HEAVY MECHANICAL PROCESSING EFFECTS ON COTTON STICKINESS

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Abstract

Sticky cottons were subjected to increased mechanical processing through sequential passages through a microdust and trash monitor. The cumulative amount of trash removed increased with each passage, but this did not significantly reduce either the sugar content or the minicard stickiness rating suggesting concentration of sticky spots on the fiber rather than on plant debris. However, the number of Thermodetector spots increased significantly with passage through the microdust and trash monitor. Since sugar content did not vary, the increased number of Thermodetector spots suggest that the larger sticky spots were broken into more numerous smaller spots when cotton is processed. Where processed cottons are concerned, the results suggest that Thermodetector test results may require a somewhat different interpretation than the results on raw cotton.

Introduction

Cleaner cotton has been shown to have a lower sugar content and lower stickiness ratings (as determined by the minicard) than corresponding uncleaned cotton (Perkins, 1993); but in tests done last year, a tangential study indicated that aggressive processing tended to increase stickiness (as determined by the Thermodetector [TD]; Chun, 1997). To resolve these conflicting observations, mildly sticky and heavily sticky cottons were subjected to increasing number of passages through a microdust and trash monitor (MTM) to simulate increasing levels of cleaning (Sasser et al., 1986; Shofner, et al., 1983). Since cleaning requires aggressive mechanical processing which results in adverse effects on the fiber, Peyer L25 measurements (by weight) were also included in the study. Stickiness was determined by the sugar content, the number of Thermodetector spots, and minicard rating (Brushwood & Perkins, 1993).

Methods and Materials

Cottons

Two levels of sticky cottons were used in this study: a mildly sticky Pima cotton and a heavily sticky cotton. The ‘mildly’ sticky cotton used was Arizona Pima from experimental plots from the 1995 harvest year (Chun, 1997). The cotton was provided as seed cotton by Dr. Don L. Hendrix (Western Cotton Research Laboratory, USDA, ARS, PWA, 4135 E. Broadway Rd, Phoenix, Arizona 85040). Shortly after arrival at the USDA, ARS, Cotton Quality Research Station (CQRS), Clemson, SC, the cotton was ginned with a 7 blade (6-in. dia.) saw gin. The ginned cotton was then homogenized. The first homogenization step involved passing the cotton through an open line blender (Syncromatic Blending System, Fibers Control Corporation, P.O. Box 1358, Gastonia, NC) three times. At the third and final passage through the blender, the entire cotton lot was passed through a pin beater (Model No. HV10024, Fibers Control Corporation) and underwent a final blending and collection on the apron of a Trützschler Axi-flo (type No, 052-25-02, Trützschler Gmbll and Co., KG, Textilmachinenfabrik, Mönchengladbach 3, Fed. Rep. Germany). The homogenized cotton was then stored in the original 55 gallon shipping barrel until used.

The heavily sticky cotton was provided by Dr. Richard Frydrych (CIRAD, CA, Laboratoire de Technologie cotonniere, BP5035, 34032 Montpellier Cedex, and France). The cotton arrived September 1997 at CQRS in two bags marked as ‘Heavy’ and ‘Very Heavy’. The heavily sticky cotton was made from the ‘Very Heavy’ and ‘Heavy’ cottons in a 2:1 ratio. The combined heavily sticky cotton mix was homogenized by passing the cotton through the open line blender 4 times.

Heavy Mechanical Processing

Heavy mechanical processing was simulated by increasing number of successive passages through a microdust and trash monitor (MTM). The MTM aggressively processes cotton with pin and perforated rollers to separate fibers from large and small trash material (Sasser, et al., 1986; Shofner, et al., 1983). Treatments of no passage through the MTM and 1, 2, 3, 4, 5, 6, or 7 passages through the MTM were randomly assigned to 64 20-gm samples of mildly sticky cotton and to 64 20-gm samples of heavily sticky cotton — 8 replicates per treatment for the mildly and heavily sticky cottons. Total trash removed was determined as the percent of the original cotton weight minus the ‘clean cotton’ weight (after passage through the MTM). The zero passage (control) samples were arbitrarily assigned zero percent total trash. Peyer measurements were made by the CQRS Testing Laboratory as Peyer L25 by weight before reducing sugar content, thermal detector and minicard information were determined (Brushwood and Perkins, Jr., 1993).

Statistical Analysis

Data were analyzed using release 6.12 of SAS (SAS, Statistical Analysis System; SAS system for Windows version 4.0950; SAS Institute Inc., Cary, NC, USA.) for making mean comparisons. Otherwise data manipulation was done with Microsoft EXCEL for Windows 95 version 8.0 (Microsoft Corporation, USA).

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Results and Discussion

The total trash increased for both the mildly and heavily sticky cottons with each additional pass through the MTM which suggested that with each pass the cottons became progressively cleaner (Tables 1 & 2). Unfortunately and as expected, the effective staple length became shorter with each successive additional pass through the MTM. After just the first passage through the MTM, the decrease in effective staple length was significantly shorter than the untreated cottons for both sticky cottons. Further significant decreases were observed essentially with each additional passage through the MTM. Reducing sugar content and minicard rating, while showing a trend toward decreasing levels with additional passes through the MTM, did not decrease significantly for the two sticky cottons despite the large increase of cumulative trash with cumulative passages through the MTM. In this study, the cleaner cottons did not have significantly lower sugar content and minicard ratings than the less cleaned cottons in contrast to what has been reported by Perkins (1993). This observation is not as clear cut as we would like since these opposing conclusions may be explained by differences in the localization of stickiness in cotton. In the work done by Perkins (1993), more sticky regions may have been on the cotton debris whereas the results shown here suggest that the sticky regions were concentrated on the fiber itself. This suggests the extent of reduction is dependent upon the amount of trash in the cotton and the content of stickiness localized on the debris.

The number of Thermodetector spots increased significantly with increased mechanical processing (Tables 1 & 2) for both sticky cottons. This is in keeping with the results first reported by Chun (1997), where a single passage of mildly sticky cotton showed a trend of increased stickiness (as indicated by TD). Here we have confirmed that mechanical processing increased the number of TD spots. The increased number of TD spots were significantly higher than control cottons and since actual stickiness (as indicated by minicard rating) and percent sugar did not change, the results lend strong support to the hypothesis that processing tends to break up large areas of localized stickiness into smaller areas of localized stickiness. This hypothesis could be further investigated by modifying the new high-speed stickiness detectors (Frydrych et al., 1995; Frydrych et al., 1994) to include spot area information. Although we have shown increased number of TD spots with increased mechanical processing, we were unable to confirm that this increase is related to increased stickiness (Tables 1 & 2). While the Thermodetector has found favor for measuring stickiness of raw cotton (Frydrych et al., 1994; Perkins & Brushwood, 1994), the Thermodetector is further removed than the minicard from actual mill carding, we can only conclude that the Thermodetector may not be the best instrument for measuring stickiness on cotton which has been processed. The Thermodetector is currently by far the best alternative to the more reliable minicard (Brushwood and Perkins, 1993; Perkins & Brushwood, 1994; Frydrych et al., 1994) and so stickiness measurements are bound to be made on processed cotton; but we caution careful interpretation of the results.

Summary

Sticky cottons were subjected to increased mechanical processing through sequential passages through a microdust and trash monitor. The cumulative amount of trash removed increased with each passage, but this did not reduce the sugar content or reduce the minicard stickiness rating suggesting concentration of sticky spots on the fiber rather than on plant debris which may explain earlier findings that cleaning may reduce stickiness. However, the number of Thermodetector spots increased significantly with passage through the microdust and trash monitor. Since sugar content and stickiness (as indicated by a minicard) did not vary significantly, the increased number of Thermodetector spots suggest that the larger sticky spots were broken into more numerous smaller spots when cotton is processed. These results suggest that although the Thermodetector is reliable for raw cottons, caution should be used in interpreting Thermodetector stickiness for processed cottons.

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Disclaimer

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Table 1. Light to moderately sticky cotton processed through the microdust and trash monitor — percent total trash, Peyer and stickiness results.

MTM Runs	Trash, %[1,3]	Peyer, in[2,3]	Sugar, %[3]	TD Spots[3]	Minicard[3]
0	0.00^{F}	1.38^{A}	0.49^{A}	3.0^{B}	1.8^{A}
1	4.06^{E}	1.33^{B}	0.44^{AB}	10.3^{A}	1.8^{A}
2	4.61^{DE}	1.27^{C}	0.44^{AB}	6.3^{AB}	1.8^{A}
3	5.20^{CD}	1.22^{D}	0.45^{AB}	10.6^{A}	1.5^{A}
4	5.57^{BC}	1.21^{D}	0.46^{AB}	9.0^{A}	1.6^{A}
5	6.21^{AB}	1.18^{E}	0.44^{AB}	7.1^{AB}	1.6^{A}
6	6.40^{AB}	1.12^{F}	0.41^{B}	6.8^{AB}	1.4^{A}
7	7.01^{A}	1.11^{F}	0.42^{B}	11.0^{A}	1.6^{A}

[1]Total Trash is the percent of the original cotton weight from the clean cotton weight after processing through the MTM; for the zero controls, total trash is set to 0% trash.
[2]Peyer L25 by mass.
[3]Mean separation within columns by Duncan's multiple range test, 5% level. Means with the same letter are not significantly different.

Table 2. Heavily sticky cotton processed through the microdust and trash monitor — percent total trash, Peyer and stickiness results.

MTM Runs	Trash, %[1,3]	Peyer, in[2,3]	Sugar, %[3]	TD Spots[3]	Minicard[3]
0	0.00^{E}	1.09^{A}	0.33^{A}	54.4^{D}	2.8^{A}
1	2.16^{D}	1.03^{B}	0.31^{AB}	87.3^{A}	2.4^{AB}
2	2.84^{C}	1.01^{C}	0.32^{AB}	79.8^{AB}	2.3^{AB}
3	3.19^{BC}	0.98^{D}	0.31^{AB}	79.3^{AB}	2.5^{AB}
4	3.49^{B}	0.97^{D}	0.32^{AB}	64.6^{BCD}	2.6^{A}
5	3.97^{A}	0.94^{E}	0.32^{AB}	81.0^{A}	1.9^{B}
6	4.07^{A}	0.94^{EF}	0.29^{B}	75.9^{ABC}	2.6^{A}
7	4.31^{A}	0.92^{F}	0.30^{B}	61.9^{DC}	2.1^{AB}

[1]Total Trash is the percent of the original cotton weight from the clean cotton weight after processing through the MTM; for the zero controls, total trash is set to 0% trash.
[2]Peyer L25 by mass.
[3]Mean separation within columns by Duncan's multiple range test, 5% level. Means with the same letter are not significantly different.