MAKING STICKY COTTON FOR LABORATORY STUDIES

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Introduction

Sticky cotton is a serious economic concern in the Cotton Industry when it occurs (Elliott, 2002). As the name implies, the cotton is sticky. The condition of sticky cotton arises from high levels of natural plant sugars or from insect honeydew (Perkins, 1971, 1993). Stickiness from naturally occurring plant sugars result in the stickiness being more uniformly distributed on the cotton and the stickiness problem usually not considered too serious. This kind of sticky cotton problem is observed as accumulation of lint and residue buildup, causing an acceleration of the cleaning schedule of the rolls and machine parts. But when insect honeydew falls on the leaves and bolls during the growing season, the fiber can be contaminated during harvest. This leaves the cotton with spotted areas of sticky residue which can additionally become discolored due to sooty mold. The non-uniform distribution of stickiness can cause acute problems in the gin and mills; and in cases of heavy stickiness, can cause production interruption and require immediate correction (Brushwood & Perkins, 1993; Perkins, 1993). As a consequence, sticky cotton is considered lower quality cotton and the grower is penalized when the cotton is discounted. For this reason, field and laboratory investigation of sticky cotton problems have been ongoing.

A major difficulty in studying sticky cotton in the laboratory is acquiring sticky cotton. Happenstance will often dictate that the year a study on sticky cotton is to proceed is the year that growers do not experience a sticky cotton problem. Even when sticky cotton can be obtained, there is the additional problem not only in regard to the quantity of sticky cotton material but in the acquiring of sufficient quantity of material with specific stickiness. At one time we could request sticky cotton from a colleague who grew cotton exposed to whiteflies under greenhouse conditions. But the most common approach is to collect sticky cottons from many sources over a long period of time (Barton et al., 2005; Chun, 2002). Then these samples must be tested and sorted to the criteria of the study. The approach reported here is to create sticky cottons of different levels of stickiness on demand.

Materials and Methods

Measurement of Stickiness

There are many ways to measure stickiness: pH spray indicator test, Benedict test, USDA potassium ferricyanide test, thermodetector, rotor ring test, the minicard test and others (Barton et al., 2005; Brushwood and Perkins, 1993; Hector & Hodkinson, 1989). Of these, the minicard test was chosen because of its widespread acceptance (Barton et al., 2005; Brushwood & Perkins, 1993; Chun, 2002; Frydrych et al., 1994; Hequet & Frydrych, 1992; Perkins & Brushwood, 1994; Watson, 1994). A detailed description of the minicard test process and minicard stickiness rating has been described (Barton et al., 2005; Brushwood & Perkins, 1993). In the minicard test, four minicard ratings are used: 0, no stickiness; 1, light stickiness; 2, moderate stickiness; and 3, heavy stickiness. These four index ratings are limited and since a skilled operator can subjectively grade levels of stickiness between these four broad categories, an in house rating system was adopted. For example, if a cotton was judged to be a light stickiness cotton a rating of '1' was used; but if the cotton was just not sticking or wrapping around the delivery rolls or leaving sufficient sticky residue specks on the delivery rolls enough to be rated as moderately sticky, '2', the operator may rate that cotton as a '1+', or a '1++', or even a '1+++'. For this study, a minicard index (MCI) was used which is based on the main rating number plus 0.33 for each subjectively assigned '+' given by the operator. For instance a '2++' or a '2+' rating would be given MCI values of 2.66 and 2.33, respectively. For each sample, the average of 2 or 3 minicard readings from the sample was used as the MCI value of that sample.

Sticky Cotton Samples

The approach was simply to blend a non-sticky batch of cotton with a highly sticky batch of cotton, so that cotton samples of increasing levels of stickiness were created by this blending of different ratios of a non-sticky lot with a heavily sticky lot of cotton. Both the non-sticky and sticky cottons were pima cotton. Two bales of cotton both of which measured beyond a 3-minicard rating were purchased by the Cotton Quality Research Station, Clemson, South Carolina, as part of its ongoing cotton stickiness studies in May, 2003. This cotton is from the 2001 harvest year from California. These bales were sought for their high degree of stickiness. Of the two bales purchased, the cotton bale numbered 6634111 was used throughout this study as the source of heavily sticky cotton. For the non-sticky cotton, initially non-sticky cotton from a previous study was used, which has been fully described (Chun & Brushwood, 1998). However as the study progressed, this cotton source became depleted and a new source of non-sticky cotton was found. For the remainder of the study, a non-sticky cotton bale, bale number 4477372, purchased in May, 2005 and believed to be from the 2004 harvest year from the San Joaquin Valley, was used. When blended with the sticky cotton, the results appeared to be the same as the non-sticky cotton previously used.

Through trial and error, mixtures of sticky and non-sticky cotton were blended to create a stepped series of 7 sticky cotton sample lots (Table 1). At the start, the specific mix of sticky to non-sticky cottons was by trial and error. But once a successful recipe, ratio of sticky to non-sticky cotton, for the particular cottons used has been made, as done here, approximate levels of the same stickiness can be reproduced as needed. The sticky and non-sticky cottons were blended by running each 50-gm sample twice through a Shirley Analyzer (Shirley Institute, Manchester, England). Each 50-gm sample was then kept in a 22.9 cm x 30.5 cm ziplock 0.05-mm thick clear plastic bag (BCU Plastics & Packaging, San Marcos, CA) until used. A 50-gm sample size was used for convenience; but other sample sizes can be created using the same ratio of sticky to non-sticky cottons.

Statistical Analysis

Data were analyzed with release 8.00 of SAS (SAS, Statistical Analysis System; SAS system for Windows NT, SAS Institute Inc., Cary, NC, USA) for Duncan mean comparisons when the analysis of variance analysis yielded significant ‘F-values’ to indicate a high degree of difference of the variable to the variation. Microsoft® Office Excel 2003 (Microsoft Corporation, USA) was used to randomize treatment assignments, to enter and store data, to sort data and prepare for SAS analysis, to transform data, to summarize and tabulate results, to obtain simple treatment statistics (means, standard deviations, regressions, t-test comparison, etc.), and to perform other spreadsheet functions.

Results and Discussion

As shown in Table 1, this approach and use of a minicard index can successfully provide cottons of at least 7 levels of stickiness, which are significantly different from one another. At the start, the specific mix of sticky to non-sticky cottons was by trial and error. But once a successful recipe for the particular cottons used has been made, as done here, approximate levels of the same stickiness can be made as needed in the 50-gm sample size. The 50-gm sample size was used for current conveniences; but there is no reason that these ratios could not be used to create larger or smaller sample sizes. What is telling about the sticky cotton used as the source to make the less sticky cotton lots (Table 1), is that it is more than just ‘heavily sticky,’ minicard rating of ‘3’. It was extremely heavily sticky cotton. When it was mixed 1 gram to 49 grams of non-sticky cotton, the minicard rating was still a ‘1’ which is considered lightly sticky cotton; but a value above a ‘1’ would already be considered too difficult to blend at a spinning plant’s ‘opening line’ to allow for maximum spinning efficiency (Barton et al., 2005). But this approach to creating repeatable levels of sticky cottons can be adjusted for sources of sticky cotton less sticky than the one used here. This approach to creating different levels of sticky cotton can also be fine-tuned and expanded to create extended levels between the minicard ratings of 0, 1, 2 and 3, for other types of studies.

Table 1. Composition of the lots of sticky cotton blended from non-sticky and sticky cotton.

Lot	Content	Average MCI[ZYX]
1	0.0 gm MCI 3 + 50.0 MCI 0	0.00[G]
2	1.0 gm MCI 3 + 49.0 MCI 0	1.00[F]
3	4.0 gm MCI 3 + 46.0 MCI 0	2.44[E]
4	8.0 gm MCI 3 + 42.0 MCI 0	3.15[D]
5	16.0 gm MCI 3 + 34.0 MCI 0	3.48[C]
6	25.0 gm MCI 3 + 25.0 MCI 0	3.66[B]
7	50.0 gm MCI 3 + 0.0 MCI 0	3.99[A]

[Z]The minicard index is averaged from 3 tests, where each sample lot in the test was assayed 3 times. [Y]The minicard index is based on the minicard rating plus .33 for each subjective '+' assigned; for example, 3+++ will be valued at 3.99 and 2+ will be valued at 2.33. [X]Mean separation within column by Duncan's multiple range test, 5% level. Means with the same letter are not significantly different.

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