ITC WINS TWO MAJOR RESEARCH GRANTS

The ITC has won two major research grants totaling over $207,000 from competitive proposals submitted to the Texas Higher Education Coordinating Board.

One of the grants came under the Advanced Technology program, which is allocated to research aimed at promoting Texas' economic growth and diversification. It is headed by Dr. Dean Ethridge, director of the ITC, and is focused on the objective selection and control of cotton for efficient textile manufacturing. It will be done in collaboration with Dr. Donald Wunsch, director of the Applied Computational Intelligence laboratory Electrical Engineering Department, Texas Tech University.

The other grant came under the Technology Development and Transfer Program, which supports the further development of technology created under previous Advanced Technology Program grants and the transfer of that technology to the private sector. It is headed by Dr. Reiyao Thu, Head of Fibers Research, ITC, and it will develop a prototype instrument capable of measuring woven fabric properties as it undergoes rapid, dynamic biaxial loading in the plane of the fabric. It is being done in collaboration with Dr. Richard Tock, Professor of Chemical Engineering, Texas Tech University; it derives from previous research by Dr. Tock on inflatable restraint devices (e.g., automobile air bags).

SPECIAL SEMINAR OFFERED TO COTTON BREEDERS

Cotton breeders increasingly rely on fiber property measurements and spinning performance tests to guide their decisions affecting the development and commercialization of new cotton varieties. In order to meet the needs of cotton breeders, the ITC initiated a special two-day seminar in June, 1995. Its success has prompted a second seminar, planned for February 27 & 28, 1996.

Participants will get detailed information about the various fiber and spinning performance tests that are useful to them. They will leave with copious notes and references on al subjects covered in the seminar.

For more information, contact Pam Alspaugh at the ITC.

ITC CONNECTED TO YOUR COMPUTER

Accessing information from the ITC will be easier now via a World Wide Web page on the Internet. The address is:

http://www.ttu.edu/~itc

The page is under construction, but eventually *Textile Topics* issues, past and present, will be available as well as information aboutthe center, fees, projects and staff members.

The Natural Fibers Research and Information Center at the University of Texas at Austin will be linked to the ITC page to provide access to the Texas Food and Fibers Commission reports.

Electronic mail access to the ITC is: itc@ttu.edu

EFFECTS OF AN ENZYME TREATMENT ON YARN PROPERTIES

Reiyao Zhu, Ph.D., Head of Fiber Research Shridhar Chikkodi, Research Associate

Introduction

Recent advances in cellulase treatments of cotton fabrics have resulted in improved softness, enhanced drapeability, and reduced piling. These changes can transform low-quality fabrics into higher quality textiles in an environmentally friendly manner. Several studies have reported the effects of cellulase enzymes on fabrics made of cotton, cotton/polyester and cotton/wool blends [1,2,4,6]. However, the literature reveals a tack of information about effects of cellulase enzyme treatments on cotton yarn properties. This is to report on a study of impacts of enzyme treatment on properties of both ring-spun and rotor-spun yarns.

Procedure

Two distinct Upland cotton fibers were chosen; Fiber A was long, strong, and mature; Fiber B was short, weak and immature. Fiber properties were measured with the Spinlab High Volume Instrument, the Uster Advanced Fiber Information System, and the Shirley Fiber/Maturity Tester. Results are tabulated in Exhibits 1 and 2.

Yarns were spun both on the Saco Lowell SF-3H ring frame and Schlafhorst Autocoro SE-9 rotor spinning machine, then wound into 10 gram skeins for the enzyme treatment. Nominal Ne 30/1 yam sizes were spun on both systems. Skeins were scoured with 1% non-ionic detergent (on the weight of the yam), at 90+C for 30 minutes in a Gaston County skein dyeing machine. A separate bath was set with a pH of 4.5 using sodium acetate as a buffer. Acetic acid was used to keep the pH at 4.5. Cellulose enzymes used were of industrial grade with an -activity of 100 CCU/gram. Enzymes (0.4 CCU per skein) were added and the skeins were agitated for 30 minutes at 60+C, then 4% soda ash (on the weight of the yam) was added to neutralize the bath pH. The skeins were then washed in deionized water at 90+C, and air-dried. For the experimental control, identical yam skeins were treated with the same procedure except no enzymes were added.

The yarn samples were then subjected to four physical tests to assess their mechanical properties. These were the following: (1) single strand strength using an Instron Tester, (2) surface friction using a

Exhibit 1.
Fiber Properties measured by HVI

Fiber Properties	Fiber A	Fiber B
1/8" gauge strength (g/tex)	31.6	21.4
Elongation (%)	7.6	9.2
Length (in.)	1.23	.096
Uniformity Ration (%)	86.3	80.1
Micronaire Index	3.8	3.2
Reflectance (Rd)	76.1	79.2
Yellowness (+b)	10.2	9.3
Color Grade	22	21
Leaf Grade	3	2

Exhibit 2.
Fiber Properties measured by AFIS & Shirley F/MT

Fiber Properties	Fiber A	Fiber B
Upper Quartile Length (w)(in)	1.29	0.98
Mean Length (in)	1.06	0.81
Percent Short Fiber (%)	6.4	11.8
Diameter (um)	11.6	13.5
Neps	253	441
Total Trash	613	543
F/MT Fineness (mg/tex)	147	132
F/MT Maturity (%)	84.0	74.2

Lawson Hemphill Friction Meter, (3) abrasion resistance using a Stoll Abrasion Tester, and (4) bending rigidity using a Drape-Flex Stiffness Tester. Diameters of the yarns were measured using an Olympus Compound microscope with 100X magnification. Visual examination was made of the yam structures using a Bausch & Lomb Stereo Microscope with 19.5X magnification. Yarn counts were also measured before and after treatment.

Results

Yarn properties before and after enzyme treatment are shown in Exhibit 3 for ring-spun yams and Exhibit 4 for rotor-spun yarns: The yarn counts were increased by 5-7%, i.e., the yarns became lighter per unit of length. Visual examination of the yarn also revealed that the enzyme treated yarn had less protruding fibers thin did control yarn surface; of course the protruding fibers are the first ones affected. Major conclusions from results in Exhibits 3 and 4 include the following:

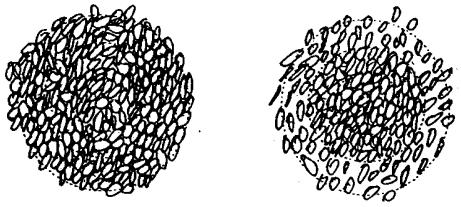
1. While the breaking strength of both ring and rotor spun yarns decreased after the enzyme treatment, the percentage loss was greater for ring-spun yams. Indeed, for the low quality fiber (fiber B), the break strength of the enzyme treated rotor spun yarn is approximately equal to that of the enzyme treated ring spun yarn. For fiber A, break strength after enzyme treatment remains tower for rotor spun yarn. These results are apparently due to the structural differences between ring and rotor spun yarns. As shown in Exhibit 5, the fibers in the ring spun yarn are evenly distributed in the cross section, whereas the fibers in the rotor spun yarn are in two layers in

Exhibit 3. Yarn Properties .9 Control and Treated Ring Spun Yarn

Yarn Properties	Fiber A			Fiber B		
	Control	Treated	% Change	Control	Treated	% Change
Count(Ne)	29.70	31.60	+6.40	29.30	31.30	+6.83
Break Strength (lbf)	0.72	0.61	-15.28	0.52	0.46	-11.54
Abrasion Resistance (number of cycles)		992	459 -53.72	221	111	-49.78
BendingLength(cm)	3.54	3.25	-8.19	3.51	3.27	-6.84
Friction Coefficient	0.23G	0.241	+2.12	0.247	0.238	-3.64
Diameter(microns)	170	184	+8.2	162	171	+5.56

Exhibit 4. Yam Properties of Control and Treated Rotor Spun Yarn

Yarn Properties	Fiber A			Fiber B		
	Control	Treated	% Change	Control	Treated	% Change
Count (Ne)	29.50	31.10	+5.42	29.20	31.10	+6.51
Break Strength (lbf)	0.60	0.53	-11.67	0.49	0.46	-6.12
Abrasion Resistance (number of cycles)	884	473	-46.49	246	134	-45.52
Bending Length (cm)	3.43	3.23	-5.83	3.37	3.01	-10.68
Friction Coefficient	0.231	0.237	+2.15	0.242	0.240	-0.83
Diameter	154.0	183.0	+18.83	156.0	169.0	+8.33



Ring Yarn Cross section Rotor Yarn Cross Section

Exhibit 5. The cross section of ring and rotor spun yarns

the cross section. The inside layer is relatively tight and dense, while the outside (wrapping) layer is relatively loose [3]. Therefore, with ring spun yarns, all the fibers in the cross section contribute equally to yarn strength, but with rotor spun yarns the outer layer of yarn had a much smaller contribution to yarn strength than the central core. Since enzymes begin attacking the yarn exterior, the central core of rotor-spun yarn escapes much of the damage; therefore, the yarn retains more of its strength.

2. The reduction in abrasion resistance was substantial for both ring and rotor yarns. The abrasion resistance of the enzyme treated, ring spun yarns was reduced by about 50-54% while that of rotor spun yarns was reduced by 45-47%. As with breaking strength, the somewhat smaller reduction for rotor-spun yarn can be attributed to the yarn structure.

Abrasion resistance is remarkably better for the higher quality cotton (fiber A) than for the lower quality cotton (fiber B). It is noteworthy, however, that after enzyme treatment, the abrasion resistance of the fiber A yarn is greater with rotor spinning. Furthermore, the abrasion resistance of the fiber B yarn is greater with rotor spinning, both before and after enzyme treatment.

3. The rigidity (i.e., bending' length) of the yarns were reduced between 6% and 11% by enzyme treatment—with the greatest reduction being for the lower quality cotton (fiber B) which was rotor spun. Of course, reduced rigidity means increased yarn softness, which should also increase fabric softness.

4. The coefficients, of friction were little changed by enzyme treatment. However, the yarn made from fiber A showed a slight increase in friction, while the yarn made from fiber B showed a slight decrease.

5. Yarn diameter was increased by the enzyme treatment. The increase in yarn diameter entails a "bulkier" yarn, which in turn imparts a softer feel to the fabric. The percentage increases were greater for the rotor spun yarns. This result is attributed to the outer layer of "wrap fibers" typical of rotor spun yarns [5]. The wrap fibers were weakened after enzyme treatment; therefore, they exerted less dimensional restraint on yarns. Consequently, rotor spun yarns had greater diameter increase.

Also noteworthy is that in rotor spinning the yarn from fiber A had a greater diameter increase than did yarn from fiber B. This was because the added length of fiber A resulted in more wrap fibers, so the impact from enzyme treatment was greater.

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SIGNIFICANT EVENTS LEADING TO THE DEVELOPMENT AND UTILIZATION OF THE MICRONAIRE TEST

Harvin Smith, Assistant Director

Introduction

The micronaire test for fineness and maturity of cotton fibers is now in such wide use that it is often taken for granted. However, inquiries from various sources regarding the history of the development of this measurement prompted us to conduct a library search and to interview many colleagues and friends who are knowledgeable about this subject.

Those interviewed were:

***Carl Cox**, retired Director, Texas Food and Fibers Commission, Dallas, Texas*

***S.R. Griffith**, USDA, AMS Cotton Division, Washington, D.C.*

***Busch Landstreet**, President, Starlab, Knoxville, Tennessee*

***H.H. "Hob" Ramey**, USDA, AMS, Cotton Division, Memphis, Tennessee*

***Larry Teague**, retired Vice President, Motion Control, Inc., Dallas; Texas*

***Emerson Tucker**, Textile Engineer, Plains Cotton Cooperation, Assn., Lubbock, Texas*

***Ed White**, retired Vice President, Spinlab, Inc., Knoxville, Tennessee*

Theoretical Basis

Early work relating to flow rate through porous media dealt with water flowing through sands and shale. D'Arcy [7] in France published the basic law in 1856. This law is summarized by the equation:

$$Q=KA\ \Delta p$$

where Q=flow rate, A=area of specimen, L=length of specimen, and Δp=the pressure difference.

Kozeny [17,18], in 1927, found that the flow rate through granular beds was inversely proportional to the square of the specific particle surface, if the porosity configuration, dimensions and pressure differences were held constant. This is written $1/S^2$, where S equals the ratio of the perimeter to the cross sectional area for textile fibers.

Experimentation with Air Flows

Clayton [61, in 1934, described the modification of an instrument designed for measuring the permeability of fabrics to accept porous plugs of fibers. The sample holder was one inch in diameter and 2 1/2 inches high. Following this, many researchers reported on the use of air flow gauges to estimate the diameter and linear density of textile fibers. The work by Ed Calkins [3], Elting & Barnes [8], Karrer and Bailey [151, Pierce and Lord [20], Fowler and Hertel [111, and later Sullivan and Hertel [24,25,26] showed significant relationships between air flow and diameter of animal and manmade fibers as well as the linear density of cotton fibers. The work by Hertel, et al., led to the development of the Aerolometer. This was an instrument to measure both maturity and linear density of cotton fibers and was manufactured by the Special Instruments Laboratory (Spinlab).

A significant paper was published by George Pfieffenberger [21] in 1946 using a modified fabric air gauge similar to that described by Clayton. He reported a very close relationship between air flow and linear density in terms of fiber weight per inch measured by the comb sorter method. At the time, Pfieffenberger was director of the Chicopee Research Laboratory, which was located at Texas Tech University in partnership with the Department of Textile Engineering.

The Micronaire

In 1947, W.S. Smith [22], West Point Mfg. Co., reported on an air gauge manufactured by the Sheffield Corporation called the "Gaugemaster's Precisionaire". He made slight modifications to this

device in order to adapt it for use with textile fibers. The instrument was found to be fast, stable and simple to operate. A special feature was a highly regulated air flow and it required little adjustment or calibration. The following year the Sheffield Company placed this machine on the market, it was quickly adopted by the cotton industry, and the term "micronaire" entered the lexicon of the cotton/textile industry

The Role of the U.S. Department of Agriculture

The cotton division of USDA was quick to accept the new Sheffield micronaire and ordered six for its Washington Laboratory and field laboratories at Clemson, Stoneville, College Station, Las Cruces and Memphis. In 1950, Burley and Rouse [2] announced the development of a curvilinear scale for Upland cotton which gave a very high correlation with values obtained from the weight per inch measurements using the Array comb sorter. In 1952, they also announced the development of another micronaire scale for Pima cotton. The Pima scale was 0.8 units lower than the corresponding value on the Upland scale.

Two pilot studies were made by USDA to determine the feasibility of making micronaire measurements in USDA cotton classing offices. The first was made in Raleigh, N.C. in 1953. This study showed that a production rate of up to 1000 samples per 8-hour shift could be achieved if two operators were used—one to weigh and the other to operate the machine and record the data. The other study was performed at the Corpus Christi, Texas USDA office in 1954. About 13 percent of the local crop was measured that year. The study concluded that it was feasible to provide micronaire, or "mike", tests in USDA offices, particularly if a blended specimen from both sides of the sample was used instead of measuring each side separately.

Standards Established

"ASTM Standards on Textile Materials" in October 1952 and again in November 1953. The method was accepted by the Society in June 1954 and adopted as standard in 1956. This method is published as method D-1448 in the "ASTM" Book of Standards". The method was later adopted as an International (ISO) Standard.

In 1956, USDA also adopted the micronaire test as an official standard measurement for cotton delivered on cotton futures contracts.

The International Calibration Cotton Standards Program was established in 1957. This program is operated by USDA and governed by a committee which includes representatives from the National Cotton Council, the Cotton Producers Steering Committee, American Cotton Shippers Association, American Textile Manufacturers Institute, the International Textile Manufacturers Federation, and the U.S. Department of Agriculture. Test laboratories were designated by these organizations to assist in establishing the values for these standards. Originally, the cotton standards included 10 different cottons covering the range of the micronaire scale. These standards include Upland, Egyptian and Asia types which represent most of the world's cottons.

New Instruments Developed

Between 1952 and 1956, several attempts were made to "improve" the Sheffield micronaire by adding a pneumatic plunger to replace the manual plunger supplied with the instrument. These attempts were generally unsatisfactory and highly dangerous to operate. In 1954, an instrument developer named Glen Witts was approached by Carl Cox to solve the problem. Mr. Witts decided he could build a complete new instrument cheaper than he could modify the Sheffield. He formed a company called "Motion Control, Inc.", and came on the market with his new "Fibronaire" in 1956. Along with the Fibronaire was a superior scale designed especially for weighing the 50 grain (3.2 grams) specimen. This was called the "Fiberweigh". These instruments operated much faster than the manual Sheffield system and were quickly adopted by both USDA and the textile industry.

USDA Made Micronaire a Fixture of Cotton Classification

In 1957, a micronaire unit was installed in the Lubbock, Texas USDA office to measure a statistical sample of the crop in that area for market news purposes. This was done in cooperation with the Plains Cotton Growers Association. The Lubbock office also participated in a study to determine the influence of the measurement on samples classified as "irregular, weak, and wasty (IWW)". Such samples were arbitrarily reduced in staple length. Judging IWW cotton was highly subjective and the opinion of different classers varied widely. It was found that almost all classers agreed that cottons measuring 2.6 and lower should be designated "JWX'V". Disagreement increased as the mike readings increased up to about 3.5, where no cottons were judged to be 'tIWW" in character.

The Phoenix USDA office began to publish mike readings in their quality reports in 1958. The west--em, southwestern and mid-south areas all published quality statistics on micronaire in 1961 and all USDA offices were included in 1963.

In 1960 the USDA began to make micronaire testing services available to merchants, mills, and producers on a fee basis. Because of the differences observed between the micronaire measurements and the actual weight-per-inch the terminology was changed in 1961 to "micronaire reading" instead of micrograms-per-inch, the Upland scale was adopted for all cottons and use of the American Egyptian scale was abandoned. [27] It was not until 1964 that an amendment to the Smith-Doxey Act was passed to include the micronaire test as a service to all qualified producers. This service became effective July 1, 1966. That same year the Commodity Credit Corporation designated the mike test as a quality-factor for all cotton entering the loan. Thus, the micronaire had become part of the official classification of U.S. cottons alon8 with grade and staple. At this time, USDA also discontinued use of the IWW" designation, since the micronaire measurement provided a very low in maturity than did the subjective judgments about fiber "character" made by human classers.

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Texas International Cotton School, Class of October 1995
19 Students from 7 Countries Attend 12th Session

Texas International Cotton School is held the first two weeks of October and April each year. Students come from around the world for an overview of the cotton/textile industry. The next session will be held April 1-12, 1996, at the ITC.

Front Row: BRENDA WYNN, Assistant Coordinator; JANA BOHACOVA, Trade Service, Czech Republic; SARARAT LERDVERASIRIKUL, Ministry of Industry Thailand; LINDA KOONCE, BioTex, Texas; BEATRICE MAUX,Compagnie Cotonniere, France; MICHELE SAWAICHTOWLER, Clemson University South Carolina; MARY POM CLAIBORNE, Zellweger Uster, Tennessee.

Second Row: TOTSAVASD HIRANSOMBOON, Thai Durable Textile Public Co., Thailand; ZENUN SKENDERI, University of Zagreb, Croatia; NARONG TANGARPHAN, Industrial Promotion, Thailand; YVES GOLDBERG, Calliope, Belgium; ARMANDO RIBEIRO, Fitrofa Fiacao Trofa, S.A., Portugal; MAHBOOB AKHTAR, Cotton Export Corporation, Pakistan; MANDY HOWELL, Coordinator.

Back Row: RON ROBERSON, USDA/FAS, Washingon, D.C.; VLADIMIR LASIC, University of Zagreb, Croatia; SCOTT SLAUGHTER, Comex, Texas: ISTVAN TENKEI, Agrotec, Austria; ANDREW KANDEL, ECOM USA, Inc., Texas; and PERRY SVENSSON, ECOM USA, Inc., Texas.