TRC

# TEXTILE TOPICS

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**SPINNING FINE OPEN-END YARNS** When open-end spinning became commercially accepted in the United States some fifteen years ago, it was believed to be suitable for coarse yarns only. It seems that some thought the mechanical features of this type machine would limit the system to coarse yarns, while others felt the economics of the process would not permit fine yarns. About 1973, several spinners stated they believed 14/1 $N_e$ was the finest practical number that could be spun. A few years later, several companies were producing 18/1 $N_e$, and then eventually the yarn numbers went higher to 24/1, 28/1 and 30/1. We are now aware that 36/1 $N_e$ is commercially spun on open-end machinery in the United States, Europe and other locations. It appears that as new developments are introduced and automation is increased by the use of robotics, finer yarns are becoming a reality at rotor spinning.

In 1978, the Textile Research Center undertook a program to determine the mechanical ability of open-end machines to spin fine yarns, regardless of any economic limitations. Using 100% Pima cotton, we found we could spin yarns as fine as 80/1 $N_e$. We were quick to point out at that time, however, that the investigation was done strictly for research and was not suggested for commercial consideration. We realized that 80/1 $N_e$ could be spun much more economically on a ring frame than on a rotor machine, but still it was interesting to know that there were no mechanical restrictions in spinning fine O-E yarns.

We have learned during the past year that a number of manufacturers not only are using rotor machines to spin yarns as fine as 36/1 $N_e$ on a regular basis, but in fact some are considering going to finer numbers. In addition, several companies are now combing the cotton that goes into O-E yarns. When we learned this, it seemed appropriate to take a second look at the work we did seven years ago and study once more the mechanical possibilities of spinning finer yarns on rotor machines. The new program we have begun is designed to spin 100% cotton into English numbers of 40, 50, 60, and even finer if the results at that point appear promising.

In order to adhere to the objective of this study, it was important to select a cotton normally used for combing. Therefore, we chose an Acala variety from the southwestern area of Texas. This had a 2.5% span length of 1.15 inches and a strength of 29.9 g/tex.

In this issue of *Textile Topics*, we are making a preliminary report on part of this study. The following tables give properties of the fiber used, the machine employed, spinning performance and yarn testing results. The yarn spun in this case was 40/1 $N_e$. It will be seen that this was done with both carded and combed sliver. For the carded sliver, we used two and three processes of drawing. The combed sliver was produced with one process of drawing before combing and two afterward. The comber was set to remove various amounts of short fiber, and Table I shows that in the three different lots we extracted 8%, 15% and 22% noils. These changes had an effect on spinning performance and yarn quality. Also, it will be noted in Table II that the short fiber content was reduced appreciably by combing (as would be expected) and continued to decline with the increased removal of noils.

The spinning of each lot was done with a twist multiplier of 4.47. The strength of the 40/1 $N_e$ yarn was about what would be expected, with the yarn produced from the combed sliver stronger than the two carded yarns. The two or three drawing processes on the carded stock seemed to have very little influence on yarn strength. It will be noted that both the count-strength-product and single-yarn tenacity varied only slightly. However, when looking at the three combed yarns, the count-strength-product increased

TABLE I

| | | | | | |
|---|---|---|---|---|---|
| FIBER DATA: | | | | | |
| Micronaire | | | 3.7 | | |
| 2.5% Span Length (in) | | | 1.15 | | |
| Uniformity (%) | | | 44 | | |
| Short Fiber Content (%)* | | | 3.9 | | |
| Stelometer Strength (g/tex) | | | 29.9 | | |
| Elongation (%) | | | 6.0 | | |
| Shirley Non-Lint Content (%) | | | 2.9 | | |
| SPINNING SPECIFICATIONS: | | | | | |
| Machine | | | Schlafhorst Autocoro | | |
| Rotor Type | | | G40 | | |
| Rotor Speed (rpm) | | | 72,000 | | |
| Opening Roller Type | | | OB20 | | |
| Opening Roller Speed (rpm) | | | 7,000 | | |
| Draft | 189.4 | 187.6 | 191.4 | 189.4 | 187.6 |
| Yarn Speed (yd/min) | | | 70.7 | | |
| Navel | | | KK4 | | |
| SLIVER | Carded | | Combed | | |
| Draw Frame Passes | 2 | 3 | 1 Before Combing; 2 After Combing | | |
| Noils Extracted (%) | 0 | 0 | 8 | 15 | 22 |
| YARN PROPERTIES: | | | | | |
| Skein Test | | | | | |
| Nominal Yarn No. ($N_e$) | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 |
| Actual Yarn No. ($N_e$) | 40.59 | 40.12 | 40.83 | 40.59 | 40.57 |
| CV% of Yarn Count | 1.6 | 1.2 | 1.0 | 3.5 | 2.2 |
| Twist Multiplier | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 |
| Count-Strength-Product | 1756 | 1759 | 1852 | 1902 | 1931 |
| CV% of CSP | 3.0 | 4.0 | 2.5 | 2.5 | 2.9 |
| Single Yarn Tensile Test | | | | | |
| Tenacity (g/tex) | 11.94 | 12.06 | 13.37 | 13.58 | 13.29 |
| Mean Strength (g) | 174 | 178 | 193 | 198 | 193 |
| CV% of Strength | 10.2 | 12.1 | 9.3 | 9.7 | 10.8 |
| Elongation (%) | 4.99 | 4.87 | 4.91 | 4.57 | 4.88 |
| CV% of Elongation | 9.9 | 11.2 | 10.8 | 10.9 | 9.8 |
| Specific Work of Rupture (g/tex) | 0.317 | 0.314 | 0.344 | 0.335 | 0.342 |
| CV% of Work of Rupture | 17.6 | 20.9 | 18.4 | 18.2 | 17.8 |
| Uster Evenness Test | | | | | |
| Non-Uniformity (CV%) | 18.55 | 19.68 | 20.10 | 19.87 | 19.71 |
| Thin Places/1,000 yds | 294 | 457 | 534 | 531 | 498 |
| Thick Places/1,000 yds | 467 | 718 | 815 | 794 | 722 |
| Neps/1,000 yds | 1499 | 2149 | 2285 | 2092 | 1852 |
| Hairs/100 yds | 300 | 335 | 357 | 368 | 333 |
| Performance | | | | | |
| Number of Breaks** | 62 | 50 | 29 | 25 | 18 |
| Break Rate/1,000 Rotor hrs | 610 | 492 | 285 | 246 | 177 |

*As determined by Digital Fibrograph. Short Fiber Content determined by Peyer AL101 on chute-feed sample was 8.07%.

**Non-mechanical

TABLE II

Sliver Short Fiber Content (Determined by Peyer AL101)

| SLIVER | Carded | | Combed | | |
|---|---|---|---|---|---|
| Draw Frame Passes | 2 | 3 | 1 Before Combing; 2 After Combing | | |
| Noils Extracted (%) | 0 | 0 | 8 | 15 | 22 |
| Short Fiber Content (%)* | 7.47 | 8.45 | 3.28 | 2.83 | 2.30 |

*Short Fiber Content measurement made on sliver fed to O-E spinning machine

noticeably as more noils were removed. This same trend was not reflected in the single-strand tenacity, however. Spinning performance was enhanced by the removal of the short fiber at combing, with a decline in the number of spinning breaks as the greater percentage of noils was removed.

Considering all aspects of this portion of our investigation, we are satisfied with these results. We have not yet produced yarns finer than 40/1, but we expect to be involved in this in the near future. Additional reports on this study will be carried in *Textile Topics* as results become available.

This research is sponsored by the Natural Fibers & Food Protein Commission of Texas and is being directed by John B. Price.

**MEASUREMENT OF COTTON FIBER LENGTH DISTRIBUTION** For those who are involved in the use of cotton, fiber length and uniformity are important factors. The first characteristic usually known about a cotton is its working length, referred to as staple length when determined by hand manipulation, Fibrograph 2.5% span length or upper-half mean length when determined by instrument. The random distribution of the length is also an important factor. Without this information, a manufacturer would not know whether a one-inch cotton had good length uniformity, or poor uniformity with a high percentage of short fibers. For many years, cotton fiber length distribution was determined by the Suter-Webb array method. While this test does give useful information, it requires considerable time to perform. In fact, our experienced technicians need an hour or more to complete one array. Because of this, we have been interested in a faster method of obtaining equal or better information on fiber length distribution.

The Peyer Corporation's AL-101 system is designed to measure length distribution by utilizing a Fibroliner sorter, computer, and printer to give uniformity and short fiber content. This can be done in a comparatively short time, approximately 15 minutes when the entire test is performed by one technician. Because of the Textile Research Center's need for reducing the time involved, we purchased an AL-101 earlier this year and have been measuring length distribution on it for the past seven months. We are pleased with the instrument's operation and the results we get from it. Some organizations that request fiber arrays at TRC are now asking that this be done on the AL-101 rather than the Suter-Webb Sorter. As our charges are often based on the length of time required for a test, we have been able to reduce the cost by using the Peyer system. Although we feel confident with the information obtained from the AL-101, we are still conducting length array tests on the Suter-Webb Sorter on a regular basis. However, it appears just a matter of time until all such measurements are done electronically.

We have a research program underway to thoroughly study this subject, and we plan to give a report on this at some point in the near future. We will carry this in *Textile Topics* when our study has been completed.

**VISITORS** Visitors to the Textile Research Center during September included Frank Werber, USDA, Washington, DC; Ray Frisbie, Texas A&M University, College Station, TX; Bill Masters, Terry Hines and John Stuckey, Cone Mills Corporation, Cliffside, NC; Thomas A. Tantillo, D. T. Atkinson, Jr., Charles G. Simmons, Jr. and L. C. McLudon, Graniteville Company, Graniteville, SC; Barnett A. Greenberg, North Texas State University, Denton, TX; Joseph W. A. Off, AMF Incorporated, Irving, TX; and Enoch Dradu, Namalonde Cotton Research Station, Uganda.