TEXTILE topics

fall 1999

International Textile Center Texas Tech University Lubbock, Texas USA

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

International Textile Center
Texas Tech University
Lubbock, Texas
79409 - 5019
phone 806.747. 3790
fax 806.747. 3796
itc@ttu.edu
http://www.itc.ttu.edu

SPECIAL GRANT TO UPGRADE SPINNING LABORATORY

A special grant from the state legislature to the Texas Food and Fibers Commission will be used to modernize the short staple spinning laboratory of the ITC. A contract has been signed with the American Suessen Corporation for a conversion of the drafting zone of the roving machine (recently completed) and a conversion of the Schlafhorst SE-8 rotor spinning machine to the Suessen SC 1-M spin box (to be done soon). It is expected that other contracts will soon be signed on new ring spinning machines and other equipment.

SAMPLE-SPINNING MACHINE DEVELOPED

A project with the Swiss Institute of Textile Machinery and Textile Industry, Swiss Federal Institute of Technology (ETH) has resulted in the development of a sliver-to-yarn laboratory ring spinning machine, to be used by the ITC for small-sample spinning tests (approximately 100 grams of fiber). This instrument will be used primarily for cotton breeders' samples, to enable preliminary evaluation of spinning performance of cotton varieties being developed.

RESEARCH GRANT AWARDED

A partnership between the ITC and the Department of Electrical Engineering at Texas Tech University has resulted in the awarding of an Advanced Technology Program grant from the Texas Higher Education Coordinating Board. The objective is to develop new technology for identifying and measuring diverse contaminants in cotton fibers.

ITC HOSTS AATCC MEETING

The 1999 AATCC Gulf Coast Sectional Meeting was held at the ITC on November 16. It was attended by textile industry professionals from Texas and Louisiana. Speakers included: Lou Protonentis from Cotton Incorporated on colorfastness, Dennis Scheer from Dyadic International on enzymes, Amy Scharges from Datacolor International on color matching, and Warren Perkins from the University of Georgia on slashing.

TRAVEL NEWS

Dean Ethridge, Director of the ITC, attended the 1999 meeting of the International Cotton Advisory Committee in Charleston, SC, during October 25-29.

DEVELOPMENT OF ROTOR-SPUN YARNS FROM BLENDS OF SHORT-SHORN WOOL AND POLYESTER

M. Dean Ethridge, Director
S. S. Ramkumar, Research Associate
James L. Simonton, Textile Engineer
William D. Cole, Training & Projects Coordinator

The Texas Food and Fibers Commission provided funding for the project reported here.

INTRODUCTION

Yarns made from wool/polyester blends are well suited for a variety of woven and knitted textile products. Desirable characteristics of products made from these blends are comfort, strength, and wrinkle resistance. Market penetration of this blend is limited, however, by the fact that the yarns are typically spun on long staple spinning systems to accommodate the wool fibers. The global capacity of these spinning systems is small and the processing costs are relatively high. If yarn spinning could be accomplished on the short staple (cotton) spinning system, then the use of this blend could be increased.

There is no fundamental reason why the long staple spinning system must be used for wool/polyester blends. Polyester is commonly cut to lengths suitable for the cotton spinning system. Wool can be provided in these lengths by shearing the sheep twice a year instead of only once. Certainly this is feasible in sheep production areas with mild winter climates, as in the southern United States, Mexico, Australia, and South Africa. The term used for this fiber is "short-shorn wool," or SSW.

The feasibility of spinning wool blends on the ring spinning system has been demonstrated [1, 2, 3]. However, if the spinning could be successfully done on the rotor spinning system, then the manufacturing costs would be much lower and the pricing point needed for profitable production would enable greater market penetration. Past experience at the International Textile Center has shown that spinning this blend on the rotor spinning system is often not feasible [4, 5]. Nevertheless, we thought that the new Rieter R 20 spinning machine had potential for doing it, because the trash ejection channels associated with the combing rollers can be manipulated to prevent the loss of wool fibers before they pass into the rotor chamber. Even if a consistent rotor spinning process is achieved, the ultimate challenge is to produce a yarn with sufficient strength to substitute for those produced on traditional, long staple systems. This article provides a short report on preliminary results obtained in producing 8 Ne rotor yarns.

PROCEDURES

In tests to select appropriate machinery settings, two different polyester fibers were utilized: Wellman Type 315 and Celanese Type 221. The fineness of both was 2.25 denier and the staple length of both was 38.1mm. Texas short-shorn wool of U.S. grade 64 was used throughout the study. The mean length of the wool was 46.7mm, with a coefficient of variation of 41.4%. Intimate blends of the fibers were used throughout; in evaluating the machinery settings, the blend was 50:50 SSW/poly.

Machinery Settings

Exhibit 1 outlines the machinery and some of the major settings used to process the fibers. All stages up to the spinning were handled in a typical fashion for this blend of fibers. It should be emphasized, however, that a well adjusted, cotton-system opening line operating on the short staple wool and polyester provides excellent cleaning and blending—both of which are critical for successful rotor spinning.

At the spinning machine numerous modifications were tested. The most important one was to partially close off the trash ejection channels below the combing rollers of the R 20. This proved to be necessary to facilitate the flow of wool fibers into the rotor. Following preliminary study of key machine variables, the major tests made are discussed below. (Note: Unless otherwise indicated, tests were done using the 50:50 blend containing Celanese T221 polyester.)

TEXTILE TOPICS
a research bulletin on fiber and textile industries.
Fall 1999 - Issue 4
Published quarterly
Texas Tech University
International Textile Center
P.O. Box 45019
Lubbock, TX 79409-5019

Combing Rollers
Preliminary spinning was done using three different combing rollers: OS21DN (standard gage, diamond coated and nickel plated), OS21/6DN (6mm gage, diamond coated and nickel plated), and regular pin-type rollers. Results, summarized in Exhibit 2, revealed a slight advantage in yarn strength with the OS21DN; therefore, this combing roller was used to spin all the yarns for this study.

Combing Roller Speeds
Preliminary spinning was done using three different speeds for the combing roller: 6,500 rpm, 7,000 rpm, and 7,500 rpm. Results, summarized in Exhibit 3, did not reveal any notable differences in yarn qualities among the speeds; therefore, 7,500 rpm was used for all yarns spun.

Rotor Types and Speeds
Preliminary spinning was done using two different rotor speeds (70,000 rpm and 61,110 rpm) in combination with three rotors of differing diameters and/or surface finishes (35mm SB, 40mm SE, and 40mm SB). The speed of 61,110 rpm was too slow for the 35mm rotor, but all other speed/diameter combinations were feasible. Results are summarized in Exhibit 4. Clearly, at 70,000 rpm the 35mm SB rotor is best. However, at 61,110 rpm there are no significant quality differences between the two 40mm rotors. Comparing the results for 40mm rotors at 61,110 rpm with those for the 35mm rotor at 70,000 rpm, there are no significant differences except for CV%, thin places and thick places. For these three quality variables, the 40mm rotors run at the slower speed give better results.

Since, as expected, the yarns do not have great strength, it is likely that the thin and thick places would result in higher yarn breakage during weaving. For this reason, the decision was made to utilize the 40mm SB rotor and run at 61,110 rpm.

To summarize, the set-up selected for the R 20 machine is as follows:

Rotor	
Type	40mm SB
Speed	61,110 rpm
Navel type	4-groved ceramic
Combing roller	
Type	OS21DN
Speed	7,500 rpm

Yarn Twist
Using the 50:50 blend containing Wellman T315 polyester, along with the above machine set-up, spinning tests were run with alternative twist multipliers (TMs). As shown in Exhibit 5, the TM was varied from 4.2 to 4.8 in increments of 0.2. Since yarn strength and the thin and thick places improved somewhat with the higher TMs, it was decided to spin the yarns with a TM of 4.8. (By comparing yarn strength results in Exhibit 5 with those in Exhibits 2-4, the reader may observe that the Wellman fibers resulted in somewhat stronger yarns than did the Celanese fibers.)

Yarns Spun

Using the machinery set-up given above, six different 8 Ne yarns were produced for testing (Exhibit 6). Each yarn represents a distinct combination of blend levels (50:50 SSW/poly or 60:40 SSW/poly), polyester brands (Wellman Type 315 or Dupont Dacron Type 54W SRW), and polyester deniers (1.5 or 1.0). The smaller denier values were used at this point in the study primarily to observe the impacts of the finer polyester fibers on yarn strength. The 10% increase for wool in the blend level was done to observe how great was the tendency for strength loss as wool is added.

RESULTS

The focus is on the six yarns identified in Exhibit 6. Major results of the yarn testing are given below.

- Yarn strength results are summarized in Exhibit 7. For the 1.5 denier polyester fibers, the Dupont fibers produced a somewhat stronger yarn than did the Wellman fibers for the 50:50 blend (yarn #1 vs. yarn #2), but not for the 60:40 blend (#3 vs. #4). For the 1.0 vs. 1.5 denier Wellman fibers, the strength is greatly increased for the 50:50 blend (#5 vs. #1), but not for the 60:40 blend (#6 vs. #2). Clearly, the loss in strength occurs quickly when wool is increased beyond the 50:50 blend level (#1, #2 & #5 vs. #3, #4 & #6). On the average, a 20% loss in yarn strength resulted from the 10% increase in wool fibers.

- Yarn Imperfection values are summarized in Exhibit 8. It reveals no significant differences in imperfections across the six yarns. All of the imperfection values are at good levels; furthermore, the visual appearance of these yarns was quite good.

CONCLUSION

This study indicates that there is potential for making high-quality yarns and fabrics with SSW/poly blends on the rotor spinning system. If so, the yarn manufacturing costs would be greatly reduced from those incurred with long staple spinning systems. At the time this study was done, the pricing point for wool/poly yarns made from the long staple system was approximately $5.00 /pound; for this rotor-spun yarn, we think a profitable pricing point would be approximately half that amount.

It seems that yarn and fabric appearance would be adequate with this process—if acceptable yarn strength and fabric durability can be achieved. Given the observed sensitivity of yarn strength to the wool content, further testing should explore the use of lower percentages of wool in the blend. Since 65:35 poly/wool blends have exhibited large-scale popularity in the clothing market, producing a comparable yarn and fabric using a 65:35 poly/SSW blend should be evaluated.

EXHIBIT 1: OUTLINE OF MECHANICAL PROCESS FOR BLENDS OF SHORT SHORN WOOL AND POLYESTER

Hunter Weigh Pan Hopper Feeder	
Monocylinder B4/1	Roll Speed = 750 rpm
Dust Remover	
ERM B5/5 Condenser	R20/10 Beater Speed = 850 rpm (Fitted with synthetic pan)
AMH Blender	
Rieter Aerofeed U Chute	
Rieter C4 Card Trashmaster	Production Rate = 60 lb/hr Sliver Weight = 60 gr/yd
Rieter RSB 851 Draw Frame I	Delivery speed = 1,320 ft/min Sliver weight = 60 gr/yd
Rieter RSB 851 Draw Frame II	Delivery speed = 1,320 ft/min Sliver weight = 65 gr/yd
Rieter R 20 Rotor Spinning Machine	

EXHIBIT 2: EFFECTS OF COMBING ROLLERS ON YARN PROPERTIES

Roller Type	CSP	Tenacity	Elongation	Mass CV	Thin Places	Thick Places	Neps	Hairiness
	(Ne • lb)	(cN/tex)	(%)	(%)	(no/ky)	(no/ky)	(no/ky)	
OS21DN	1822	11.03	21.15	15.30	29	103	6	7.61
OS21/6DN	1757	10.88	20.66	15.35	29	111	6	7.51
Pin Roller	1658	10.27	18.12	15.00	18	88	7	7.72

EXHIBIT 3: EFFECTS OF COMBING ROLLER SPEED ON YARN PROPERTIES

Roller Speed	CSP	Tenacity	Elongation	Mass CV	Thin Places	Thick Places	Neps	Hairiness
(rpm)	(Ne • lb)	(cN/tex)	(%)	(%)	(no/ky)	(no/ky)	(no/ky)	
6,500	1864	11.08	21.83	15.43	30	106	12	7.60
7,000	1811	10.88	21.20	15.30	27	98	8	7.65
7,500	1822	11.03	21.15	15.30	29	103	6	7.61

EXHIBIT 4: EFFECTS OF ROTOR TYPE AND SPEED ON YARN PROPERTIES

Rotor Type*	CSP	Tenacity	Elongation	Mass CV	Thin Places	Thick Places	Neps	Hairiness
	(Ne • lb)	(cN/tex)	(%)	(%)	(no/ky)	(no/ky)	(no/ky)	
<u>70,000 rpm</u>								
35mm SB	1823	11.03	21.15	15.30	29	103	6	7.61
40mm SE	1755	10.63	18.79	15.68	46	139	9	9.16
40mm SB	1771	10.54	19.43	15.58	32	142	13	8.38
<u>61,110 rpm</u>								
40mm SE	1856	11.23	21.14	14.68	15	70	6	8.47
40mm SB	1842	11.26	21.42	14.50	11	70	6	8.17

* S denotes the type of rotor groove and the second letter denotes the material or coating for the rotor; B stands for boron and E identifies an experimental rotor.

EXHIBIT 5: EFFECTS OF TWIST ON YARN PROPERTIES

Twist Multiplier	CSP	Tenacity	Elongation	Mass CV	Thin Places	Thick Places	Neps	Hairiness
	(Ne • lb)	(cN/tex)	(%)	(%)	(no/ky)	(no/ky)	(no/ky)	
4.2	1922	11.81	14.91	15.12	18	74	7	7.67
4.4	1955	11.94	15.09	14.85	17	76	8	7.56
4.6	1989	12.02	15.43	14.80	13	62	6	7.46
4.8	2025	11.95	15.54	14.66	10	66	8	7.45

EXHIBIT 6. VARIABLES INVOLVED IN SPINNING DIFFERENT YARNS

Yarn ID	% Wool in Blend	Polyester Source	Polyester Denier
#1	50	Wellman	1.5
#2	50	Dupont	1.5
#3	60	Wellman	1.5
#4	60	Dupont	1.5
#5	50	Wellman	1.0
#6	60	Wellman	1.0

EXHIBIT 7. YARN STRENGTH RESULTS FOR DIFFERENT YARNS

Yarn ID	CSP	Tenacity	Elongation
	(Ne • lb)	(cN/tex)	(%)
#1	1839	10.30	19.17
#2	2017	11.48	23.14
#3	1569	9.46	18.55
#4	1591	9.66	21.80
#5	2037	12.38	14.37
#6	1555	9.63	13.49

EXHIBIT 8. YARN IMPERFECTION VALUES FOR DIFFERENT YARNS

Yarn ID	Mass CV	Thin Places	Thick Places	Neps	Hairiness
	(%)	(no/ky)	(no/ky)	(no/ky)	
#1	14.23	7	60	5	7.50
#2	14.01	4	51	6	7.12
#3	14.62	8	80	9	7.80
#4	14.41	11	62	11	7.62
#5	14.18	4	62	11	7.11
#6	14.71	11	82	11	7.67

R E F E R E N C E S

1. Harry, A. A., and G. A. Robinson, "Processing of Wool and Wool-Rich Blends on the Short Staple System. I. A Modified System for Wools of Average 40mm length but with a Non-square Fiber Length Distribution," CSIRO Rep. No. G31, 1977.
2. Louis, G. L. and C. E. Pardo, "SRRC Natural Fiber Blend Research," *Textile Research Journal*, 50, 130-136, 1980.
3. Lupton, C. J., "Wool Processing on the Cotton System: A Comparison Between Cut-Top wool and Six-Month Shorn Wool in a Blend with Polyester," *Textile Research Journal*, 50-2, 119-129, 1980.
4. Price, J. B., "The Development of Woven and Knitted Fabrics from Blends of Texas Cotton, Wool and Mohair," *Annual Progress Report to the Texas Food and Fibers Commission for the Period September 1, 1989 – August 31, 1990*, pp. 251-292.
5. Zhu Reiyao and William D. Cole, "Study of Short Staple Processing of Wool/Cotton Blends on Rotor Spinning System," *Textile Topics*, International Textile Center, Spring 1997.