STUDY OF SHORT STAPLE PROCESSING OF WOOL/COTTON BLENDS ON ROTOR SPINNING SYSTEM

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This study examined the processing of wool/cotton blends on the open-end rotor spinning system. The intent is to take advantage of higher production speeds possible with this system. Optimization of the spinning parameters may enable the commercial production of wool/cotton blend yarns with sufficient quality for coarse knitting and weaving applications.

Three different wool/cotton blends were tested. These were 75% wool / 25% cotton, 50% wool / 50% cotton, and 25% wool / 75% cotton. The fiber properties are listed in Table 1. Yarns were spun at 6Ne on the Rieter M1/1 system, using a 45mm rotor. Three twist multipliers (4.5, 4.8 and 5.42) and three rotor speeds (55,000, 50,000 and 45,000 rpm) were used, in order to cover the optimum parameters for spinning.

Resulting yarn properties examined included count-strength-product (measured on Scott Pendulum Tester), single yarn tensile properties (on Uster Tensorapid), and yarn evenness (on Uster Tester 3).

Results

Table 2 summarizes the yarn properties that resulted from different twists and alternative wool/cotton blends. The rotor speed used to produce this data was 55,000 rpm. It can be seen that yarn properties showed no significant differences due to twist. Since 4.8 twist multiplier is the manufacturer recommended twist, this was used for further study.

The higher the wool fiber percentage, the lower the yarn quality (Table 2). Thus, as the fiber content changed from 25w/75c to 75w/25c, both yarn CSP and tenacity dropped significantly (about 50 percent). The other properties, such as yarn evenness and elongation, also deteriorated.

The effect of the rotor speed on yarn quality is shown in Figures 1-4. When the rotor speed decreased, yarn strength properties (CSP and tenacity) did not show any improvement; however, yarn evenness and elongation displayed a noticeable improvement. Over all, yarn properties with high wool content were consistently poor.

In order to explain the lower yarn quality with higher wool content, we inspected the yarn cross sections under the microscope. The pictures of three yarn cross sections are shown in Figure 5. By comparing Figure 5a with 5c, it is clear that the number of fibers in the cross section is much less in the high wool content yarn than in the high cotton content yarn. This is due to a heavier linear density of wool fibers. The yarn with more wool is also less compact due to the larger diameter of wool fibers. It is known that, in general, rotor spun yarns are weaker than ring spun yarns. A major reason is that the rotor spun yarns lack compactness. High wool fiber content aggravates this deficiency, as revealed in Figure 5.

Conclusion

While cotton/wool blend yarns can be spun on the rotor system, yarn quality is poor when the content of wool fibers in the blend is high. These results indicate that the 25% wool/75% cotton blend makes yarn that is adequate for most coarse knitting and weaving applications. However, the 50%/50% blend would be generally inadequate. Therefore, elevating the wool content above 25% should be done only with great care.

Table 1. Fiber properties

Cotton fiber properties	
Strength (g/tex)	28.4
Elongation (%)	6.2
Length (inch)	1.17
Uniformity Ratio (%)	84.2
Micronaire	4.7
Leaf	3
Reflectance	76.7
Yellowness	8.9
Wool fiber properties	
Mean length	1.842
Coefficient of variation	41.36

Test No.	4.5				4.8				5.42			
	CV%	CSP	Tenacity	Elongation	CV%	CSP	Tenacity	Elongation	CV%	CSP	Tenacity	Elongation
75w/25c	15.39	847.5	5.29	5.96	15.68	839	5.45	5.62	15.64	813	5.45	5.44
50w/50c	15.6	1198	7.48	6.03	15.43	1204	7.59	5.94	15.12	1189	7.73	6.21
25w/75c	14.74	1706	10.36	6.61	14.74	1738	10.3	6.68	14.47	1729	10.49	6.85

Table 2. Yarn properties for different twist multipliers

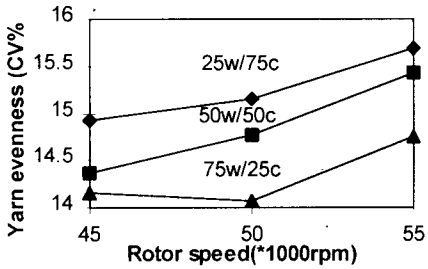


Figure 1. Yarn evenness for three wool/cotton blends at different rotor speeds

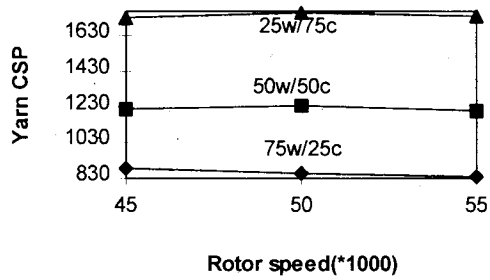


Figure 2. Yarn CSP for three wool/cotton blends at different rotor speeds

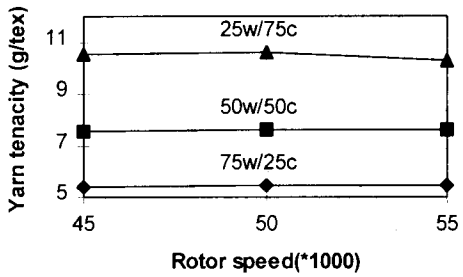


Figure 3. Yarn tenacity for three wool/cotton blends at different rotor speeds

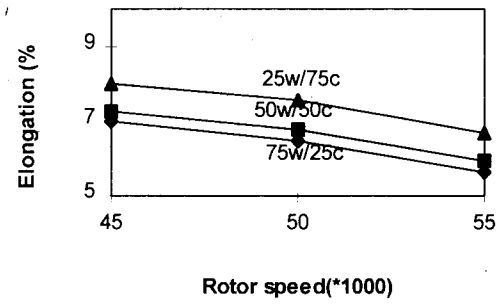
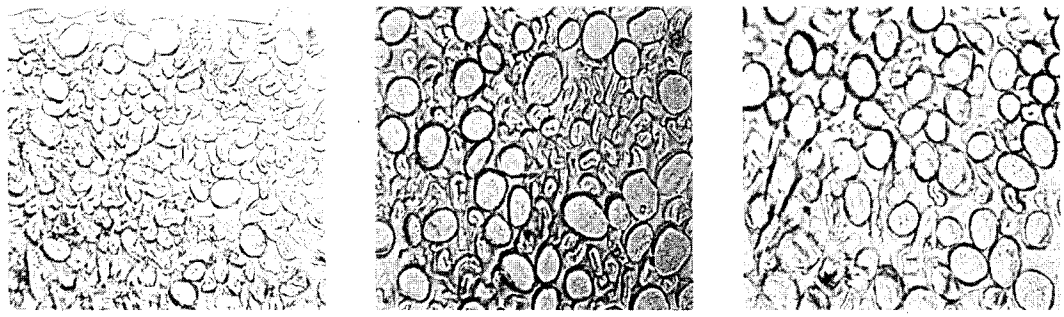


Figure 4. Yarn elongation for three wool/cotton blends at different rotor speeds



a(25w/75c) **b(50w/50c)** **c(75w/25c)**

Figure 5. The cross sections of three wool/cotton blending yarns