EVALUATING COMBING ROLL FIBER DAMAGE IN ROTOR SPINNING USING THE AFIS

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Introduction

Questions have been raised from time to time concerning how much cleaning of the fiber and at what cost to fiber properties occurs during the opening action of the combing roll. The Uster AFIS, with the ability to measure fiber length, quantify trash and neps, et cetera, has made this study easy to perform provided fiber could be collected without damage after passing through the opening process of the combing roll.

The purpose of this study was to quantify the influence on fiber properties and the cleaning effect of the rotor spinning combing roll as measured by the Uster AFIS machine. The objective was to test the effect of the processing rather than compare varieties.

The four cotton varieties selected for this study were from excess cottons from a former project.[1] These were chosen to give a range of staple lengths, micronaire, nep and trash counts. Each variety was tested from the bale on Spinlab 900B for HVI data and Uster AFIS.

This article uses the averages of the four varieties to show the overall trends of the influence on fiber properties by processing. The full report is in the 1994-95 Annual Report to the Texas Food and Fibers Commission, available from the ITC.

Procedure

Spinning Preparation

Mechanical processes are outlined in Exhibit 1.

Each variety was processed in the same manner. Maximum cleaning was used in blowroom and waste through carding quantified (Table 1). Carding was on a Rieter C-4 cotton card setup to process Texas Upland cottons. Two drawing processes were used: breaker drawing on a Platt Saco Lowell Versamatic draw frame and finisher drawing to 55 gn/yd on a Rieter RSB-851 draw frame.

Finisher drawing sliver from each variety was collected and a knot was placed in the trailing end to ensure the correct direction of running through the AFIS. These samples provided the reference data from AFIS prior to the combing roll action.

A Schlafhorst Autocoro SE-8 rotor spinning machine was chosen for this project. A fixed draft of 114.4 was used throughout the study. This draft gave an intake speed for the sliver of 1.18 meters per minute and a yarn delivery rate of 135 meters per minute.

Two different Schlafhorst combing rolls designed for cotton processing were used. The OB20F has been the standard for 100% cotton processing, and the B174DN is a Schlafhorst product with a different design. Although the geometry of the teeth area is similar, the OB20F is wire wound, whereas the B174DN is machined from one piece of metal. Some advantage has been demonstrated in other studies[2] in terms of yarn quality with the B174DN having advantage over the OB20F.

In addition to the two different types of combing rolls, a range of speeds were used. Samples were run and collected from each rpm starting with 6,500 and increasing each time by 500 rpm up to 9,000.

A large rotor with its appropriate feed channel was used to maximize the amount of fiber that could be passed through opening at one time. Lengths approximately 6" long of 55 gn/yd sliver were passed through with no stoppages to eliminate fiber damage due to the combing roll running through a stationary sliver beard.

Fiber Testing

Refer to Table 2. Fifty-two separate fiber samples were collected to be tested on the Uster AFIS. This number included four sliver samples from each of the four varieties, and forty-eight opening roll samples from four varieties, two combing roll types and six combing roll rpms. Three replications were run on each sample on AFIS for complete analysis—that is fiber parameters, trash, and neps.

Results and Analysis

Uster AFIS: Raw Stock vs Finisher Drawing Data

Refer to Figures 1, 2, and 3. AFIS data from raw stock and finisher drawing slivers were as expected in good processing. Comparing the finisher drawing sliver with the raw stock samples, the following observations can be made:

1. The upper quartile length increased by an average of 0.08 inches.
2. Mean length increased by an average of 0.07 inches.
3. Percent short fibers decreased by an average of 2.0%.
4. Nep count (no./g) decreased by an average of 64.
5. Total trash (no./g) decreased by an average of 411.

Uster AFIS: Finisher Drawing vs Combing Roll Fiber

This comparison measured the before and after action of the combing roll. Disregarding combing roll types and rpms, the following observations can be drawn:

1. Upper quartile length decreased by 0.05 to 0.09 inches.
2. Mean length decreased by 0.03 to 0.09 inches.
3. Percent short fiber increased from 0.4% to 2.5%.
4. Nep count (no./g) decreased from a low of 1.6% to a high of 35.7%.
5. Total trash (no./g) decreased 5.2% to 69.1%.

Conclusions

There are many effects that the combing roll action has on the fiber from finisher sliver to rotor groove. Some of the most obvious from this study are:

1. The combing roll is an effective cleaning device removing a significant amount of trash from the sliver.
2. The cleaning was at a cost to fiber damage in terms of increased short fiber content, shorter mean length and shorter upper quartile length.
3. The combing roll action reduces the nep count significantly.
4. Percent short fiber increases as combing roll rpm goes up.
5. Cleaning efficiency goes up with rpm after 7,500.
6. Nep count goes down as rpm increases.
7. Advantages of one combing roll type over the other is a "mixed bag" and would best be determined by spinning efficiency and yarn quality studies.

The above statements as general truths are supported by this study, however, exceptions can be found and are likely to happen in actual experience.

References

1. Unpublished work, ITC Project 1731.
2. Boone, Harriet, ed. "Effects of Schlafhorst Autocoro Opening Roller Speed on Yarn Quality: Results Using California Acala Cotton", ITC Textile Topics, Volume 22, No. 3, Spring 1994.

EXHIBIT 1: Outline of Mechanical Processes

Hunter Weight Pan Hopper Feeder		
Monocylinder B4/1	Roll Speed	= 750 rpm
Dust Remover		
ERM B5/5 Condensor	R20/10 Beater Speed	= 850 rpm
ERM B5/5	R10/10 Beater Speed	= 950 rpm
AMH Blender		
Rieter Aerofeed U Chute		
Rieter C-4 Card Trashmaster	Production Rate Sliver Weight	= 100 lb/hr = 60 gr/yd
Platt Saco Lowell DE-7C Draw Frame	Delivery Speed Sliver Weight	= 570 ft/min = 55 gr/yd
Rieter RSB 851 Draw Frame	Delivery Speed Sliver Weight	= 1320 ft/min = 55 gr/yd
Schlafhorst Autocoro SE-9 Rotor Spinning Machine	Draft Intake Speed Delivery Speed	= 114.4 = 1.18 m/min = 135 m/min

Figure 1. Average AFIS Short Fibers for All Bales Using Different Combing Rolls at Various Speeds

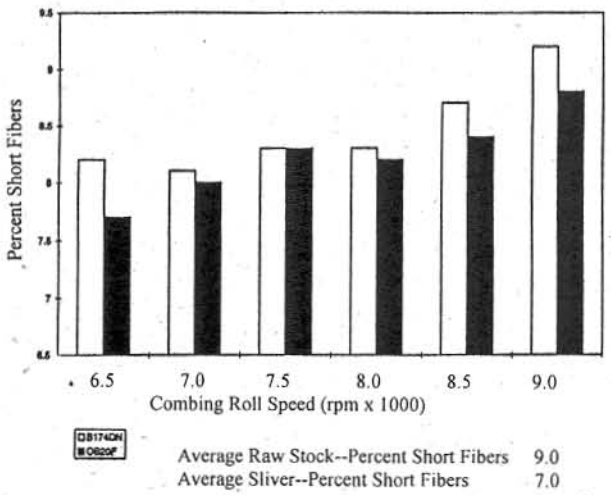

Figure 2. Average AFIS Neps for All Bales Using Different Combing Rolls at Various Speeds

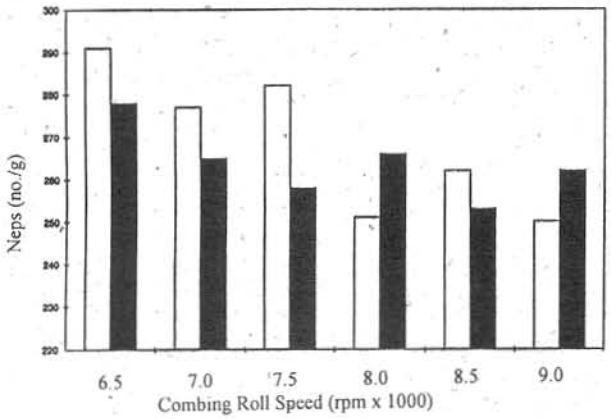

Figure 3. Average AFIS Total Trash for All Bales Using Different Combing Rolls at Various Speeds

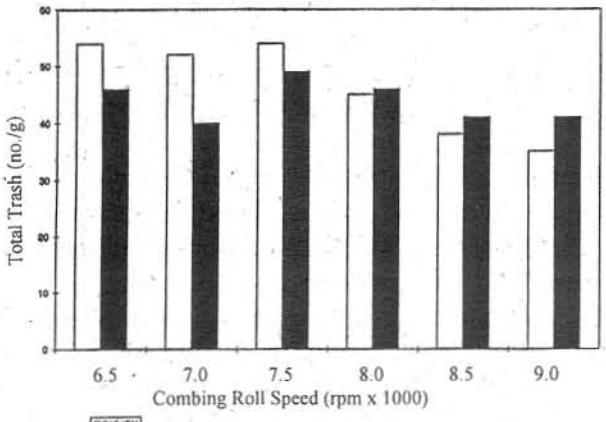

Table 1. Waste Data Percentages

Bale Number	2697	2698	2699	2700
Blowroom				
Monocylinder	1.12	0.98	1.33	0.93
ERM 1	0.67	0.70	0.99	0.80
ERM 2	0.45	0.53	0.75	0.59
Total Blowroom	2.24	2.21	3.07	2.32
Card				
Undercard	0.68	0.74	0.80	0.74
Filter	2.65	1.98	2.28	2.09
Total Card	3.33	2.72	3.08	2.83
Total Waste	5.57	4.93	6.15	5.15

Table 2. HVI and AFIS Data

Bale Number	2697	2698	2699	2700
1/8"Gauge Strength (g/tex)	35.9	31.4	36.7	29.6
Elongation (%)	6.2	5.8	5.9	6.5
Length (in)	1.20	1.09	1.23	1.02
Uniformity Index	84.0	82.4	84.6	81.3
Micronaire Index	3.9	4.5	3.3	4.7
Reflectance (Rd)	68.3	68.4	68.1	68.9
Yellowness (+b)	11.7	11.9	11.5	11.9
Color Index	33	33	33	33
Leaf Grade	1	1	1	1
Uster AFIS-Raw Stock Data				
Upper Quartile Length (w) (in)	1.24	1.11	1.29	1.03
Mean Length (in)	1.01	0.91	1.04	0.86
Percent Short Fibers	8.2	9.7	8.0	9.9
Diameter ((m)	11.9	13.9	11.2	15.0
Neps (no./g)	435	294	493	307
Total Trash (no./g)	492	237	954	301