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FIBER QUALITY CHARACTERISTICS OF CONVENTIONAL CONTROLLED-BATT VERSUS NON-CONVENTIONAL FLOW-THROUGH SAW-TYPE LINT CLEANERS

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Abstract

Fiber samples were taken simultaneously from side-by-side installations of conventional (Model 108) and non-conventional (Sentinel™) Lummus saw-type lint cleaners at three ginning facilities and subjected to fiber quality tests. Fiber properties were compared to better understand the effects of lint cleaner design on fiber damage during the lint cleaning process under production conditions.

Background

Conventional controlled-batt, saw-type lint cleaners have been at the center of attention regarding fiber damage in the ginning process for decades. It is generally agreed that the vast majority of fiber damage (creation of short fiber and neps) occurs within the feed works of the lint cleaner, where a slow-moving blanket or batt of cotton is transferred to the high-speed lint cleaner saw in an aggressive fashion (Hughs, 2004). While this transfer facilitates the combing and blending of the fibers, producing the smooth appearance that is still rewarded in the current cotton marketing system, there is strong consensus that the saw plowing through the fiber batt does not promote true fiber spinning quality preservation.

As an answer to the conventional saw-type lint cleaner, Lummus introduced the Sentinel™ Lint cleaner (Figure 1) in 1999 (Rutherford, et. al., 1999). Rather than agglomerating the fiber into a batt on a slow-moving condenser drum, the Sentinel™ operates on the concept of feeding the individual tufts of fiber directly to the saw, through the use of a high-speed perforated air separator cylinder. In addition to the gentler feeding of the saw, dust removal from the lint cotton is more effective, and the entangled trash is never compressed into the fibers, as is the case with a conventional saw-type lint cleaner.

Initial performance characteristics from some early Sentinel™ installations were reported in 2002 (Rutherford, et.al, 2002). While the fiber properties produced by the Sentinel™ looked promising, little data existed for any head-to-head comparisons of the Sentinel™ versus Lummus' corresponding conventional saw-type lint cleaner (the Model 108). This was primarily because most Sentinel™ installations featured only Sentinel™ Lint cleaners as the saw-type lint cleaner and only in single configurations.

2003 Testing

Plant Installations

With subsequent installations, however, machinery arrangements were such that direct comparisons could become a reality. Three different gin plants where both Sentinel™ and Model 108 Lint cleaners were installed were selected for sampling in order to obtain comparison data. The installations were North Gin Ltd. in Dimmitt, Texas, United Cotton Growers Cooperative in Levelland, Texas, both stripper-harvested areas, and Brighann Ginning in Moree, New South Wales, Australia, a spindle picker-harvested area. All plants featured Lummus 170-Saw Imperial III gin stands and Super-Jet® air-type lint cleaners prior to the saw-type lint cleaning. Figure 2 shows the machinery arrangement of the saw-type lint cleaning at North Gin Ltd., and the other two installations were identical to this.

Testing Protocol

Fiber samples were obtained simultaneously before and after the Sentinel™ and Model 108. Three replications per sampling point were done over four modules, yielding twelve samples per sampling point. All samples were assigned identification numbers. The samples were sent to the USDA-ARS Textile Research Center at Clemson, SC. HVI and AFIS analyses were performed on all samples. The results for each gins' four sampling points (before Sentinel™, after Sentinel™, before Model 108, and after Model 108) were averaged and are presented in this paper.

Results

Since there were only 12 samples per sampling point per gin plant, the results presented here show some wide variations in the cotton before the lint cleaners and are not to be considered statistically significant. The data are presented simply to note fiber characteristic differences for each installation based upon the type of lint cleaner. Further testing will be done in the future, and more extensive sampling should lead to even more conclusive results.

In order to maintain confidentiality for the gins participating in this study, each has been arbitrarily designated Gin A, B, or C. HVI results for each gin are presented in Tables 1 through 3, while AFIS results can be found in Tables 4 through 6.

HVI results for all three installations showed improvement in color grade (C Grade) and leaf grade (Leaf) for both lint cleaners. An interesting item regarding the Sentinel™ lint cleaners at Gin A was that the Sentinel™ took the leaf grade from a 5 to a 4, while the Model 108 reduced leaf grade from a 5 to a 3. At first, this would seem to favor the performance of the Model 108, but there is a strong trend in the ginning industry to target leaf grades of 4 in order to maximize the return to the farmers by not over-cleaning. This is a clear example of the Sentinel™ doing a better job of processing to a leaf grade of 4. Gin B's HVI results were similar, as the Sentinel™ maintained the 4 leaf, while the Model 108 reduced the 4 leaf to a 3. At Gin C, both lint cleaners processed leaf essentially the same.

Another definite trend in HVI results for all three locations was that the Sentinel™ reduced uniformity (Unif.) by less than half of the Model 108, and the same was true for upper half mean (UHM) at Gins A and B. Reflectance (Rd) and yellowness (+b) results were similar for both lint cleaners at all the locations.

The AFIS results for all three gins were even more indicative of the quality-preserving attributes of the Sentinel™. At Gin A, short fiber content (SFC) was actually slightly reduced passing through the Sentinel™, compared to an increase of over 14% for the Model 108. Nep creation (Neps) was substantially less through the Sentinel™ at all installations – at a minimum half as much, and at Gin B, neps actually were reduced through the Sentinel™. Trash (Trash) and visible foreign matter (VFM) results were similar for both machines, with the Model 108 actually cleaning slightly more than the Sentinel™. However, this points back to the HVI results reported above, in which the Model 108 lint cleaners could actually clean the cotton more than the target amount that is most beneficial in the marketplace for maximum grower return. Length (L) results for all locations and both lint cleaners were substantially the same

Summary

Despite the small sample lots, many trends from the data reported in this paper point to the fact that the Sentinel™ lint cleaner is on the right path not only to maximize return to the grower, but to provide a quality product for the textile mill. In fact, it is important to note that the results from the lint cleaners evaluated in this study show that both the Sentinel™ and Model 108 do an excellent job of cleaning and preserving fiber quality.

The whole purpose of a lint cleaner is to clean the fiber while minimizing any fiber damage – the Sentinel™ and Model 108 both excel at this. Lint cleaners that are designed to retain trash at the gin (in order to maximize weight), only to pass this trash along to the textile mill (which increases mill waste) are not the future of a quality-conscious ginning industry. This concept is short-sighted and will spell trouble for the industry, since more and more cotton in the future, regardless of production region, will be competing in a worldwide marketplace, not the regional marketplaces of the past.

Acknowledgements

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Disclaimer

Use of the name of the USDA-ARS Textile Research Lab or any of its personnel does not constitute any endorsement of any machinery discussed in this paper.

References

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Table 1. HVI data for fiber samples from Gin A (2003).

	Mike	Rd	+b	C Grade	Leaf	UHM (inches)	Unif. (%)	Strength (g/tex)
Before Sentinel™	4.66	75.8	8.4	31-2	4.9	1.183	83.4	32.2
After Sentinel™	4.58	77.3	8.4	31-1	3.8	1.169	82.9	31.5
Percent Change		1.98%	0.00%			-1.20%	-0.60%	
Before Model 108	4.65	75.9	8.4	31-2	5.3	1.192	84.0	32.3
After Model 108	4.53	77.1	8.5	31-1	3.2	1.164	82.8	32.2
Percent Change		1.58%	1.19%			-2.31%	-1.43%	

Table 2. HVI data for fiber samples from Gin B (2003).

	Mike	Rd	+b	C Grade	Leaf	UHM (inches)	Unif. (%)	Strength (g/tex)
Before Sentinel™	3.47	76.2	8.1	31-2	4.1	1.022	81.7	27.4
After Sentinel™	3.54	76.9	8.3	31-2	3.7	1.017	81.1	26.8
Percent Change		0.85%	2.61%			-0.52%	-0.71%	
Before Model 108	3.53	76.7	8.1	31-2	3.8	1.023	81.0	27.2
After Model 108	3.52	78.9	8.4	31-1	2.9	1.003	80.6	26.9
Percent Change		2.90%	3.56%			-2.01%	-0.48%	

Table 3. HVI data for fiber samples from Gin C (2003).

	Mike	Rd	+b	C Grade	Leaf	UHM (inches)	Unif. (%)	Strength (g/tex)
Before Sentinel™	3.71	78.8	7.8	31-1	2.8	1.142	81.5	29.1
After Sentinel™	3.72	80.8	7.9	21-2	2.0	1.123	81.4	28.6
Percent Change		2.59%	1.39%			-1.69%	-0.02%	
Before Model 108	3.73	78.9	7.8	31-1	2.7	1.137	81.8	28.9
After Model 108	3.76	81.3	8.1	21-1	2.0	1.122	80.7	28.9
Percent Change		3.10%	3.97%			-1.36%	-1.41%	

Table 4. AFIS data for fiber samples from Gin A (2003).

	L(w) (inches)	UQL(w) (inches)	SFC(w) (%<0.50)	L(n) (inches)	Mat. Ratio	Neps (Cnt/g)	Trash (Cnt/g)	VFM (%)
Before Sentinel™	0.98	1.22	10.93	0.76	0.93	163.25	102.33	2.22
After Sentinel™	0.98	1.22	10.87	0.76	0.91	166.25	80.25	1.74
Percent Change	0.00%	0.00%	-0.55%	0.00%		1.84%	-21.58%	-21.62%
Before Model 108	0.99	1.23	10.18	0.78	0.93	159.50	94.17	2.06
After Model 108	0.96	1.20	11.65	0.75	0.91	198.33	73.75	1.56
Percent Change	-3.03%	-2.44%	14.44%	-3.85%		24.34%	-21.68%	-24.27%

Table 5. AFIS data for fiber samples from Gin B (2003).

	L(w) (inches)	UQL(w) (inches)	SFC(w) (%<0.50)	L(n) (inches)	Mat. Ratio	Neps (Cnt/g)	Trash (Cnt/g)	VFM (%)
Before Sentinel™	0.870	1.068	12.71	0.690	0.87	262.44	230.44	5.12
After Sentinel™	0.880	1.068	11.91	0.700	0.87	236.89	181.56	3.50
Percent Change	1.15%	0.00%	-6.29%	1.45%		-9.74%	-21.22%	-31.68%
Before Model 108	0.851	1.050	14.07	0.664	0.87	294.22	199.33	4.06
After Model 108	0.870	1.063	13.01	0.682	0.87	324.00	138.89	2.80
Percent Change	2.22%	1.27%	-7.50%	2.68%		10.12%	-30.32%	-31.20%

Table 6. AFIS data for fiber samples from Gin C (2003).

	L(w) (inches)	UQL(w) (inches)	SFC(w) (%<0.50)	L(n) (inches)	Mat. Ratio	Neps (Cnt/g)	Trash (Cnt/g)	VFM (%)
Before Sentinel™	0.948	1.170	11.09	0.738	0.89	279.50	93.17	2.21
After Sentinel™	0.949	1.186	11.43	0.735	0.87	327.67	63.33	1.39
Percent Change	0.18%	1.35%	3.01%	-0.45%		17.23%	-32.02%	-37.22%
Before Model 108	0.960	1.181	10.38	0.755	0.88	259.00	109.83	2.45
After Model 108	0.957	1.182	10.71	0.748	0.88	354.17	64.00	1.34
Percent Change	-0.35%	0.07%	3.21%	-0.88%		36.74%	-41.73%	-45.35%

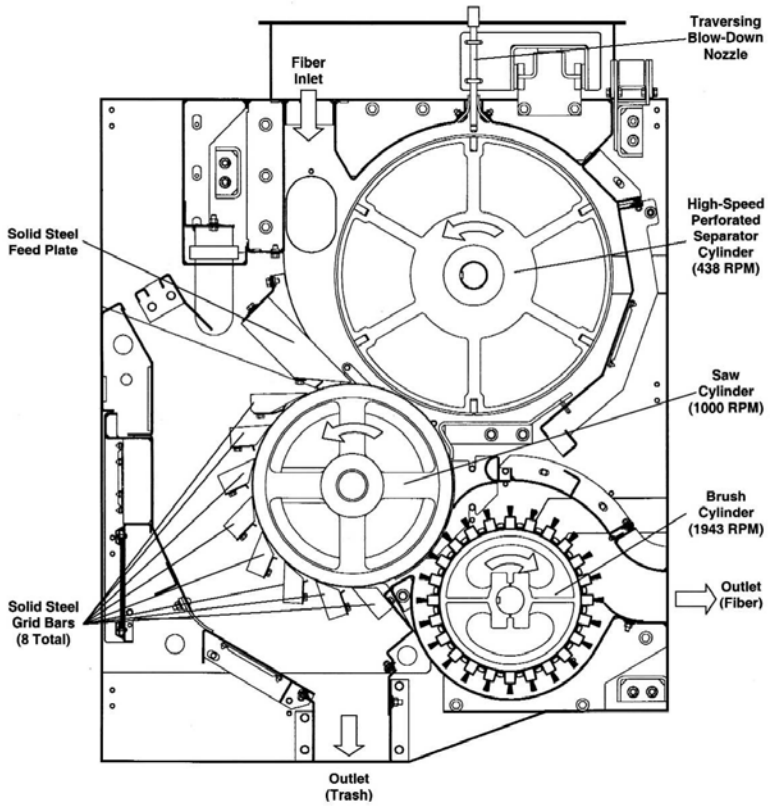

Figure 1. Cross-section of the Lummus Sentinel™ Lint cleaner.

Figure 2. Sentinel™ Lint cleaner (left) and Model 108 Lint cleaner (right) installation at North Gin Ltd.