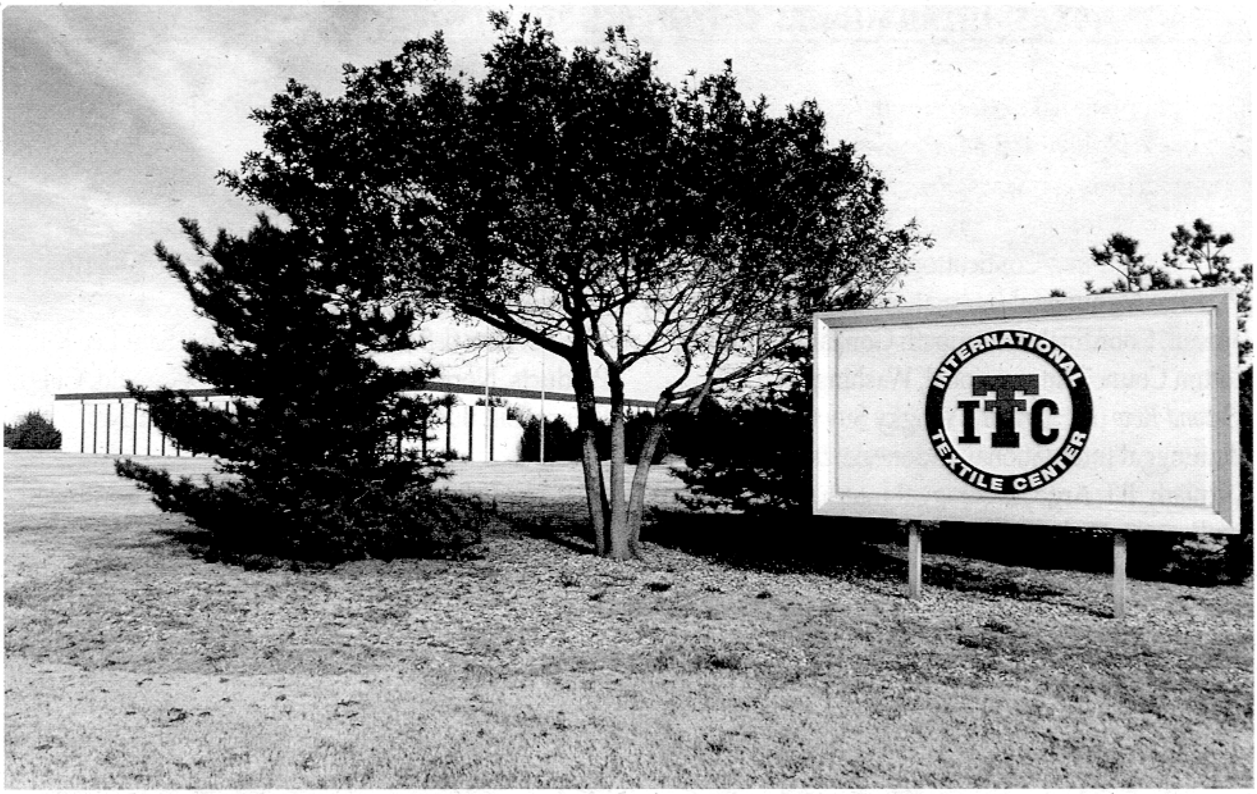
It may be noted that the signs (+ or -) are the same in all cases except for the fiber trash columns in Exhibits 6 and 7. For trash, the signs are reversed when going from the measurements at the chute to the derived measurements. The signs for the chute-sampled measurements are consistent with expectations; e.g., we expect an inverse relation between yarn strength and trash, a positive relation between yarn irregularity and trash, etc. These relationships should be captured by sampling at the chute because it is the cleaned cotton that goes forward through the spinning process. The information is relevant to assessing the cleaning performance of the opening line, because trash is a contaminant rather than an inherent fiber property. For trash content, therefore, the derived measures are virtually irrelevant, except perhaps for assessing the effectiveness of the cleaning process. This provides an example of interaction effects between fibers and machines; these must be considered and resolved in order to reach sensible conclusions.

These results indicate that, in general for yarn quality control with blends of raw and reclaimed cotton fibers, the HVI and AFIS are better utilized on each group of fibers separately, rather than on blends of them. This is a convenient solution for commercial textile mills, because the formulaic derivation of the blended properties is straightforward. All that is necessary is to give careful attention to achieving an intimate blend of the raw and reclaimed fibers.

Thanks go to William D. Cole, Manager of the Short Staple Spinning Laboratory at the ITC, who supervised the opening/blending/cleaning/spinning processes involved. As always, the tests performed by the Materials Evaluation Laboratory at the ITC, managed by Pauline Williams, provided the data necessary for authoritative analysis.

Exhibit 7: Correlation Coefficients: 16 Ne Yarn Properties Versus Fiber Properties

Yarn	*Fiber Properties*							
	HVI Measurements					*AFIS Measurements*		
Properties	Strength	Micronaire	Length	Uniformity	Elongation	Short Fiber	Trash	Neps
	Fiber Properties Measured at Chute after Blending							
CSP	0.803	-0.699	0.967	0.891	0.409	-0.896	-0.816	-0.970
Tenacity	0.879	-0.724	0.954	0.893	0.372	-0.919	-0.889	-0.987
Elongation	0.877	-0.752	0.891	0.950	0.188	-0.923	-0.832	-0.936
CV%	-0.775	0.738	-0.987	-0.735	-0.580	0.755	0.782	0.973
Thin Places	-0.505	0.537	-0.604	-0.239	-0.522	0.130	0.329	0.610
Thick Places	-0.705	0.682	-0.973	-0.625	-0.693	0.738	0.810	0.937
Neps	-0.721	0.696	-0.990	-0.702	-0.639	0.730	0.748	0.957
Hairiness	-0.863	0.768	-0.946	-0.906	-0.320	0.907	0.849	0.971
	Fiber Properties Derived from Unblended Measures							
CSP	0.992	-0.990	0.992	0.992	0.992	-0.992	0.992	-0.992
Tenacity	0.990	-0.990	0.990	0.992	0.990	-0.990	0.990	-0.990
Elongation	0.917	-0.914	0.917	0.919	0.917	-0.917	0.985	-0.985
CV%	-0.985	0.986	-0.985	-0.981	-0.985	0.985	-0.917	0.919
Thin Places	-0.423	0.422	-0.423	-0.418	-0.423	0.423	-0.420	0.425
Thick Places	-0.862	0.858	-0.862	-0.871	-0.862	0.862	-0.862	0.864
Neps	-0.900	0.896	-0.900	-0.903	-0.900	0.900	-0.900	0.902
Hairiness	-0.992	0.991	-0.992	-0.991	-0.992	0.992	-0.992	0.992



INTERNATIONAL TEXTILE CENTER, Texas Tech University

The International Textile Center fulfills the original charter of Texas Tech University — providing cotton and textile research since 1925. The work of the ITC revolves around academic and contract research, and the testing and evaluation of fibers, yarn and fabric.

.. research, education and consultation related to fiber properties and textile manufacturing, in order to increase the market value and use of natural fibers

OBITUARY

We regret to inform our readers that Richard N. Combs, 73, died in Lubbock on July 27, 1996. He was retired as Manager of Chemical Processing at the International Textile Center and continued to work on a part time basis. He came to work at Texas Tech University in May of 1976.

He was born Dec. 26, 1922 in Morristown, NJ. He was a US Army Air Corps veteran of World War II. He graduated from the Philadelphia College of Textiles and Science. He was a member of the Phi Psi Textile Fraternity and AATCC. He married Joyce Abbott in 1951. Survivors include his wife, four sons and a daughter, a sister, and five grandchildren.

Texas International Cotton School was held on October 7-18, 1996 at the ITC. Seventeen students represented six countries.

•*Front row (left to right):* Brenda Wynn, Asst. Coordinator; Ana Marbury, Conticotton, Tennessee; Jeffrey NG, P.T. Argo Manunggal International, Indonesia; Mandy Howell, Coordinator; Floribeth Gonzalez-Schuyler, Cotton Council International, Washington, D.C.

•*Second Row (left to right):* Yongky Suyapto, P.T. Argo Manunggal International, Indonesia; Indrawan Kurniadi, P.T. Argo Manunggal International, Indonesia; Rezwan Fazlur Rahman, Arenco, Ltd., Bangladesh; Ricardo Ayala, Textufil, S.A. de C.V., El Salvador; Allen Vandergriff, USDA/FAS., Washington, D.C.

•*Third Row (left to right):* Nurman Haripin, Ameritrade International, Texas; William Sheehan, Lands's End/Coming Home, Wisconsin; Alberto Madrid, IUSA, El Salvador

• *Fourth Row (left to right):* Vern Tyson, Sara Lee Knit Products, North Carolina; M. Patrice Grimald, CFDT, France; Bill Buchanan, Doran Textiles, Inc. North Carolina

• *Top Row (left to right):* Chuck Thompson, Southwest Textiles, Texas; Guillermo Aguirre, HIFISA, Guatemala; Tim Crawford, Norwest Bank, Texas