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RESEARCH ON ROTOR SPINNING OF WOOL In the November 1983 issue of *Textile Topics* (Vol. XII, No. 3), we carried an article on spinning blends of cotton and wool and gave the results of producing yarns at ring and open-end spinning. We have had a number of inquiries about this study and have been requested to report additional information on the rotor spinning of wool. Because of this interest, we are reproducing a report on research conducted for the Natural Fibers & Food Protein Commission of Texas (NFFPC) that we have found quite interesting. The full report is too lengthy to carry in a single issue of *Topics*, so we plan to include only part of it here and the remainder in subsequent issues.

While the article in the November 1983 *Textile Topics* dealt with blending cotton and wool, the report we present here is concerned with 100% wool. Different aspects were investigated and we believe the best way to report this is to carry an edited version of the NFFPC report.

The objective of this program was to determine the quality of yarns produced and the spinning performance of each lot of wool included in the study. The different wools are listed in Table I as A through G and then X, Y and Z. Another lot, designated as "mixed lot" or ML, was made up of fiber taken from each of the other lots (see Table II). This was the combined portions of the other lots which were residual from the preparatory processes and was used for exploratory trials to derive spinning specifications suitable for the comparison of all other lots.

The rotor spinning trials were conducted at the Textile Research Center on the Suessen Spintester, which was fitted with four spinboxes of the S.A.C.M. design. This type of spinbox is unique in that sliver is fed by aprons to a selector roll. The selector roll comprises a series of off-set arcuate metal plates in contact with a pressure roller covered with synthetic rubber. Fibers proferred by the apron to the nip of the pressure roll and selector roller are gripped between the covered top of a plate and the synthetic roller. Ideally, the aprons permit fibers to be withdrawn from the fiber bundle while still retaining control of the remaining fibers, irrespective of their length. The manufacturers claim, with some justification, that this system of fiber individualization is suitable for relatively delicate fibers such as wool. The conventional system, which uses a wire or pin-clothed opening roller to tease fibers from a beard protruding from a feed roll/feed plate nip, is more intensive in action and more likely to cause fiber damage.

Experience in the rotor spinning of wool was obtained using lot ML as feedstock. Having analyzed the trends of yarn properties obtained from variations in machine parameters, spinning specifications were selected to permit comparison of the performance of the other lots. The ten lots of wool were processed into sliver weighing approximately 70 grains per yard. Evenness tests were performed on the sliver produced from each lot, and the same samples were used for the determination of fiber properties presented in Table II.

At the beginning of the spinning trials, the influences of selector roller speed and design were determined. By spinning yarns at various twist multipliers, the influence of navel design was characterized in terms of spinning performance and yarn properties. The influences of rotor speed and diameter on yarn properties were then assessed prior to an appreciation of the influence of yarn count. An analysis of the results of the preliminary trials was made to assist in the choice of a spinning specification to highlight differences between wools. The yarn count was chosen to be N_e 6 (N_w 9). Spinning results from lot ML are given in Tables III and IV. Graphs 1 to 4 show the trends in yarn properties with varying selector roll speeds.

Previous experience with the conventional type of spinbox (the SPE 6/8 design) suggested that satisfactory spinning performance can be achieved using OS21 wire-clothed opening rollers rotating at 7,000 to 8,000 rpm, blocking off the trash extraction airflow and spinning with 66 mm rotors. Attempts to spin N_e 6 from the ML wool lot were unsuccessful due to loading of the opening roller. The regular eight-grooved navel was seemingly worse than the larger eight-grooved navel (8GS), however, in terms of spin-

ning stability.

More stable spinning was experienced when using the S.A.C.M. design of spinbox to evaluate the use of two designs of selector roll. The two designs differed only in the profile of the gap between consecutive staggered plates, i.e. "square" or "vee" notched. The performance of each design of selector roll was characterized by determining the properties of N_e 6 yarns spun at selector roll speeds from 4,000 to 7,000 rpm, varying in increments of 500 rpm. Loading occurred at speeds of 5,000 rpm and lower when operating with the "square" notch selector roll. Stronger, more even and less hairy yarns were produced from the "vee" notched selector roll. A selector roller speed of 5,000 rpm gave maximum yarn strength. These opening conditions were adopted as standard for all forthcoming trials.

As mentioned previously, we will present additional results of this program in future issues of *Textile Topics*. We would like to express our appreciation to the Natural Fibers & Food Protein Commission of Texas for permitting us to publish this report. Also, we wish to recognize contributions to this study by James M. Lambert, D. Rainey Speed, and John P. Goen, all of the TRC staff. The rotor spinning portion of the program was conducted by John B. Price, William D. Cole and Albert Esquibel, and the report was prepared by Mr. Price.

TABLE I

Physical Properties of Wool Top (Supplied by USDA)

Lot Number	Mean Diameter (μm)	Standard Dev. of Diameter (μm)	Coefficient of Variation of Diameter (%)	Staple Length (in)	Grade (ASTM 3991-81)
A	25.2	5.10	20.2	3.17	58's
B	25.5	5.54	21.7	3.23	58's
C	25.8	5.80	22.9	3.18	58's
D	26.2	5.87	22.4	3.10	58's
E	26.6	5.92	22.3	3.22	56's
F	27.2	6.28	23.1	3.14	56's
G	27.6	6.37	23.1	3.10	56's
X	26.0	7.21	27.7	3.11	56's
Y	26.0	6.26	24.1	3.12	58's
Z	26.1	6.84	26.2	3.07	58's

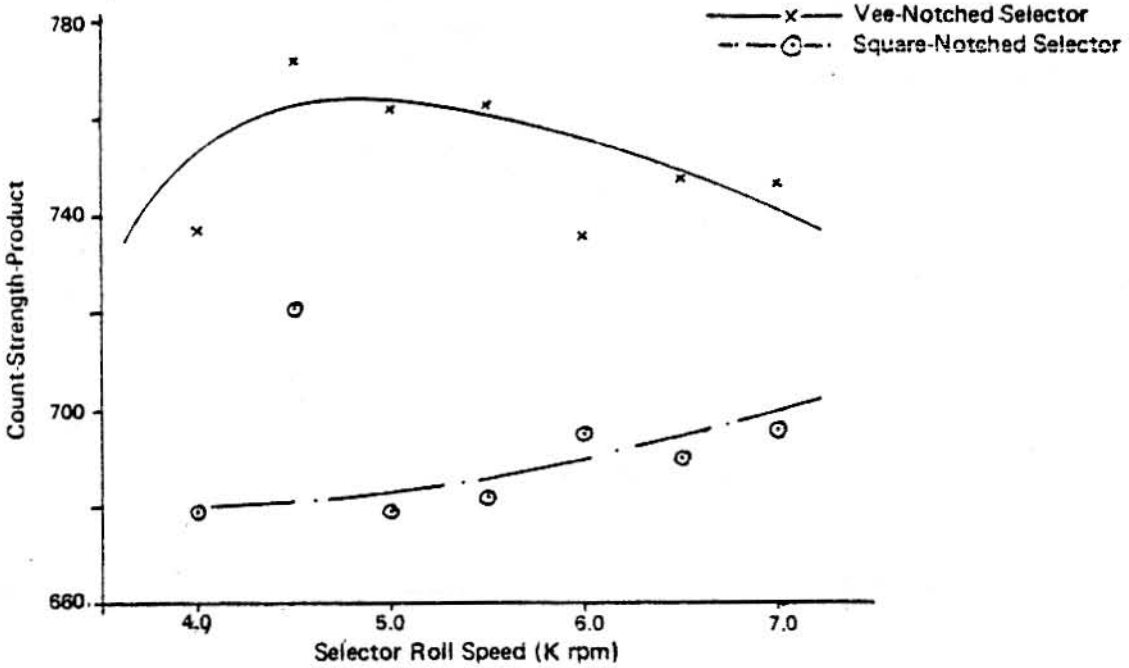
TABLE II

Physical Properties of Finished Drawn Sliver Supplied to Rotor-Spinning

Lot Number	Fiber Tenacity (Stelometer) (1/8" Gauge) (g/tex)	Fiber Elongation (%)	Mean Fiber Diameter (μm)	S. D. of Diameter (μm)	C. V. of Diameter (%)	Wool Array Length (in)	S. D. of Length (in)	C. V. of Length (%)	Grade (ASTM3992-81)
A	11.7	24.0	24.7	5.3	21.4	2.48	0.99	39.8	60's
B	9.6	26.0	25.5	6.0	23.6	2.63	1.03	39.1	60's
C	11.8	24.5	25.5	5.9	23.1	2.61	0.99	38.0	60's
D	12.0	27.8	25.6	5.4	20.9	2.56	1.01	39.4	60's
E	11.8	27.0	26.4	6.3	23.9	2.47	0.99	40.0	58's
F	11.8	27.0	26.7	5.9	22.0	2.62	1.00	36.9	58's
G	12.5	24.0	28.0	6.4	22.9	2.69	1.02	37.7	56's
ML	11.5	27.0	25.6	6.2	24.3	2.29	0.95	41.6	60's
X	11.7	25.5	25.1	6.6	26.1	2.44	0.94	38.4	60's
Y	12.1	28.5	26.6	7.3	27.4	2.32	0.97	36.8	58's
Z	12.5	28.0	25.1	6.6	26.5	2.36	0.92	38.8	60's

TABLE III
Rotor Spinning Data – "Vee" Notch Selector Roller

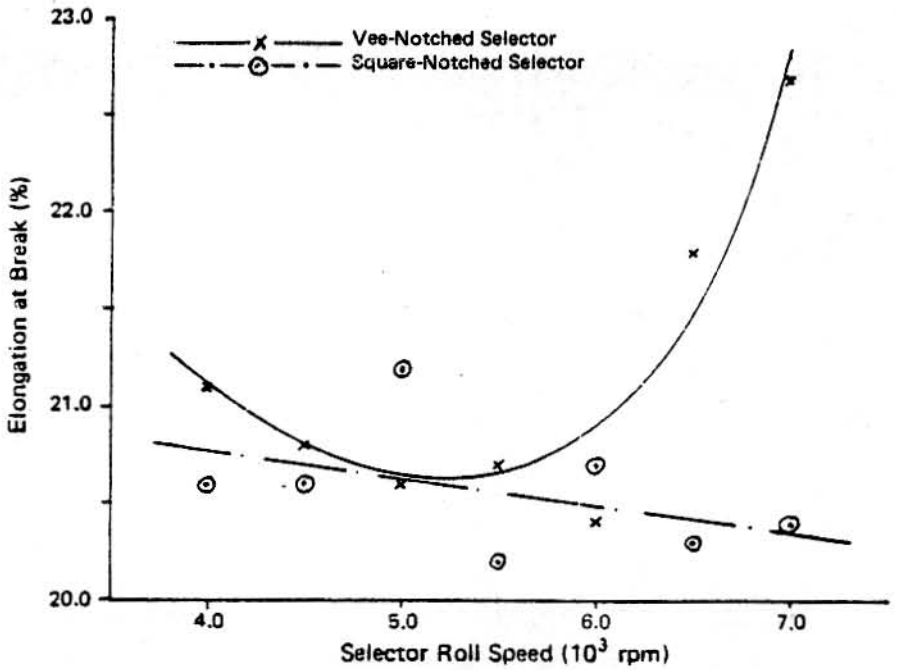
Sliver	70 gr/yd Finisher Drawframe						
Rotor-Spinning Machine	Suessen Spintester, SACM Unit						
Nominal Yarn No.	N_e 6 (N_w 9)						
Rotor Type	66 mm						
Rotor Speed (rpm)	25,000						
Opening Roller Type	Selector – "Vee Notch"						
Opening Roller Speed (rpm)	4.0 K	4.5 K	5.0 K	5.5 K	6.0 K	6.5 K	7.0 K
Draft	49.0						
Twist Multiplier	3.99						
Yarn Speed (yd/min)	71						
Navel	8G						
Ambient Conditions	70°F/56% RH						
Tension Draft	0.99						
Test Duration	24 minutes						
Skein Test:							
Actual Yarn Number (N_e)	5.98	5.96	5.92	5.87	5.91	5.93	5.85
CV of Yarn Number (%)	2.8	2.4	0.8	1.6	1.7	2.5	0.8
Count-Strength-Product	737	772	762	763	736	748	747
CV of CSP (%)	0.3	1.6	1.4	0.4	3.0	1.1	1.2
Single Yarn Tensile Test:							
Tenacity (g/tex)	4.96	5.06	5.00	5.03	4.84	4.89	4.88
Mean Strength (g)	492	506	492	497	461	488	489
CV of Strength (%)	8.0	7.4	6.0	8.0	6.9	8.0	6.9
Elongation (%)	21.1	20.8	20.6	20.7	20.4	21.8	22.7
Uster Evenness Test:							
Non-Uniformity (CV%)	15.19	15.02	14.66	14.83	15.02	15.13	15.18
Thin Places/1,000 yds	16	16	10	16	18	32	18
Thick Places/1,000 yds	50	42	34	54	38	44	26
Neps/1,000 yds	4	8	8	4	4	0	2
Hairs/100 yds	1966	2000	2010	2027	1957	2034	2043
Performance:							
Number of Breaks	1	0	1	0	1	0	1



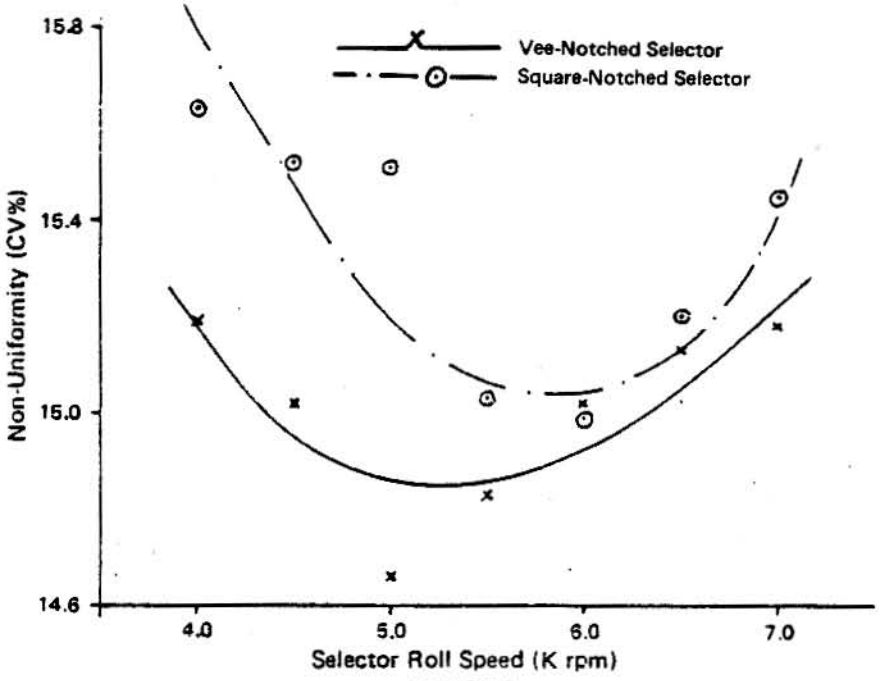
GRAPH 1
Count-Strength-Product vs. Speed

TABLE IV
Rotor Spinning Data —"Square" Notch Selector Roller

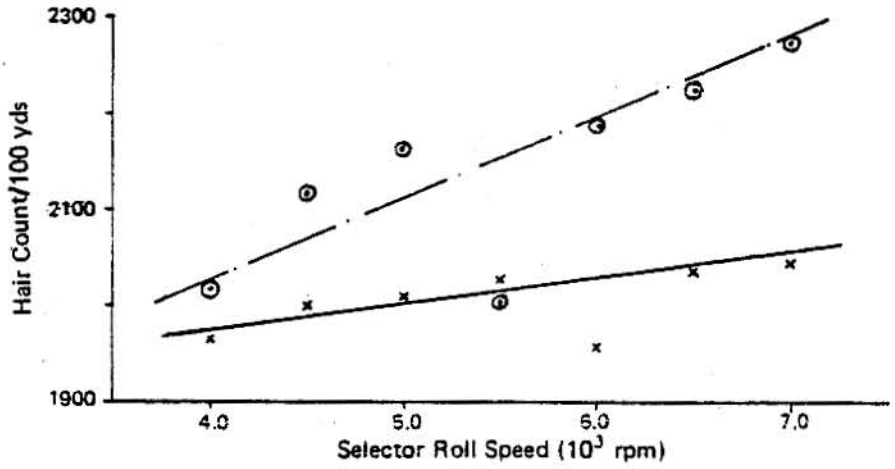
Sliver	70 gr/yd Finisher Drawframe						
Rotor-Spinning Machine	Suessen Spintester, SACM Unit						
Nominal Yarn No.	N_e 6 (N_w 9)						
Rotor Type	66 mm						
Rotor Speed (rpm)	25,000						
Opening Roller Type	Selector – "Square Notch"						
Opening Roller Speed (rpm)	4.0 K	4.5 K	5.0 K	5.5 K	6.0 K	6.5 K	7.0 K
Draft	49.0						
Twist Multiplier	3.99						
Yarn Speed (yd/min)	71						
Navel	8G						
Ambient Conditions	70°F/56% RH						
Tension Draft	0.99						
Test Duration	24 minutes						
Skein Test:							
Actual Yarn Number (N_e)	5.84	5.95	5.90	5.85	5.94	5.96	5.92
CV of Yarn Number (%)	1.8	2.1	2.3	0.3	1.6	2.3	0.9
Count-Strength-Product	679	721	679	682	695	690	696
CV of CSP (%)	4.4	1.1	2.1	1.2	2.2	1.9	2.2
Single Yarn Tensile Test:							
Tenacity (g/tex)	4.70	4.75	4.77	4.65	4.68	4.67	4.71
Mean Strength (g)	478	471	503	455	476	464	475
CV of Strength (%)	8.5	8.3	7.8	7.5	8.0	7.8	6.9
Elongation (%)	20.6	20.6	21.2	20.2	20.7	20.3	20.4
Uster Evenness Test:							
Non-Uniformity (CV%)	15.63	15.52	15.51	15.03	14.90	15.20	15.45
Thin Places/1,000 yds	28	28	12	22	22	20	20
Thick Places/1,000 yds	52	58	48	48	38	30	38
Neps/1,000 yds	6	4	4	0	2	4	6
Hairs/100 yds	2018	2119	2162	2002	2189	2226	2272
Performance:							
Number of Breaks	5	3	2	1	2	1	1



GRAPH 2
Elongation at Break vs. Speed



GRAPH 3
Non-Uniformity vs. Speed



GRAPH 4
Hair Count vs. Speed

NOTICE OF ADDRESS CHANGE The mailing address for *Textile Topics*, the Textile Research Center and the Department of Textile Engineering at Texas Tech University has been changed. Please note that all mail should now be addressed to:

Post Office Box 5888
Lubbock, Texas 79417
USA

You will note that the post office box number only has changed – the zip code remains the same. We ask that all correspondents note this change and place our new address in their files.

VISITORS The few visitors to the Textile Research Center during December included Wolfgang Strahl and Glenn Morton, Cotton Incorporated, Raleigh, NC; Karl Mueller, American Wool Council, New York, NY; Madelaine Lowe, Houston Community College, Houston, TX; and Vibert Lanferman, Sanata Textiles Ltd., Ruimveldt, Guyana, South America.