PREDICTION OF STICKINESS OF SELECTED COTTON SAMPLES

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Abstract

A new device to rapidly estimate the stickiness of both seed cotton and lint cotton was patented in 1997. This study further evaluated the new device using 500 reference samples that were evaluated with a standard thermodetector as well as an automated thermodetector (H2SD) at other laboratories. Measurement of the stickiness of cotton is typically accomplished with the thermodetector method which is time-consuming, somewhat objective, and destructive. In this study, samples were classified into level of stickiness from 0 to 3 based on the thermodetector as the reference method. The thermodetectors differed from each other as to level of stickiness about 80% of the time and misclassified the samples as to sticky or non-sticky 22% of the time. The new device correctly identified 76% of the samples as either sticky or non-sticky when compared to either thermodetector.

Introduction

Cotton stickiness interferes with the operation of textile processes such as carding and spinning, and as such, becomes an extreme detriment to successful processing of cotton. Stickiness is usually caused by the presence of natural (physiological) sugars and/or contamination from insects. The most commonly used methods for measuring cotton stickiness are the thermodetector and the minicard (Brushwood and Perkins, 1993). Each test requires a well trained operator, is sample destructive, time consuming and objective. A newer, more automated and less objective version of the thermodetector (H2SD) is currently under evaluation at Cotton Incorporated. The thermodetector classifies samples into four levels: non-sticky or 0 with 0 to 4 sticky points; slightly sticky or 1 with 5 to 14 sticky points; moderately sticky or 2 with 15 to 24 sticky points; and extremely sticky or 3 with more than 25 sticky points. The minicard, which is also destructive and objective, is also used to classify samples into degrees of stickiness. In a similar fashion the minicard card ratings for those same levels are reported as 0, 1, 2, and 3. The H2SD uses the following sticky points for similar classifications into five levels of stickiness usually called levels: A, B, C, D, E classified according to sticky points 0-2, 3-8, 9-17, 18-27 and 28 or more, respectively. For simplicity, levels A, B, C, D, and E were called 0, 1, 2, 3, and 4, respectively, for this study.

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A new method, the Stoneville Stickiness Tester (SST), is a direct contact and nondestructive method using near infrared spectroscopy and electrical resistance to independently measure moisture and predict stickiness (Anthony et al., 1997). This device has proven quite successful in previous studies using samples provided by several cooperators. In general, the instrument is 75% - 80% accurate (Anthony, 1999; Anthony et al., 1995; and Anthony et al., 1994).

The purpose of this research was to establish the ability of the SST to predict the stickiness of reference cottons measured by other laboratories using either the standard thermodetector method or the H2SD.

Methodology

Ten samples from each of fifty bales of cotton provided by the International Textile Center were evaluated at the Stoneville laboratory using two models of the SST. Minicard and standard thermodetector stickiness of the samples were determined at the Cotton Quality Research Station, Clemson, SC; the H2SD evaluation was provided by Cotton Incorporated, Raleigh, NC.

The SST measurements for each of the 500 samples provided by the International Textile Research Center were evaluated in three replications in random order. Four readings were taken on each sample by rotating the sample from side to side and top to bottom. Reference measurements for stickiness based on thermodetector technology were provided by the cooperators. Two versions of the automated SST--the Arizona SST and the Mississippi SST--were evaluated. The testers are named because of their initial test locations. The laboratory reference measurements were compared with the automated measurements with the SST using the SAS discriminate analysis procedure.

Results and Discussions

Comparison of the classifications based upon the reference instruments referred to as H2SD, TD and MINICARD indicate that the samples were classified differently in many instances by the various reference instruments. For the two thermodetector methods, 22% of the samples were classed either sticky or not sticky differently by each of the techniques. The remaining samples were rarely classified at the same level of stickiness by all three instruments; in fact, one or more devices were inconsistent 80% of the time. The majority of these inconsistencies occurred at stickiness levels 1 and 2 whereas level 3 was almost the same with some fluctuation between levels 2 and 3 between devices. The minicard called all of the samples sticky with stickiness levels ranging from 1(low) to 4(high). The minicard results were not consistent with other classification results at the 0 stickiness level. As a result of the inconsistency of the various reference techniques in terms of establishing both the sticky or non-sticky category and the degree of stickiness, only the ability of the SST to classify the samples into sticky or non-sticky categories was considered.

For the Arizona SST and TD classifications in Table 1, nine of the non-sticky samples were placed into the sticky category--this essentially represented all of the non-sticky samples; four sticky samples were called non-sticky. Thus, 13 or 26% of the samples were incorrectly classified. For the H2SD reference device, 2 of the non-sticky samples were called sticky and 6 of the sticky samples were called non-sticky for a total of 8 samples out of 48 incorrectly identified or 17%. The Arizona SST misclassified 26% of the samples based on the thermodetector method. For the MINICARD reference device, all of the samples were classified as sticky by the minicard and as sticky by the discriminate analysis of the data with the Arizona meter, thus little inference can be drawn.

For the Mississippi SST, the results were similar. For the TD reference device, 7 of the non-sticky samples were called sticky and 6 of the sticky samples were called non-sticky for a misclassification rate of 13 or 26% (Table 2). For the H2SD reference device, 5 of the sticky samples were called non-sticky and 2 of the non-sticky samples were called sticky for a total misclassification of about 15%. On average, the Mississippi SST misclassified 24% of the samples based on the thermodetector method. Again for the MINICARD since all of the samples were classified as sticky by both the minicard and the Mississippi meter, the misclassification rate was 0.

Synopsis of the frequency of stickiness levels by each thermodetector device and the Stoneville Stickiness Testers is shown in Table 3. The SST devices misclassified about 25% of the samples as to sticky and non-sticky categories. The SST technology requires that the device be trained with samples that represent the population that is potentially available for assessment.

Conclusions

The Stoneville Stickiness Tester can predict stickiness without destruction of the sample with about 75% accuracy. Based on these data, a significant problem exists with the inconsistency between various classification methods even within the thermodetector method when comparing the same samples. It is believed that some improvement in the estimation technology with the Mississippi and Arizona meters can be done by changing the frequency or wavelength of the filters. More consistent results need to be obtained between the various thermodetector reference devices before significant improvements can be made in correlations.

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Table 1. Comparison of the frequency of stickiness levels by the reference methods and the Stoneville Stickiness Tester - Arizona.

	Frequency of stickiness level, %				
Device	**0**	**1**	**2**	**3**	**4**
TD	18	22	14	46	-
SST-AZ	6	16	18	28	-
H2SD	10	16	12	24	38
SST-AZ	16	20	42	8	18
MINICARD	0	8	14	24	50
SST-AZ	0	16	20	36	28

Table 2. Comparison of the frequency of stickiness levels by the reference methods and the Stoneville Stickiness Tester - Mississippi.

	Frequency of stickiness level*				
Device	**0**	**1**	**2**	**3**	**4**
TD	18	22	14	46	-
SST-MS	16	26	22	36	-
H2SD	10	16	12	24	38
SST-MS	14	24	12	24	24
MINICARD	0	8	14	24	50
SST-MS	0	12	18	30	40

Table 3. Synopsis of Stoneville Stickiness Tester (SST) prediction of stickiness measured by three thermodetectors. Note that the three thermodetector devices called non-sticky samples sticky differently over 20% of the time. The devices differed as to level of stickiness 80% of the time.

Misclassification type	Samples, %, misclassified by: Arizona meter, Thermodetector method: TD	Arizona meter, Thermodetector method: H2SD	Mississippi meter, Thermodetector method: TD	Mississippi meter, Thermodetector method: H2SD
SST sticky or non-sticky	22	16	24	14
SST level of stickiness	38	48	32	48
SST called sticky samples not sticky	8	10	8	10