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**Les polluants du coton :
cas du collage et des débris de coque**

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Carded Spinning of Sticky Cotton

Part I: Stickiness Effects on Productivity

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ABSTRACT

Ever since cotton stickiness first appeared, spinners have been reporting the disturbances it causes in the spinning process. Despite this, few quantitative studies have evaluated the detrimental effects caused by stickiness. This initial section, Part I, presents the results of an experimental study to evaluate the effects of stickiness on efficiency and breakage in industrial-scale spinning. The relationships between cotton stickiness, breakage, and efficiency are discussed for the card, drawing frame, roving frame, ring spinning frame, and rotor spinning frame. Different methods are used to measure stickiness and select that which most accurately predicts stickiness-induced effects: sugar content determined by HPLC (high performance liquid chromatography), number of sticky points determined by an SCT thermodetector, and number and size of sticky points measured by H2SD (high speed stickiness detector). The roving frame is the most sensitive to stickiness and the H2SD appears to be the most accurate predictor of stickiness-induced effects during spinning.

Cottons are rendered sticky by sugars derived primarily from entomological and physiological sources [2, 6]. Entomological sugars take the form of honeydew produced by insects living on the cotton plant, mainly the aphid *Aphis gossypii* and the white fly *Bemisia tabaci*. Physiological sugars are natural cotton sugars produced as residues after the synthesis of cellulose.

Papers about cotton stickiness [1, 2, 3, 4, 5, 6] clearly describe how machine parts in contact with the fibers are fouled by the stickiness and underline the increased breaks during spinning. Substantial productivity losses have been reported. Although numerous reports have been published, these cannot be used for a quantitative approach to the stickiness phenomenon. Which kind of stickiness measurement is the most suitable for predicting fiber behavior during spinning? What is the exact relationship between breaks, efficiency, and stickiness? These questions, and many others required to address the stickiness problem, have yet to be answered with precision. It is therefore difficult to accurately evaluate the economic effects of stickiness on the spinning industry [1], and consequently, it is impossible to determine in a rational manner the discount that should be applied to sticky cottons [4].

To address these questions and gain a more precise understanding of the effects of stickiness on spinning, we have conducted a quantitative study of a broad range of sticky cottons. The bales of cotton are spun into yarn on an industrial production line. Different qualitative and quantitative parameters are recorded throughout the processing from bale opening to yarn in order to monitor product quality and machine productivity. Part I considers process productivity; the quality aspects of production are described in Part II.

Materials and Methods

This study of the effects of stickiness on carded spinning involved twenty-six bales of cotton (*Gossypium hirsutum*). Two nonsticky bales included in the study originated from Central Asia. The remaining twenty-four were various varieties of Acala cottons produced in Sudan in 1996–1997. Ten of them were roller ginned and fourteen were saw ginned. These cottons were selected to cover a broad stickiness range, from nonsticky to very sticky, but with the most homogeneous length, fineness, maturity, and strength characteristics possible. These characteristics were evaluated in ten samples taken from each raw bale for analysis by HVI (high volume instru-

ment), FMT3 (fineness maturity tester), SCT thermodetector, and H2SD (high speed stickiness detector).

Once each of the twenty-six bales was characterized, the cotton was processed by industrial-scale carded spinning. The spinning facility was composed of two rooms with independent conditioning: a preparation room and a spinning room. The cotton fibers were processed successively by the following machines: bale breaker (Laroche), opéner-cleaner (RN Trützschler), opener-mixer (RSK Trützschler), card (DK 715 Trützschler), drawing frame (D1/1 Rieter), roving frame (F1/1a Rieter), ring spinning frame (CF-6 SACM), rotor spinning frame (SE-9 Schlaflhorst), and a winder.

CONDITIONS AND OPERATING PROCEDURE

The order in which the bales were processed was randomized to avoid any bias in the interpretation of the results. Before actually starting the processing, the bale was homogenized by recycling between the RN opener and the Laroche breaker. This reduced the natural variability within each bale and thus improved the precision of the relationships between stickiness and spinning incidents. Once the homogenization was complete, the bale entered production at a temperature of $25 \pm 2^\circ\text{C}$ and a relative humidity of $47.5 \pm 2.5\%$. These hygrometric conditions corresponded to those generally recommended for preparation. The card was set to a delivery speed of 120 m/min to produce a 5 ktex sliver. At the first drafting pass, the doubling was set at 6, sliver count at 4 ktex, and delivery speed at 400 m/min. For the second drafting pass, only the doubling was modified, to 8. The 24 spindles on the roving frame were set at 900 rpm to produce 0.5 ktex roving. The sliver and roving were then transferred to the spinning room, where atmospheric conditions consisted of a temperature of $25 \pm 2^\circ\text{C}$ and a relative humidity of $57.5 \pm 2.5\%$. The ring spinning frame, with 100 spindles spinning at 8000 rpm, and the rotor spinning frame with 24 rotors spinning at 90000 rpm, were set to produce 20 tex yarn with a twist of 800 turns per meter.

During the spinning of each bale, the number of breaks, fiber wraps, and stops for cleaning were recorded for each machine. These incidents were then listed with respect to the part of the machine where they occurred and their cause. Thus, three principal incidents were recorded for the card: breakage of the web, breakage of the sliver at the condenser, and breakage of the sliver at the can coiler. Breaks were noted on the drawing frame at the feed creel, the roller drafting, and the sliver condenser. Breaks on the roving frame were noted at the feed creel, the roller drafting, and the flyer. Only two kinds of breaks could be monitored on the ring spinning

frame: those of the roving and those of the yarn. By contrast, several different incidents were possible on the rotor spinning frame. The number of yarn piecings and the efficiency at each step of the process could be determined thanks to on-line management of the production. In addition to these automated recordings, the number of times the technician intervened in the process was also recorded for the four main structures in the process, *i.e.*, the feed cylinder, the taker-in, the rotor, and the yarn navel.

The results were used to calculate the breakage incidence and efficiency of the different machines. Breakage incidence was expressed by unit length of the roving, sliver, or yarn to avoid any effects caused by machine stops. Thus, when considering the card, total breaks corresponded to the number of breaks per 100 km of sliver. This number is therefore equivalent to the hourly breakage rate in a card room with fourteen machines. The breaks on the drawing frame were also expressed for 100 km of sliver, *i.e.*, equivalent to the hourly breakage rate of two machines working at 800 m/min. The breakage rate of the roving frame was calculated for 100 km of roving, equivalent to the hourly breakage rate for 100 spindles (*i.e.*, approximately two roving frames with forty-eight spindles each). Breaks were expressed per 1000 spindle hours for the ring spinning frame and per 240 rotor hours for the rotor spinning frame. These productivity parameters were then compared with stickiness results, determined using three different methods: The SCT thermodetector measuring the number of sticky points (SCT); H2SD measuring the number of sticky points (H2SD), their total size (Size-H2SD), and their size category (*Small*, *Medium*, and *Large*); and HPLC measuring the content of the different sugars: inositol (I), trehalose (T), glucose (G), fructose (F), trehalulose (W), melezitose (M), and sucrose (S).

Samples of cotton fibers, sliver, roving, yarn, and waste were taken to evaluate the effects of stickiness on the quality of these products. Thus, ten fiber samples were taken at regular intervals from the breaker, RN opener, RSK opener, and card. These samples were analyzed on the SCT and H2SD thermodetectors to evaluate stickiness at the different steps of the process. In addition, RSK samples were analyzed by HPLC. Samples of sliver and roving were used to evaluate regularity at the card, drawing frame, and roving frame. Yarn quality was evaluated in samples taken from the yarn bobbins and packages. This section focuses on the effects of stickiness on productivity. The effects of stickiness on product quality are described in Part II.

Results and Discussion

Of the twenty-six bales selected for this spinning study, only twenty-four could be spun. Processing of the

other two was impossible because of card clogging. Both of these bales were very sticky. One had been roller ginned and showed forty-two sticky points (H2SD measurement). The other had been saw ginned and showed fifty-eight sticky points. We were nevertheless able to spin another bale of similar stickiness, but with great difficulty and extremely low efficiency. Fifty H2SD sticky points would appear to be the threshold above which the stickiness immediately blocks the process when the opening operation is conducted at a relative humidity of 45 to 50%.

No particular stickiness effects occurred during the opening of the other twenty-four bales, *i.e.*, we encountered no problems from the bale breaker to the card feeder. Inspection of the magnetic baffles, condenser, and most parts of the machines in contact with the fibers did not reveal any fouling that required machine stops. We nevertheless noted traces of stickiness regularly on the breaker needles and in the waste produced by all the machines, so it is very likely that certain very sticky cottons would have clogged this section of the line if production had continued for several days. Detecting clogging of the piping, condensers, and magnetic baffles would therefore require a specific study with larger quantities of starting materials.

The machines further downstream in the spinning process were all adversely affected by cotton stickiness. From the card to the spinning frames, the entire production line reacted to stickiness, suffering decreased efficiency and increased breakage.

SCT measurements were closely related to H2SD (Figure 1). When adjusted to a log-linear model, all H2SD measurements were proportional to each other, except after carding. The H2SD count probability distribution is known as a negative binomial [7] with variance $v = m + m^2/k$, where m is the mean and k is a shape parameter related to cotton homogeneity. The H2SD mean and dispersion index $1/k$ decreased downstream from raw cotton to carded cotton (Table I). We retained the H2SD measurements at the RSK opener stage for subsequent analysis, since they were less dispersed and still proportional to those for raw cotton.

CARD

Card performance was closely related to cotton stickiness. The stickiness measurements showed a negative correlation with card efficiency, and all the correlations were approximately the same order of magnitude. Here, Figure 2 shows that the closest correlations were obtained with the number of H2SD sticky points—physical measurement—and with the trehalulose levels (W)—chemical measurement. Figure 3 shows the fitting of a

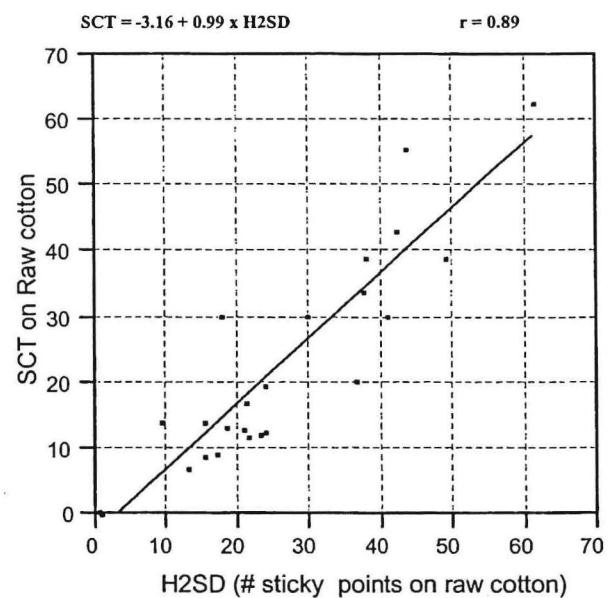


FIGURE 1. SCT number of sticky spots versus H2SD (measurement on raw cotton).

TABLE I. H2SD measurement means and overdispersion index of the negative binomial distribution, as estimated by maximum likelihood: 24 bales, 10 replicates per bale.

Stage	Mean	Overdispersion index $1/k$
Raw cotton	25.9	0.104
Breaker	21.5	0.072
RN opener	23.6	0.037
RSK opener	19.5	0.040
Card	15.1	0.000

regression line where efficiency is plotted versus the number of H2SD sticky points. The 94% efficiency in the absence of any stickiness decreases in a linear manner by 6.5% for 10 H2SD sticky points (Equation 1):

$$\text{Card-EFF.\%} = 93.7 - 0.653 \text{ H2SD} \quad (1)$$

As far as breakage is concerned, we could detect no correlation between the total number per 100 km of sliver and the sugar levels determined by HPLC. Therefore, only the H2SD results could be used for this parameter (Figure 4). The number of breaks increased linearly with stickiness (Equation 2) but, as we already saw for efficiency, the results showed considerable dispersion around the regression line:

$$\text{Card breaks} = 6.94 + 0.602 \text{ H2SD} \quad (2)$$

DRAWING FRAME

The performance of the drawing frame in both drafting passes correlated closely with cotton stickiness. The

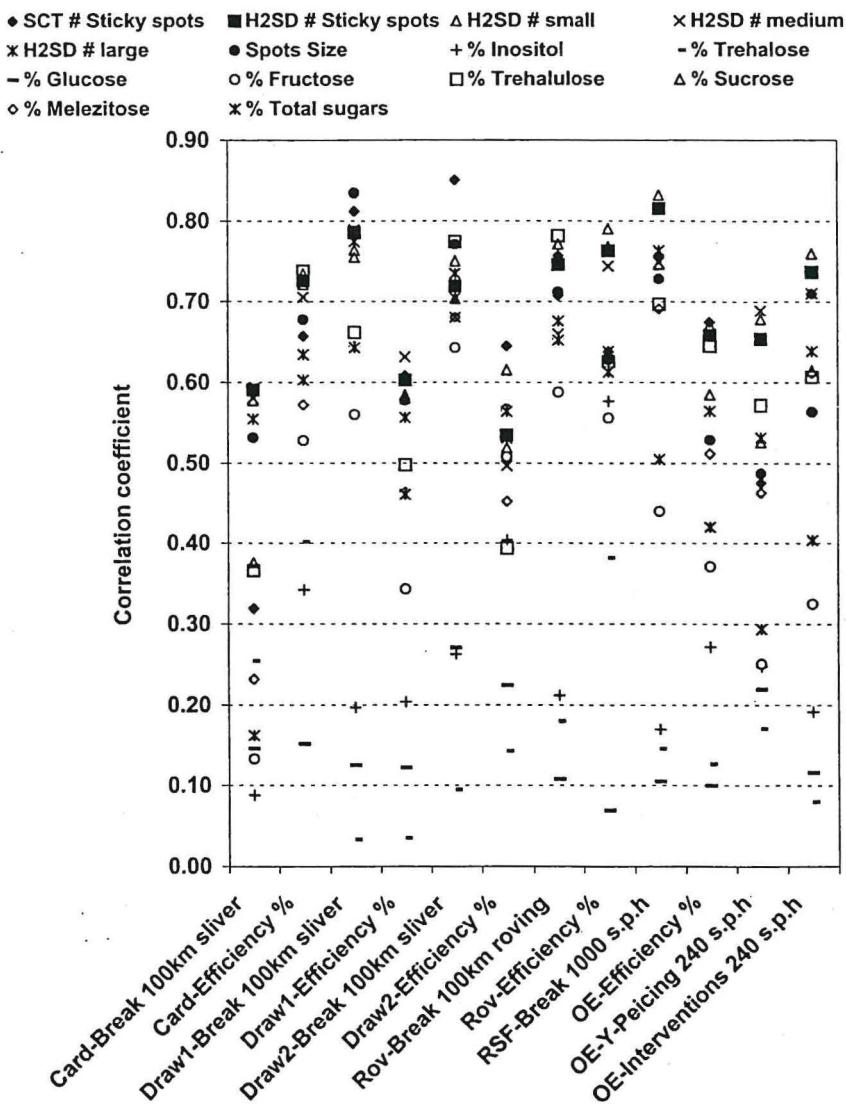


FIGURE 2. Correlations between productivity parameters of spinning and stickiness measurements.

breakage rate, expressed for 100 km of sliver, increased with cotton stickiness. The correlation was closer for the number of H2SD sticky points than for trehalulose and melezitose levels. Figure 5 shows breaks during the first drafting pass plotted versus the number of H2SD sticky points (Equation 3). We obtained similar results during the second drafting pass:

$$\text{Drawing breaks} = 0.68 + 0.02675 (\text{H2SD})^2 \quad . \quad (3)$$

As far as efficiency is concerned, although we obtained a significant negative correlation with the number of H2SD sticky points and the trehalulose level, the correlation was not as clear as for breaks. Figure 6 shows the efficiency noted during the second drafting pass as a

function of H2SD count. Dispersion of the values is excessively high for any prediction of efficiency based on stickiness. Thus, Equation 4 should be considered simply as a general trend:

$$\text{Drawing-EFF. \%} = 79.7 - 0.875 \text{ H2SD} \quad . \quad (4)$$

This dispersion may be explained by the relatively short drawing time used for each test. Here, at 400 m/min, processing of each test sliver lasted from 1.5 hours for the slightly sticky cottons to 2.5 hours for the stickiest cottons. The effect of machine stoppage is therefore excessive under such conditions and induces considerable variability into the efficiency results.

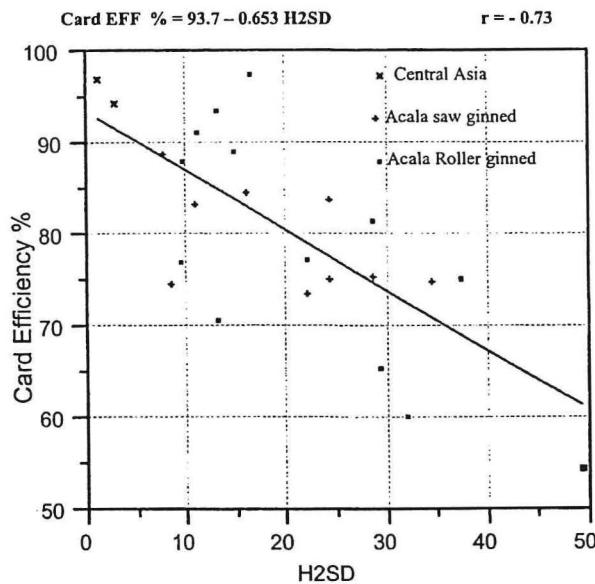


FIGURE 3. Card efficiency versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

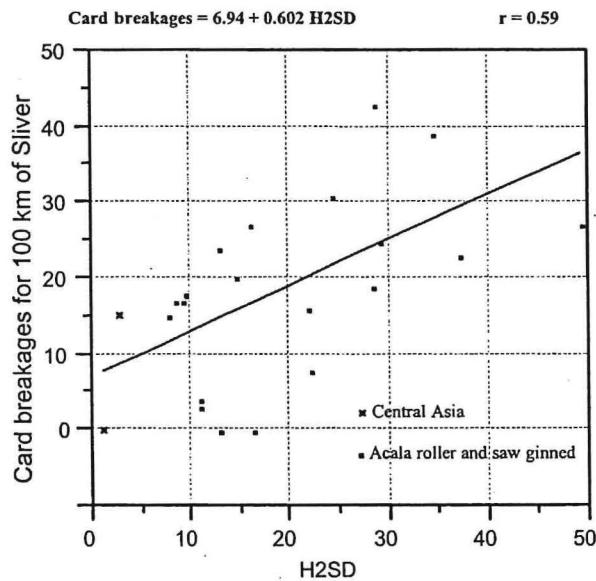


FIGURE 4. Number of breaks for 100 km card sliver versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

ROVING FRAME

The roving frame is extremely sensitive to stickiness. In the course of the tests, the fibers rose upwards because of small beads of sugar clearly visible on the drafting rollers and the aprons. This phenomenon occurred even with cottons that were only very slightly sticky. The number of breaks was closely correlated to stickiness. We noted significant correlations with the number of

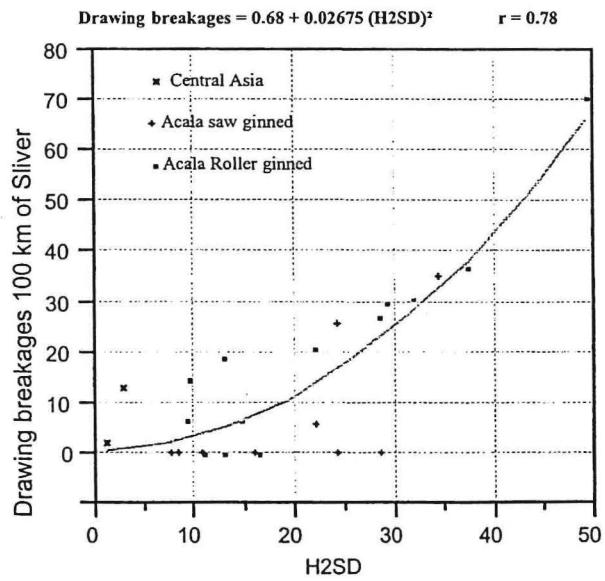


FIGURE 5. Drawing frame: breaks for 100 km sliver (first drawing) versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

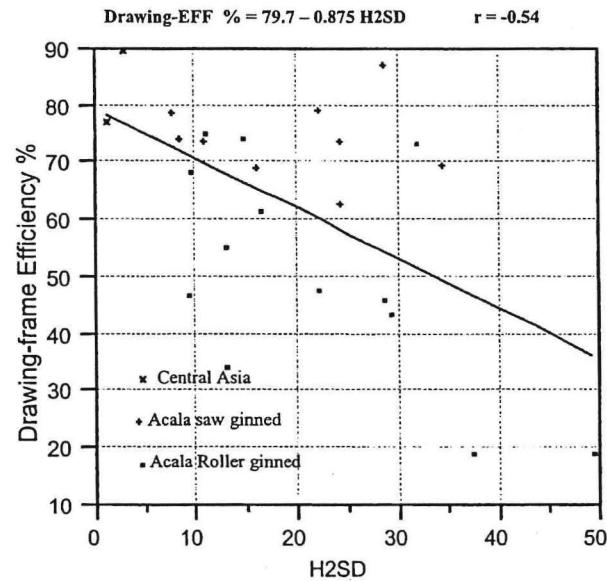


FIGURE 6. Drawing frame: efficiency (2nd drawing) versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

H2SD and SCT sticky points, and with the trehalulose and melezitose levels. The closest correlation ($r = 0.79$) was obtained with a quadratic model (Equation 5) linking the number of H2SD sticky points to total breaks in 100 km of roving (Figure 7):

$$\text{Breaks } 100 \text{ km roving} = 1.57 + 0.0195 (H2SD)^2 \quad (5)$$

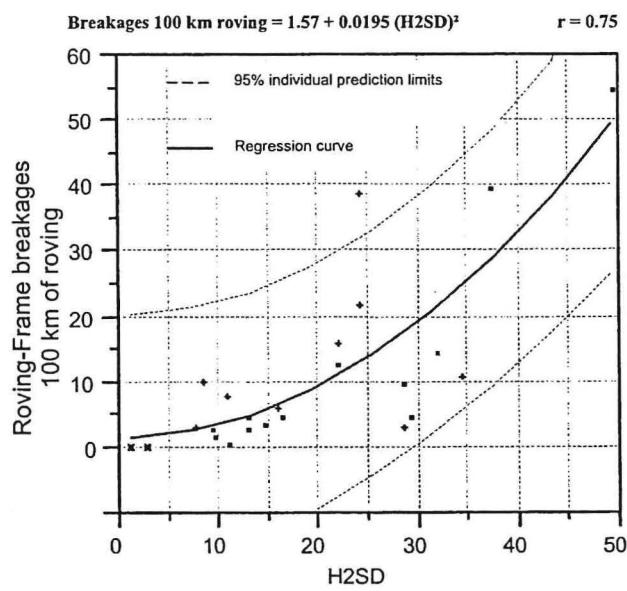


FIGURE 7. Roving frame: breaks on 100 km roving versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

Efficiency also correlated well with the number of sticky points and with the trehalulose and sucrose levels. Figure 8 shows a substantial decline in efficiency correlated with the number of H2SD sticky points. The H2SD number of sticky points is the most reliable marker of roving frame efficiency ($r = 0.76$). The equation of the best regression we found is

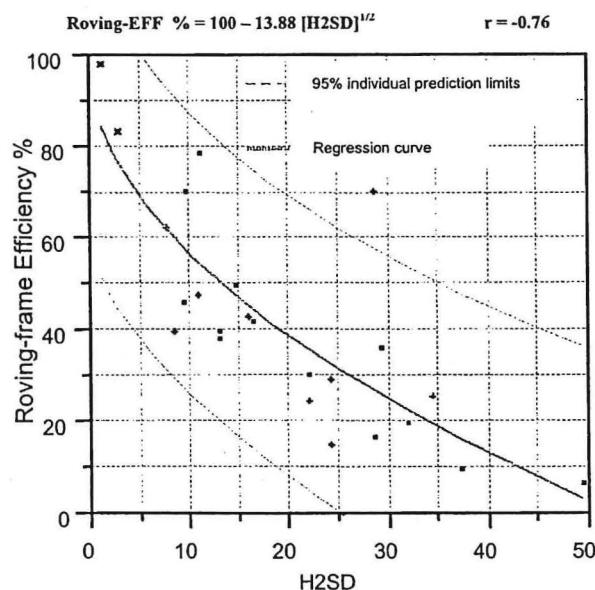


FIGURE 8. Roving frame: efficiency versus H2SD number of sticky spots: 45 to 50% relative humidity and 25°C.

$$\text{Roving EFF. \%} = 100 - 13.88 (H2SD)^{1/2} \quad .$$

(6)

RING SPINNING FRAME

The breakage incidence per hour for 1000 spindle positions showed a good correlation with stickiness. The number of H2SD sticky points gave the closest correlation, with an r value of 0.82. Although the sugar levels determined by HPLC showed a good correlation with breakage rate, this correlation was lower than that provided by the number of sticky points. Here, the trehalulose and melezitose levels gave an r value of only 0.68. Figure 9 plots the number of breaks for 1000 spindle positions per hour (sph) versus the H2SD number of sticky points. The y -intercept at the origin is not significantly different from 0 (Equation 7):

$$\text{Breaks } 1000 \text{ sph} = -29.7 + 11.38 H2SD \quad .$$

(7)

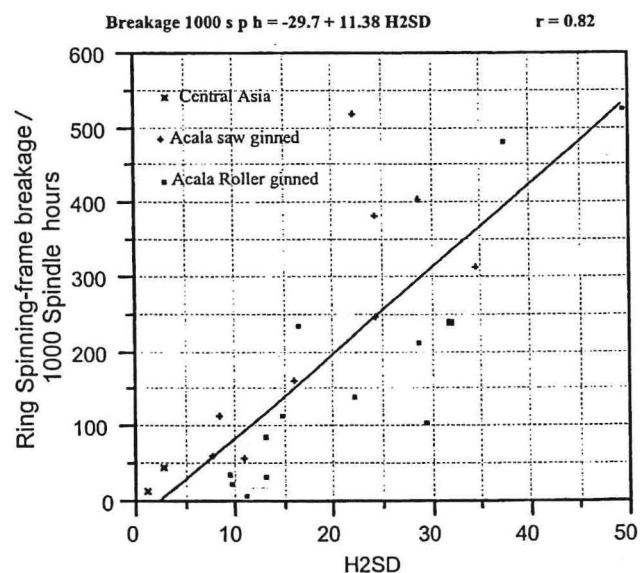


FIGURE 9. Ring spinning frame: breakage on 1000 spindles/hour versus H2SD number of sticky spots: 55 to 60% relative humidity and 25°C.

OPEN-END ROTOR SPINNING FRAME

The efficiency of the rotor spinning frame decreased as stickiness increased. We obtained the closest correlations with the H2SD and SCT sticky point counts rather than with the sugar levels determined by HPLC. Here, the correlation coefficients were approximately 0.67 for H2SD, whereas they did not exceed 0.64 for the best sugar

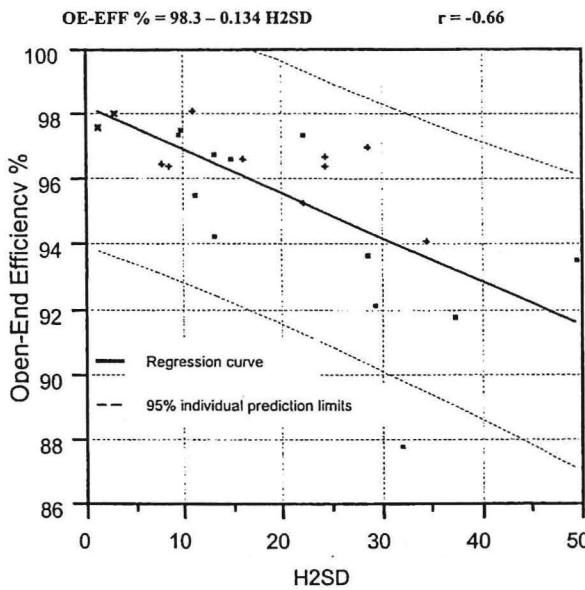


FIGURE 10. Rotor spinning frame: efficiency versus H2SD number of sticky spots: 55 to 60% relative humidity and 25°C.

marker (trehalulose). Efficiency for a nonsticky cotton was about 98%, but this fell to 90% for stickiness exceeding 30 H2SD points. Efficiency can be far lower if clogging occurs, as illustrated by the cotton in Figure 10 outside the cluster of points. The values predicted by the number of H2SD points again showed a moderate dispersion (Equation 8):

$$OE\ EFF.\ \% = 98.3 - 0.134\ H2SD \quad (8)$$

We monitored the number of yarn piecings in addition to machine efficiency. Figure 11 reveals that the number of piecings per hour for 240 spinning positions increased with the number of H2SD points, showing a significant correlation between these two variables with $r = 0.74$ (Equation 9):

$$(OE\ Y-P\ 240\ sph)^{1/2} = 5.19 + 1.429\ (H2SD)^{1/2} \quad (9)$$

After making three attempts to re-attach the yarn, the machine abandons the process and alerts the operator that intervention is necessary at the stopped spinning position. The number of interventions by the technician per hour is thus a reliable indicator of rotor spinning productivity. These interventions generally consist of cleaning the feed table and the breaker or the rotor to remove sticky deposits. The results of our tests showed that the hourly intervention rate due to clogging for 240 positions depends on the stickiness of the cotton. Whereas the number of interventions was very low for nonsticky cottons, interventions exceeded the threshold

of three/hour when spinning cottons with more than 20 H2SD sticky points.

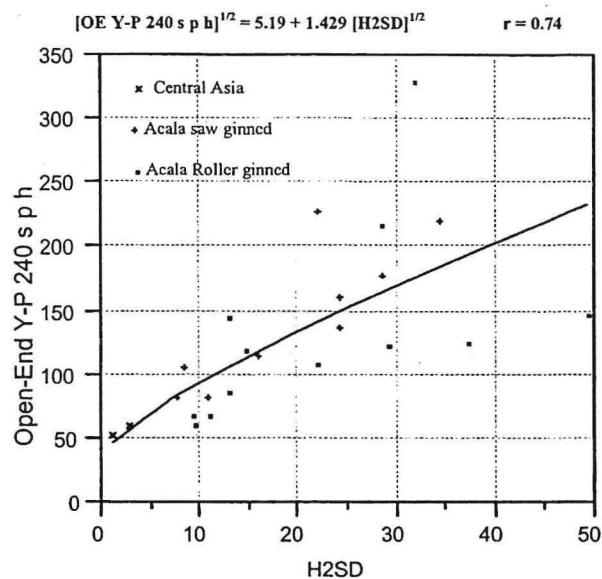


FIGURE 11. Open-end yarn piecing for 240 spinning positions per hour versus H2SD number of sticky spots: 55 to 60% relative humidity and 25°C.

The models we used in this study to predict productivity parameters were based on the results of stickiness measurements. In an effort to improve these models, we added different variables to the H2SD count, but all these attempts were inconclusive. When we added variables about the size of the sticky points, this did not improve the models, and neither did the addition of sugar levels determined by HPLC, even when the tests were based on different combinations, e.g., the sum of the trehalulose and melizitose entomological sugars. All the models tested showed that only a single variable was significant. This effect is due to the close correlation between the H2SD and SCT sticky point counts and certain sugars, notably trehalulose and melezitose.

Our results showed that the number of sticky points measured by the H2SD is more closely correlated to spinning productivity parameters than the SCT and HPLC results. The H2SD count provides the best prediction of breakage rate and spinning machine efficiency. However, dispersion of the results may occasionally be too great for practical predictions. This is because the confidence intervals around the values determined from the regression curve of the H2SD sticky points are relatively broad for certain machines. The prediction method cannot differentiate between two cottons showing fairly similar stickiness potentials. It is therefore difficult to

predict different efficiencies or breakage rates for cottons whose stickiness potentials are similar to within two or three sticky points. Nonetheless, if the precision of the results is taken into account, certain limits can be set for stickiness with respect to the acceptable number of breaks and the efficiency desired during spinning. In our tests, and under the relative humidity conditions we used, the stickiness limits for a highly automated production unit would appear to be fairly low, particularly for ring spinning, since the roving frame is highly sensitive to stickiness.

Conclusions

The performance of spinning machines depends on the stickiness of the starting cotton material. In our study, machine performance decreased when sticky cottons were processed under the hygrometric conditions generally recommended, *i.e.*, 45 to 50% RH during opening and carding and 55 to 60% RH during spinning. We quantified the effects of stickiness on machine productivity, and the results of our regressions showed that the number of sticky points determined by H2SD is a more reliable predictor of stickiness effects than the SCT count or the sugar content measured by HPLC. Here, although the SCT count correlates with productivity parameters, the correlation coefficients obtained with H2SD are even better. As far as sugar contents are concerned, not all correlated with breakage incidence and machine efficiency. In fact, only trehalulose and melezitose could be correlated with these two parameters, but not for all the machines, and here, when we detected a correlation, it was generally no better than that obtained with the H2SD sticky points count.

The blocking threshold for spinning sticky cottons under the relative humidity conditions described here is about 50 H2SD sticky points. The spinning process is blocked at the card when the count exceeds this value. In addition, stickiness affects the machines and seriously reduces productivity well below this blocking limit. The roving frame is the most sensitive to stickiness.

Relative humidity appears to be of prime importance. The very sticky bales (50 H2SD sticky points) that initially required machine stoppage were subsequently processed

successfully at 40% relative humidity. However, the breakage rate even under these conditions was prohibitively high and machine efficiency was very low. A study to evaluate the effects of stickiness at different relative humidities is ongoing and will be the subject of a future paper.

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Qualitative Classification of Cotton Stickiness in the H2SD High Speed Stickiness Detector

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ABSTRACT

Regularly confronted with the problem of cotton stickiness during spinning, those in the international market wish to see the implementation of a cotton bale classification system to describe the degree to which a given cotton is contaminated. Thermo-detection equipment such as the H2SD high speed stickiness detector may be suitable for such a task. With a working capacity equivalent to that of HVI lines, this instrument evaluates the stickiness of cottons contaminated by insect honeydew. This paper discusses the feasibility of a qualitative classification based on within-bale distribution of the number of sticky points. A detailed example obtained with the H2SD illustrates the qualitative classification procedure. Sticky bales can be separated from uncontaminated bales for the latter to be marketed with a guaranteed stickiness level below a set threshold and a litigation risk selected in advance.

Cotton stickiness caused by insect honeydew manifests during industrial processing as deposits of sticky substances on textile machines. Spinning is particularly sensitive to this phenomenon, as fouling of the card rollers causes the fibers to rise upwards, occasionally leading to considerable wraps that can rupture the web. The problem can also spread to the roving frame, spinning frame, and rotor machines [5, 9, 10]. Other sectors of the cotton processing industry are also affected because consequent yarn breakages in the weaving result in lower yields and poorer quality finished products.

As far as the cotton market is concerned, those cottons reputed to be highly contaminated can only be sold at a discount [6]. For a producing country, the losses incurred by this problem can be considerable [8] since, in the absence of an official classification system, the entire production reputed to be contaminated may have to be discounted, whereas in fact it only contains a small fraction of truly contaminated cotton. The establishment of a cotton stickiness classification system would allow discounts to be attributed in a more rational manner. To do this, a high-capacity measurement device is required together with established methodology to sample and measure bale stickiness.

The H2SD high speed stickiness detector [4] provides a quantitative measurement of the potential stickiness of a cotton by electronically counting the number of sticky points revealed by thermo-detection, i.e., heat and pressure exerted on the cotton. Two possibilities are envisaged for a bale stickiness classification: quantitative classification, i.e., each bale is allocated a guaranteed level of stickiness; and qualitative classification, where the bales are divided into two categories (sticky or nonsticky) with reference to a fixed limit called the critical stickiness threshold.

At present, the quantitative classification is unjustified because it greatly increases the number of lots to be constituted after analysis of the different characteristics of the bale. This classification method is also costly in comparison with its expected benefits. In addition, the spinner's primary concern is to know whether or not the bale is likely to cause problems during processing. Research is currently ongoing to determine the limit beyond which sticky cottons are no longer suitable for spinning, i.e., the number of sticky points below which the cotton may be spun without difficulty.

In the study reported here, we evaluate the feasibility and inherent risks of classifying cotton bales (using the

H2SD) into sticky or nonsticky cottons, or at least whether the contamination is sufficiently slight for the spinning process to be unaffected. Our analysis is based on a sampling study where we have determined the within-bale distribution of the number of sticky points. We then deduce a method for calculating the litigation risk of such a qualitative classification.

Materials and Method

When considering a qualitative classification, a bale may be declared sticky if the mean M of r measurements is greater than the previously established critical stickiness threshold t_s . If this bale is submitted to a valuation with the same number of measurements r and the same critical threshold, it will be declared nonsticky if the mean M' is lower at the same t_s value. In brief, if A is the "nonsticky bale classification" event, B is the "nonsticky bale valuation" event, and \bar{A} and \bar{B} are the opposite events, *i.e.*, "sticky bale classification" and "sticky bale valuation," the probabilities for the classification and valuation are

$$P(A) = P(M \leq t_s) \quad P(\bar{A}) = 1 - P(A) \quad , \quad (1)$$

$$P(B) = P(M' \leq t_s) \quad P(\bar{B}) = 1 - P(B) \quad . \quad (2)$$

Litigation arises when event \bar{B} succeeds event A , *i.e.*, when a bale classified as nonsticky is appraised as being sticky. The litigation risk is the product of the probabilities of these two events. Here, if $F(x)$ is the distribution function of M , this risk (LR) is

$$LR(m) = P(A) P(\bar{B}) \quad , \quad (3)$$

or in terms of the distribution function,

$$LR(m) = F(t_s)(1 - F(t_s)) \quad . \quad (4)$$

This litigation risk therefore depends on the distribution of the stickiness within the bale, and particularly on the mean stickiness of this bale.

To evaluate this distribution, 100 bales (50 roller ginned and 50 saw ginned) were selected from Sudanese production. During the ginning process, 16 levels were sampled from each bale. Note that the bales were selected with the intention of obtaining a large range of stickiness and do not in any way represent the general stickiness level of cotton produced in Sudan. After conditioning at 65% relative humidity and 21°C, the samples were tested on the high speed stickiness detector (H2SD). In brief, using a rotor opener, a specimen of 3 to 3.5 g of cotton is transformed into a 12 × 16 cm web and placed on a belt-conveyed aluminum sheet. Pressure is applied by a hot plate (53°C), then by a cold plate at room temperature. This process first melts the honeydew drop-

lets, then sticks some cotton fibers with the solidifying droplets to the aluminum sheet. The free fibers are then removed by a cleaner, and the adherent sticky points are counted and their size is evaluated by an image analyzer.

Results and Discussion

The number of sticky points is a discrete random variable obtained by counting each point that occupies a small surface area on the aluminum foil. If we hypothesize that the sticky points in a given bale of cotton show a perfectly random distribution and are of homogeneous density, the number of points per sample, according to the punctual processes theory [1, 11], should follow a Poisson distribution. If this is not the case, the probability distribution is overdispersed with respect to the Poisson distribution. A one-sided χ^2 test can be used to select between these two hypotheses for, if Poisson distribution is respected, the ratio between the sum of squares of deviates (SSD) and the mean of n measurements follows asymptotically a χ^2 distribution with $n - 1$ degrees of freedom [2, 3]. When considering p bales and n_j measurements per bale, Equation 5 gives the expression of the χ^2 observed χ_{obs}^2 with $\sum_{j=1}^p (n_j - 1)$ degrees of freedom:

$$\chi_{obs}^2 = \sum_{j=1}^p \left(\frac{SDD_j}{x_j} \right)^2 \quad . \quad (5)$$

If the probability of exceeding this χ_{obs}^2 is greater than the type I error selected, the sticky point counts can be assigned a Poisson distribution. If this is not the case, the ratio of the χ^2 to its number of degrees of freedom gives an estimate of the overdispersion with respect to the Poisson distribution.

Each of the 100 bales provided 16 samples for measurement. As a few samples were missing, χ^2 calculated from Equation 5 gave 7213 for 1492 degrees of freedom. Its probability of exceeding the χ^2 was less than 0.01%. We therefore rejected the hypothesis of a Poisson within-bale distribution. The overdispersion index, corresponding to the ratio between the variance and the mean, was approximately 4.84.

We fitted this distribution to a statistical distribution using the mean variance relationship. The variance appeared to be a quadratic function of the mean with respect to the regression between the logarithm of the variance and that of the mean (Figure 1). Such a relation corresponds to a negative binomial distribution, which describes a large variety of processes [7].

The negative binomial distribution possesses two parameters: the mean m and the shape parameter k . Its probability mass function may be expressed as

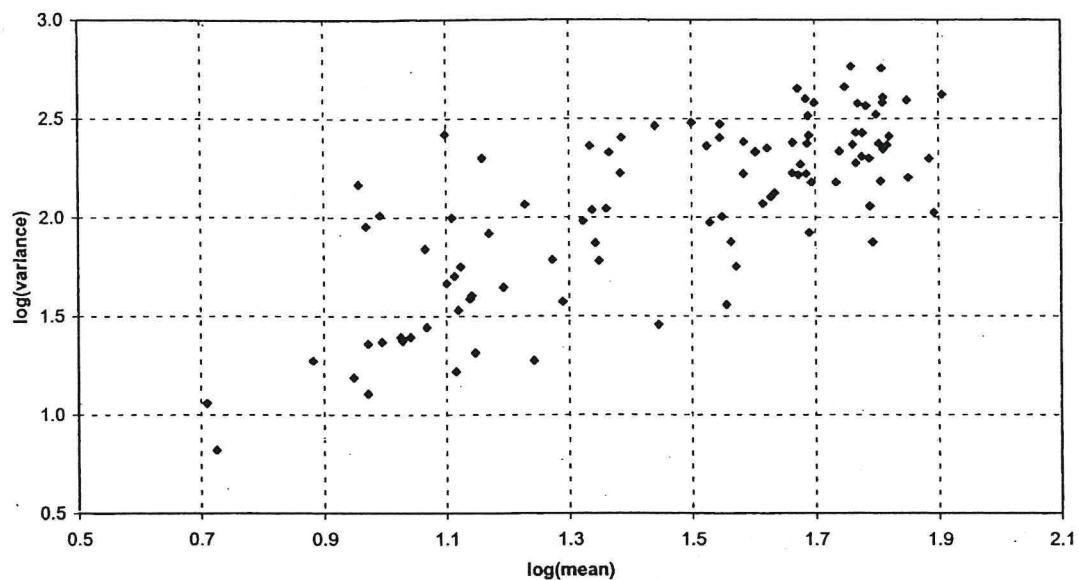


FIGURE 1. Mean-variance relationship.

$$P(X = x) = \frac{\Gamma(k + x)m^x k^k}{\Gamma(x + 1)\Gamma(k)(m + k)^{(k+x)}} , \quad (6)$$

with gamma (Γ) the generalized integral defined as

$$\Gamma(k) = \int_0^\infty x^{k-1} \exp(-x) dx . \quad (7)$$

Its expectation is

$$E(X) = m , \quad (8)$$

and its variance is

$$V(X) = m + \frac{m^2}{k} . \quad (9)$$

ESTIMATING PARAMETERS m AND k IN THE NEGATIVE BINOMIAL DISTRIBUTION

The arithmetic mean x_j is a good estimation of parameter m_j . By contrast, the k shape parameter can be estimated in several ways, with the maximum likelihood method being the most precise. This method consists of evaluating the maximum of function L :

$$L = \prod_{j=1}^n \prod_{l=1}^{n_j} \frac{\Gamma(k + x_{jl})(x_{jl})^{x_{jl}kk}}{\Gamma(x_{jl} + 1)\Gamma(k)(x_{jl} + k)^{(k+x_{jl})}} .$$

$$(10) \quad P(A) = P(M \leq t_s) = P(X \leq rt_s)$$

In practice, estimating $1/k$ is preferred because $1/k$ is less biased than k and gives more symmetrical confidence intervals.

We used a χ^2 test based on the maximum likelihood ratios to verify the homogeneity of the k coefficients within a group of p bales. Here, if L is the maximum likelihood obtained when considering that all the bales have the same coefficient k , and L_j is that obtained with a k for each bale taken individually, then the quantity $-2(\log L - \sum \log L_j)$ follows a χ^2 with $p - 1$ degrees of freedom. The probability of exceeding χ^2 is greater than the type I error selected, and we may therefore state that the k coefficients are homogeneous. The results of the analysis by SAS software converge toward a homogeneous value of $k = 9.43$.

BALE CLASSIFICATION AND LITIGATION RISK FOLLOWING VALUATION

The classification system is intended to provide a cotton bale certified as having a lower stickiness potential than the limit tolerated by the spinner, while also controlling the litigation risk. It is therefore essential to determine the relationship between the litigation risk, the critical stickiness threshold, and the number of measurements per bale.

The litigation risk for a given bale, defined above, is quantified using Equation 4. Expressing the mean from total X of r measurements gives

$$P(B) = P(M' \leq t_s) = P(X \leq rt_s) \quad . \quad (11)$$

where total X follows a negative binomial distribution of parameters rm and rk , since the counts are independent [7]. This gives

$$\begin{aligned} LR(m) &= P(A) - P(A)^2 \\ &= F(rt_s)[1 - F(rt_s)] \quad . \quad (12) \end{aligned}$$

The litigation risk LR described in this way depends on the mean m , the number of measurements r , and the critical stickiness threshold t_s . For a given threshold t_s and a given number of measurements r , this risk varies with the mean m and shows a maximum as demonstrated in the example illustrated in Figure 2. We further investigated this maximum because it corresponds to the maximum litigation risk for each bale considered individually. The litigation risk LR depends primarily on the t_s threshold imposed by the cotton purchaser. Its maximum with respect to m is the same as with respect to $P(A)$, since this probability is a strictly decreasing function of m . The derivative of LR with respect to $P(A)$ gives

$$\frac{\partial LR(m)}{\partial P(A)} = -2P(A) \quad , \quad (13)$$

and therefore a maximum LR_{\max} of 0.25 for means close to the critical threshold. This risk is excessively high for the classification because the costs involved in terms of

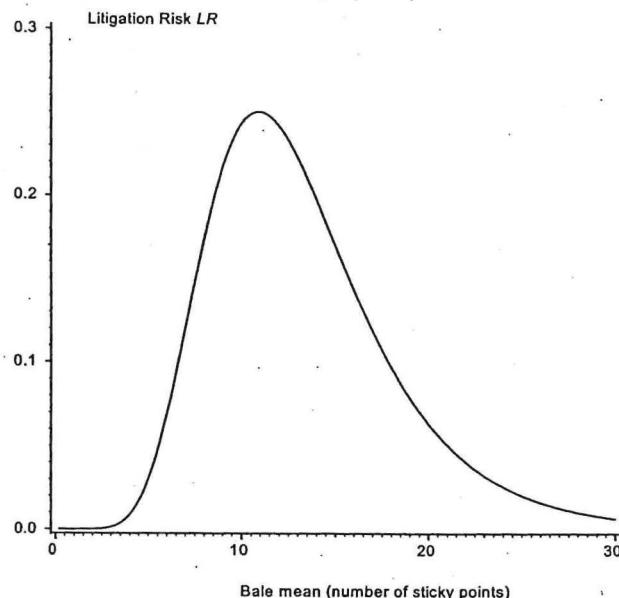


FIGURE 2. Litigation risk on bale classification as a function of bale mean. Classification threshold = valuation threshold = 11 sticky points, 1 measurement per bale. Negative binomial distribution $k = 14$.

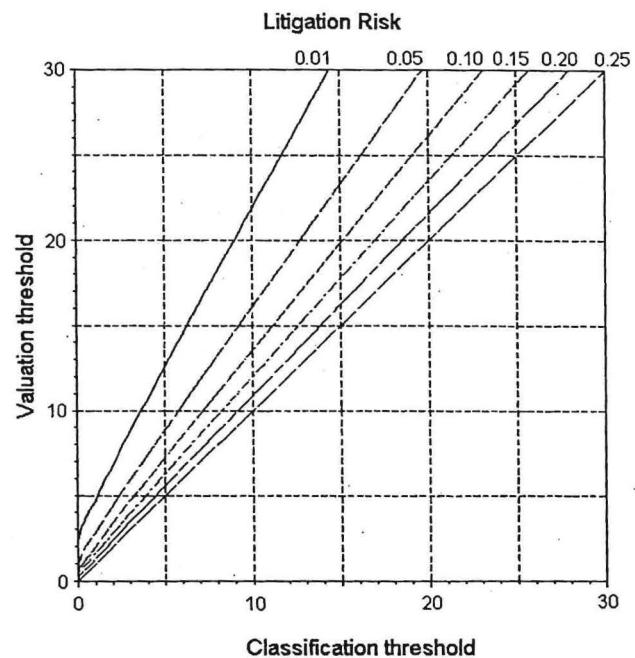


FIGURE 3. Maximum litigation risk on bale classification as a function of classification and valuation thresholds. Two measurements per bale. Negative binomial distribution $k = 9.43$.

product returned and purchaser complaints would be prohibitive. One method of decreasing the risk incurred by the producer is to set a classification threshold t_c that is lower than the critical threshold set by the purchaser (called the valuation limit l_v). Under these conditions, the expression for litigation risk $LR(m) = P(A)[1 - P(B)]$ becomes

$$\begin{aligned} LR(m) &= \sum_{x=0}^{r_c} \frac{\Gamma(rk + x)(rm)^x(rk)^{rk}}{\Gamma(x + 1)\Gamma(rk)(rm + rk)^{rk+x}} \left[1 \right. \\ &\quad \left. - \sum_{x=0}^{rl_v} \frac{\Gamma(rk + x)(rm)^x(rk)^{rk}}{\Gamma(x + 1)\Gamma(rk)(rm + rk)^{rk+x}} \right] \quad (14) \end{aligned}$$

We used Equation 14 to establish graphs to determine the classification threshold as a function of the valuation limit for a given number of measurements and for different maximum litigation risks. Figure 3 illustrates the results obtained for the 100 cotton bales tested on the basis of two measurements per bale. For example, if stickiness is to be guaranteed at less than 20 sticky points after two measurements of the bale, the producer must set the classification limit at 9 sticky points for a maximum litigation risk of 1%. If the risk is set higher, e.g., at 5%, the classification limit can be increased to 12.5

sticky points. Figure 4 presents the same information but with only one measurement per bale.

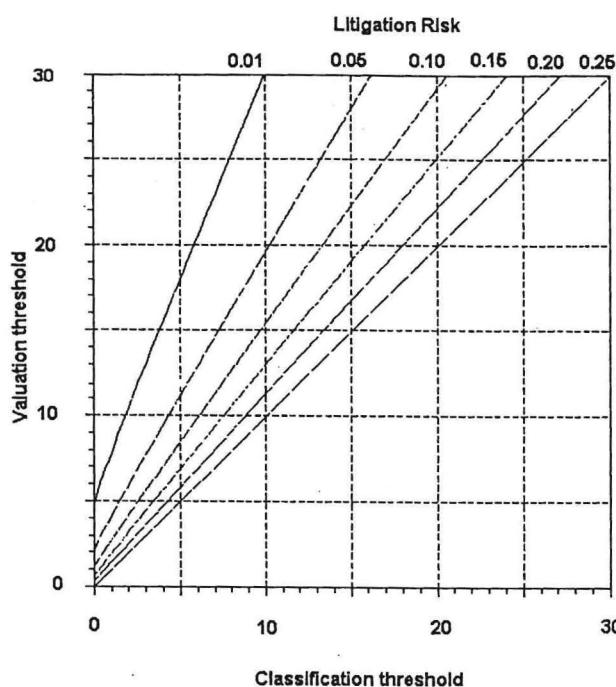


FIGURE 4. Maximum litigation risk on bale classification as a function of classification and valuation thresholds. One measurement per bale. Negative binomial distribution $k = 9.43$.

If, rather than considering the litigation risk for each bale, we consider the mean risk for the entire production, this mean is weighted by the probability density function $f(m)$ of the mean stickiness per bale. The global risk GR may therefore be calculated by

$$GR = \int_0^{\infty} LR(m) f(m) dm \quad (15)$$

This GR must be evaluated by studies specific to each country and its production methods. Such studies would require a sampling procedure statistically representative of the entire production.

Conclusions

Our results show that a qualitative classification of stickiness is feasible with the H2SD high speed stickiness detector. The producer, knowing the within-bale distribution of stickiness, can set a stickiness threshold

guaranteeing that this level is lower than that demanded by his clients. The effectiveness of this classification procedure directly depends on the within-bale distribution of the stickiness, and it is therefore crucial that this distribution should be evaluated locally because it may vary from one production area to another.

Several machines would be required to provide a classification of the entire production of a given country. The between-machine repeatability of the measurements would have to be evaluated to assess the precision of the results.

The stickiness threshold discussed in this paper may be insufficient to predict the behavior of sticky cottons during spinning, since studies to determine the spinability of sticky cottons have shown that the size of the sticky points is also of considerable importance in industrial-scale spinning. Our current studies are focusing on the combination of the number of sticky points and their size distribution as evaluated by the H2SD. These studies attempt to characterize the stickiness potential of cotton correlated with cotton behavior during spinning. The results of our ongoing studies will be the subject of subsequent papers.

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Détermination du potentiel de collage des cotons par thermodétection

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RÉSUMÉ

L'évaluation du potentiel de collage des cotons se montre, suivant les méthodes employées, difficile et de résultat incertain. Pour la première fois, une méthode thermique quantitative associant la chaleur apportée, l'humidité de l'échantillon et la pression

exercée sur celui-ci, permet de détecter l'importance des niveaux de collage des cotons, en comptabilisant le nombre de points collants sur un support spécial. Elle est en bonne corrélation avec le test carte de laboratoire.

MOTS CLÉS : coton collant, thermodétection, carte.

INTRODUCTION

De plus en plus fréquemment, les cotons provenant de certains pays provoquent des problèmes de collage en filature. Des points collants apparaissent au niveau des *cross rolls* de cardes, des cylindres cannelés et de pression des bancs d'étirage, et provoquent l'enroulement des fibres. En filature *open-end*, des dépôts collants sur les parois des turbines sont à l'origine des fils irréguliers et des casses.

De nombreuses recherches ont été entreprises, d'une part pour repérer les cotons collants, et d'autre part pour expli-

quer le phénomène de collage afin de tenter de le supprimer.

En ce qui concerne la détection, il existe déjà des tests plus ou moins fiables, rapides et précis (tests chimiques, colorimétrie, mécanique).

Une nouvelle méthode, appelée thermodétection, est présentée ici. Nous l'avons comparée au test mécanique de la carte de laboratoire, considéré et reconnu comme donnant des résultats voisins de ceux obtenus en usine de filature (bien que cela n'ait jamais été démontré très précisément).

MATÉRIEL ET MÉTHODES

La méthode par thermodétection nécessite la préparation d'un échantillon de 2,5 g de coton sous forme de nappe, à l'aide d'un *blender* manuel, avec comme dimension de carte 60 cm × 16 cm. Cette nappe est placée entre deux feuilles d'aluminium, puis l'ensemble est déposé sur le plateau inférieur d'une presse chauffante adaptée pour cette étude. On exerce par la plaque chauffante supérieure de la presse, thermostatée à 140 °C ± 5 °C, une pression pendant six secondes. Après avoir soulevé le couvercle, une nouvelle pression est réalisée sur l'échantillon à l'aide d'un plateau non chauffant, pendant au moins deux minutes. Ensuite, la préparation est mise au repos pendant une heure.

La détection s'effectue de la manière suivante : la feuille supérieure, soulevée délicatement par une extrémité, est enlevée complètement (il est possible de voir les points collants) puis mise de côté pour le comptage. La nappe de coton se retire de la même façon de la feuille inférieure et sert à balayer légèrement les feuilles inférieure et supérieure, de façon à éliminer les fibres, les masses de fibres et points collants, peu adhérents. Ne sont comptabilisés que les points gros, moyens, petits avec fibres qui sont restés bien attachés à chaque feuille.

Le classement s'obtient en reportant la somme des points collants relevés sur les feuilles supérieure et infé-

rieure dans la grille des niveaux de collage A, B, C, D, E, où :

- A = aucun collage,
- B = léger collage,
- C = moyen collage,
- D = fort collage,
- E = très fort collage.

Cette méthode présente l'avantage d'être quantitative ; une valeur numérique est attribuée à chaque échantillon. Toutefois, trois échantillons par coton à analyser doivent être testés pour fournir un résultat correct, soit 7,5 g de coton.

Conditions nécessaires pour la thermodétection du collage

Les essais ont été réalisés dans une atmosphère conditionnée, $55\% \pm 2\%$ d'humidité relative et $23^\circ\text{C} \pm 2^\circ\text{C}$ de température, identique à celle des tests effectués habituellement à la carte de laboratoire. Le coton à 55% HR contient une humidité d'environ 6,8%. Sous l'action de la chaleur de la presse, thermostatée à $140^\circ\text{C} \pm 5^\circ\text{C}$, l'humidité entre les bandes d'aluminium augmente et dépasse 75%. Par les effets conjugués de la chaleur et de la pression d'une part, de l'humidité libérée par l'échantillon d'autre part, les points collants se fixent sur les feuilles d'aluminium.

RÉSULTATS

Parmi 64 cotons de provenances diverses, nous avons testé 51 cotons (avec 3 répétitions soit 153 échantillons) par thermodétection et parallèlement à la minicarte. Une corrélation a été établie entre ces deux méthodes. Les 13 autres cotons ont servi à vérifier cette corrélation. La régression obtenue en comptabilisant les points du haut plus ceux du bas donne les résultats les plus intéressants (fig. 1). Elle est de la forme :

$$Y = 0,324 + 0,802 X$$

avec $X = \sqrt{\text{nombre total des points collants thermodétection}}$.

TABLEAU 1
Correspondance entre les résultats de la thermodétection et ceux obtenus avec la carte.
Correspondence between thermodetection and card results.

Niveau de collage	Définition	Méthode de détection	
		Carte estimation visuelle	Thermodétection points haut + bas
A	aucun collage	1 à 1,50	0 à 2,15
B	léger collage	1,51 à 3,50	2,16 à 15,69
C	moyen collage	3,51 à 4,50	15,71 à 27,11
D	fort collage	4,51 à 5,50	27,12 à 41,65
E	très fort collage	5,51 à 7	41,66 à

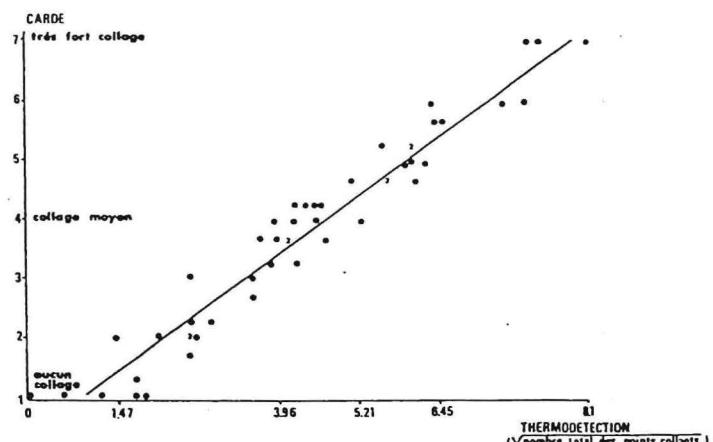


Figure 1
Projection croisée entre carte et thermodétection.
Cross projection between card and thermodetection.

CONCLUSION

Jusqu'à présent, l'évaluation du potentiel de collage des cotons s'effectue le plus couramment par voie chimique ou mécanique. Les méthodes chimiques (1, 2, 3) fournissent seulement une indication sur les possibilités de collage en filature des cotons testés, les résultats étant souvent divergents et contradictoires. La carte de laboratoire (6, 7) est encore la méthode reconnue comme la plus fiable pour identifier le comportement réel en filature des cotons ; toutefois, elle présente des limites d'utilisation (matériel important, onéreux, nécessitant de l'entretien et un conditionnement bien contrôlé, résultats qualitatifs).

La méthode par thermodétection que nous venons de décrire est en bonne corrélation avec la carte de labora-

toire. Elle pourra rendre accessible à un plus grand nombre d'utilisateurs l'évaluation du phénomène de collage. C'est pourquoi, les Directions Techniques I.R.C.T./C.I.R.A.D. financent la fabrication d'un prototype de presse chauffante avec ses annexes (*blender* manuel, boîte à conditionner pour 30 échantillons). Cette presse, référencée, I.R.C.T. — RF 13, est simple de conception, d'un faible coût, sans entretien. Pour le chercheur, elle constituera un outil de choix dans l'étude des phénomènes de collage.

Les Sociétés de Développement pourront être informées sur les cotons souillés. Les filateurs apprécieront le degré de souillure de la fibre avant son lancement en fabrication.

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Determination of the potential of cotton stickiness by thermodetection

R. Frydrych

SUMMARY

Estimating the potential of cotton stickiness is, depending on the methods used, difficult and unreliable. For the first time, a quantitative thermal method associating heat supply, sample humidity and pressure on the sample, makes it possible to detect the degree

of cotton stickiness, by counting the number of sticky spots on aluminium sheets. This method is well correlated with the laboratory card test.

KEY WORDS : sticky cotton, thermodetection, card.

INTRODUCTION

Cottons from certain countries increasingly cause disturbances due to stickiness in spinning mills. Sticky spots appear at card cross rolls, top and fluted rollers, causing fiber rolling ups. In open-end spinning mills, sticky spots on turbine walls originate ends down and uneven yarns.

Many researches have been undertaken to detect sticky cottons and explain the phenomenon in order to suppress it.

Various detection tests exist, which are more or less reliable, rapid and accurate (chemical, mechanical, colour measurements).

A new method, called thermodetection, is described here. We compared it with the laboratory card test, the results of which are considered and accepted as being close to those obtained in the mill (although this has never been precisely demonstrated).

MATERIALS AND METHODS

The thermodetection method requires the preparation of a sample of 2.5 g of cotton in the form of a web by means of a manual blender with a 60 cm × 16 cm card. This web is placed between two aluminium sheets and the whole is put on the bottom plate of a heating press adapted for this study. Pressure is exerted on the top heating plate of the press, thermostated at 140 °C ± 5 °C, during six seconds. Having the cover been lifted up, pressure is exerted again on the sample with a non-heating plate, during at least two minutes. The preparation is left to settle during one hour.

Detection is carried out as follows : the top sheet is delicately lifted up by one end and completely removed (sticky spots are visible) and kept aside for counting purposes. The cotton web is taken off the bottom sheet the same way. It is used to give a slight sweeping on both sheets in order to remove the fibers, fiber masses and spots which are little sticky. Only large, medium and small spots with fibers which remained stuck on each sheet are counted.

The classification is obtained by transferring the sum of sticky points counted on the top and bottom sheets in the scale of stickiness results A, B, C, D, E where :

- A = no stickiness,
- B = slight stickiness,
- C = medium stickiness,
- D = strong stickiness,
- E = very strong stickiness.

This method has the advantage of being quantitative ; a numerical value is assigned to each sample. However, three samples per cotton to analyse must be tested to give a correct result, i.e. 7.5 g cotton.

Conditions required for stickiness thermodetection

The tests were performed in a conditioned atmosphere, 55 % ± 2 % relative humidity and 23 °C ± 2 °C temperature, identical to that of the tests usually carried out with the laboratory card. The cotton with 55 % RH approximately contains a humidity of 6.8 %. Under the action of the heat of the press, thermostated at 140 °C ± 5 °C, the humidity between the aluminium sheets increases beyond 75 %. By the joint effects of pressure heat and sample humidity, sticky spots adhere to the aluminium sheets.

RESULTS

We tested by thermodetection and at the same time with the minicard 51 out of 64 cottons of various origins (with 3 replications, i.e. 153 samples). A correlation was established between these two methods. The 13 other cottons were used to check this correlation. The regression obtained by counting the spots on the top and bottom sheets gives the most interesting results (Fig. 1). It is of the form :

$$Y = 0.324 + 0.802 X$$

with $X = \sqrt{\text{total number of sticky spots thermodetection}}$.

Correlation is equal to 0.974 with a variance explained of 0.948.

In practice, we grouped the results obtained with the card in five stickiness degrees. The correspondence between thermodetection and card is shown in Table 1.

CONCLUSION

In general, the estimate of the potential of cotton stickiness has so far been carried out chemically or mechanically. Chemical methods (1, 2, 3) only give an indication of the possibilities of stickiness in the spinning mill of the cottons tested, being the results often divergent and contradictory. The laboratory card (6, 7) is admitted as being the most reliable to identify the real behaviour of cottons in the spinning mill ; however, its utilization is limited (the equipment is considerable and expensive, requiring maintenance and well-controlled conditioning, the results obtained are qualitative).

The thermodetection method that we have just described

is well correlated with the laboratory card. It will make it possible for a larger number of users to estimate the phenomena of stickiness. This is the reason why IRCT-CIRAD technical managements finance the making of a prototype of heating press with its annexes (manual blender, conditioning box for 30 samples). This press, under the reference IRCT-RF 13, is of simple design and low cost and needs no maintenance. It is a valuable tool for researchers to study the phenomenon of stickiness.

Development companies will be able to get information on sticky cottons. Spinners will estimate the degree of fiber stickiness before processing is started in the mill.

ACKNOWLEDGMENTS

Thanks are extended to Mr J. GUTKNECHT, Head of IRCT Fiber Testing Division for his help to write this

paper and for charging the author with the monitoring and finalization of the prototype.

Identification et comptage des diverses imperfections rencontrées sur le fil de coton.

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Résumé

L'étude met en évidence les différentes imperfections rencontrées sur le fil, déterminées avec un appareillage électronique auquel nous avons adjoint un dispositif permettant de visualiser le fil analysé. Les imperfections sont composées de fragments de

coques, fragments divers (végétaux et miellat) et de neps fibres. Il apparaît que les fragments de coques représentent un pourcentage élevé des imperfections totales, les neps fibres se situent à un niveau faible.

MOTS CLÉS : fil, imperfections, fragments de coques, neps, miellat.

Introduction

Le comptage des imperfections (neps, fragments) qui se trouvent dans la fibre, s'effectue généralement sur la nappe à la sortie de la carte; celles-ci peuvent être aussi appréciées sur le fil à l'aide de divers appareils électroniques. Ces derniers détectent l'ensemble des imperfections classées sous le terme de «neps», sans qu'il soit possible de distinguer celles causées par les enchevêtements de fibres et appelées neps fibres, des autres imperfections.

Actuellement, la tendance de la recherche est de produire des fibres plus fines, plus résistantes. L'influence de

cette nouvelle orientation doit être analysée dans le détail au niveau technologique, afin de fournir au généticien des éléments pour le choix de nouvelles variétés.

Nous avons réalisé sur le fil une étude, pour identifier les imperfections et les répertorier en fragments de coques, fragments divers (végétaux, miellat), neps fibres (fig. 1). Les résultats obtenus sont ainsi plus détaillés et permettront, à l'avenir, de mieux définir l'influence de certains facteurs tels que milieu, égrenage...

Méthodes et résultats

Quarante trois variétés de coton dont certaines avaient été cultivées dans plusieurs lieux ont été filées en 27 tex, à l'aide de la microfilature SHIRLEY PLATT.

Identification et comptage des diverses imperfections

Méthode

Le régularimètre GGP,IPI d'USTER a été utilisé et complété du dispositif «imperfector selector» (USTER news, 1965). Sur cet appareil, chaque fil a subi l'analyse globale habituelle (NEPST), puis une analyse détaillée pour l'identification des différentes imperfections: frag-

ments de coques (NC), fragments divers tels que miellat et débris végétaux (ND), et neps fibres (NF).

La méthode se réalise en deux opérations.

Le fil se déroule pendant un temps défini, à une vitesse de 25 m/mn. Le choix des sensibilités correspond aux réglages normaux 50%-3-3. Le fil est récupéré sur un cylindre rapporté, entraîné par les rouleaux d'appel du fil.

Les neps totaux sont comptabilisés (NEPST).

Ensuite, le fil enroulé sur le cylindre monté à la partie

supérieure de l'appareil est engagé dans l'«imperfector selector» qui le stoppe à chaque imperfection rencontrée. Celle-ci est alors examinée en détail à l'aide d'une loupe et sous un fort éclairage, placés devant le dispositif d'analyse du fil. Les différentes imperfections sont comptabilisées suivant leur catégorie: NC, ND, NF. Le total CDF est comparé au résultat global obtenu à la première opération.

Résultats

Les résultats obtenus sont représentés par les figures 2 et 3, et peuvent être commentés de la façon suivante.

Les neps totaux (NEPST) relevés sur le compteur USTER sont bien corrélés ($r=0,969$) avec le total des imperfections CDF trouvées par l'analyse visuelle à l'aide de «l'imperfector selector» (fig. 2). Les NC sont corrélés de façon excellente avec les NEPST ($r=0,975$), ainsi qu'avec les CDF ($r=0,989$). Les NF ont une corrélation faible avec les NEPST ($r=0,519$).

Les résultats montrent que sur les cotons examinés, l'augmentation importante des CDF est due essentiellement aux fragments de coques (fig. 3). Les pourcentages des différentes imperfections varient de 70% à 90% pour les fragments de coques et seulement de 10% à 25% pour les neps fibres, suivant l'importance du CDF. Dans cette étude, les fragments divers étant faibles, de l'ordre de 1% à 5%, ils n'ont pas été représentés sur la figure 3.

Pour les variétés ayant été cultivées dans des lieux différents, les écarts entre NEPST sont plus ou moins importants (fig. 4). Un effet lieu apparaît donc pour la caractéristique fragments de coques.

Identification et comptage des fragments

En parallèle, nous avons essayé d'apprécier différemment et plus rapidement les fragments de coques et divers, en rendant bicolore la plaquette classique noire d'aspect de fil. Une des faces reste noire tandis que l'autre est blanche.

Nous utilisons la face noire pour observer l'aspect du fil, selon la méthode traditionnelle, par contre la face blanche a été quadrillée pour permettre un comptage des fragments. La photocopie ou la photo de cette seconde face met nettement en évidence ce type d'imperfection (fig. 5). Les fragments divers représentant un faible pourcentage ne sont pas différenciés.

Par cette méthode, le comptage est relativement rapide et précis. Il est possible de classer les fragments de coques selon leur grosseur et de faire, ainsi, une comparaison plus fine entre les cotons examinés. L'usage de photocopies facilite le stockage pour des études et comparaisons ultérieures.

Pour des travaux de routine, nous remplaçons les comptages par des comparaisons avec des standards que nous avons réalisés (fig. 5). Ils permettent une appréciation plus immédiate de l'importance des fragments contenus dans le fil. Nous avons retenu ici quatre classes de charges: A pas de charge, B charge légère, C charge moyenne et D forte charge.

Une étude est actuellement menée pour comparer les résultats obtenus sur la plaquette avec ceux de l'USTER, réglé à des sensibilités différentes.

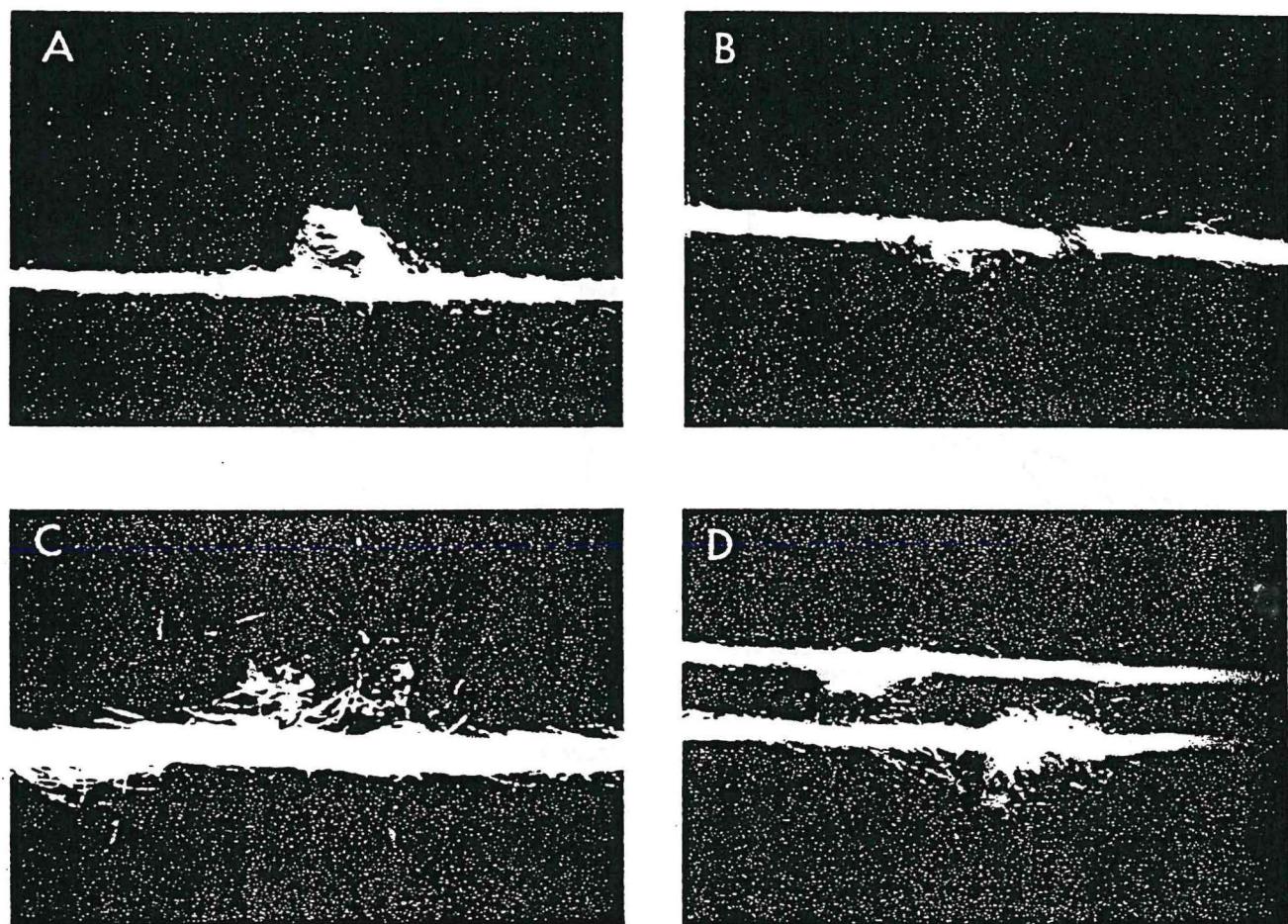
Conclusion

Jusqu'ici, les imperfections ou «neps» sont comptabilisées de façon globale par les appareils électroniques. L'étude réalisée montre qu'il est nécessaire d'apprécier en détail chaque type d'imperfection car, si la valeur des «neps totaux» est bien représentative du nombre de fragments de coques, elle peut donner une mauvaise indication du nombre de neps fibres.

Ainsi, le sélectionneur de coton doit être prudent lors de l'interprétation des résultats bruts concernant les imperfections sur le fil. Une identification détaillée s'impose car, actuellement, avec la création de nouvelles variétés

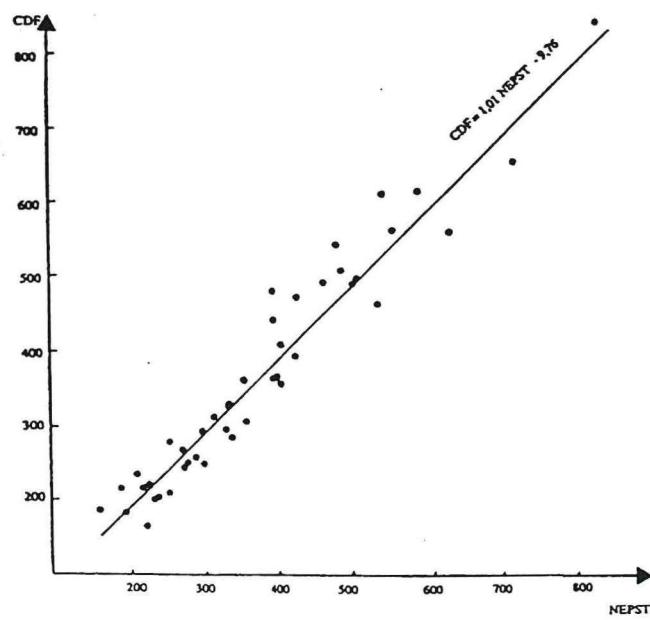
plus fines, plus résistantes, il est indispensable de pouvoir quantifier les types d'imperfections ; celles-ci nuisent à l'obtention d'un fil et d'un produit fini de bonne qualité.

Les résultats obtenus sur les imperfections du fil montrent des différences très importantes entre variétés, ainsi que l'influence du lieu de culture. L'étude sur l'identification des imperfections se poursuit à différentes étapes de la fabrication du fil : sur la nappe, le ruban, le fil ; elle fait intervenir des caractéristiques telles que finesse, maturité, seed-index, égrenage...

**Figure 1**

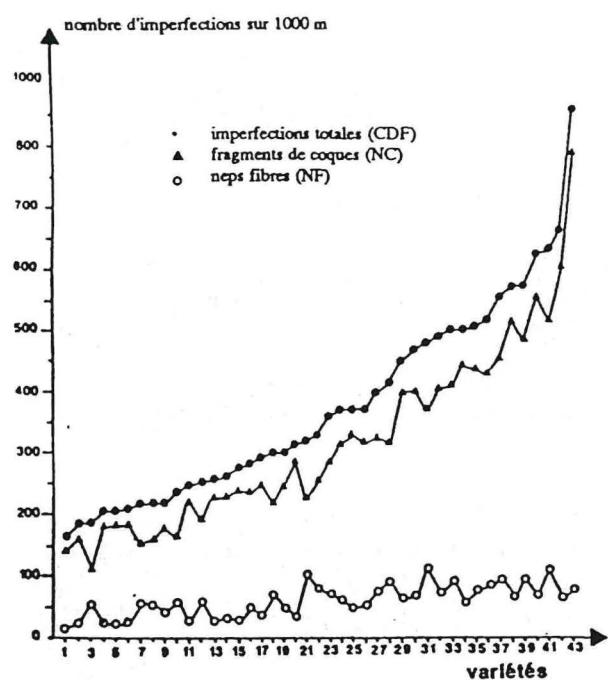
Identification des divers types d'imperfections : fragments de coque (A), de tige (B), miellat (C) et nepis (D).

Identification of the various types of imperfections: seed-coat fragments (A), stem fragments (B), honeydew (C), and fibre nepis (D).

**Figure 2**

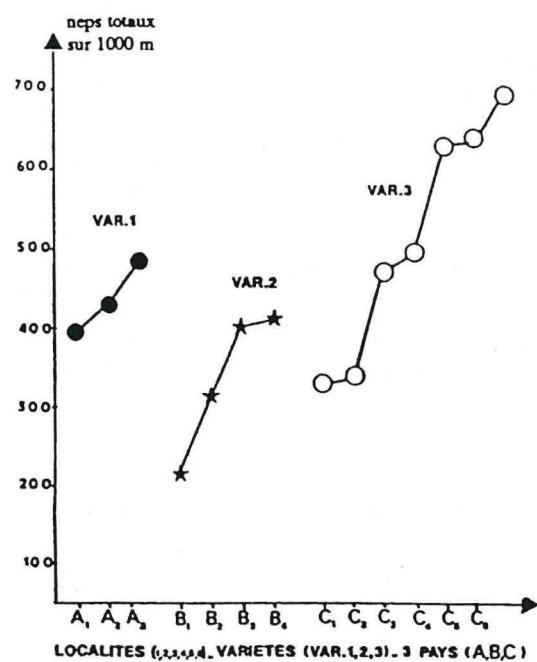
Relation entre les imperfections comptabilisées au régularimètre par la méthode globale habituelle (NEPST) et par la méthode analytique (CDF).

Relationship between the imperfections counted by the usual global method (NEPST) and the analytical method (CDF).

**Figure 3**

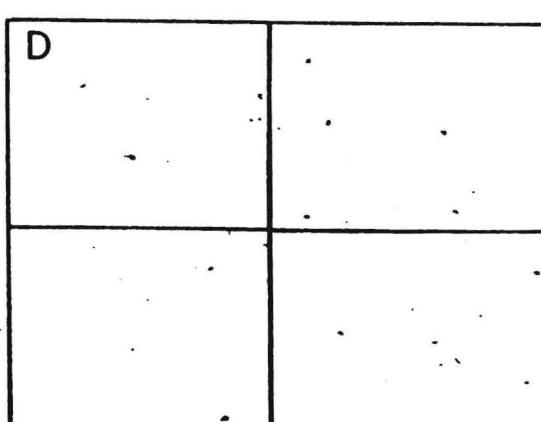
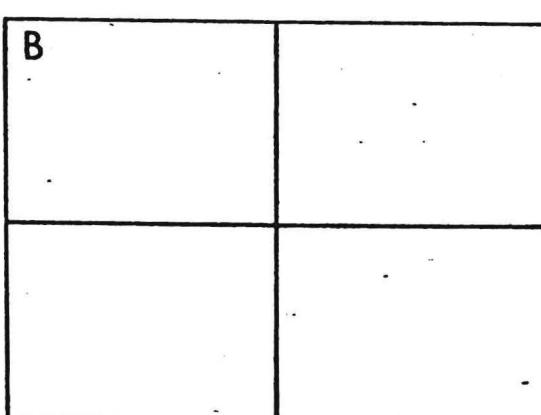
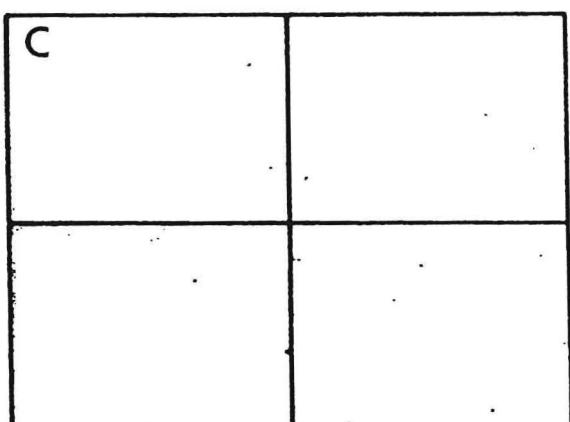
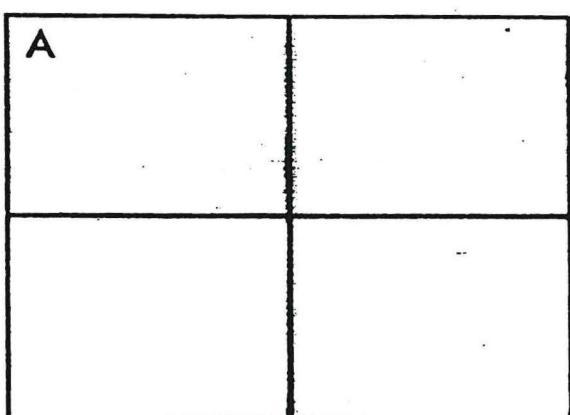
Diverses imperfections dénombrées pour 43 variétés, à l'aide du régularimètre USTER équipé du dispositif de visualisation.

Various imperfections counted for 43 varieties with the USTER regulator equipped with the visualizing device.

**Figure 4**

Influence du lieu de culture sur les neps totaux pour 3 variétés.

Influence of the growing location on the total neps for 3 varieties.

**Figure 5**

Standards pour les fragments de coques sur le fil : charge nulle (A), légère (B), moyenne (C) et forte (D).

Standards for the seed-coat fragments on the yarn : no load (A), light load (B), average load (C) and heavy load (D).

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Identifying and counting the various imperfections found on cotton yarn.

R. Frydrych and J. Gutknecht

Abstract

The study focuses on the various imperfections found on the yarn and defined by means of an electronic apparatus to which we have added a device that enables us to visualize the analysed yarn. The imperfections are composed of seed-coat fragments,

various fragments (vegetable fragments and honeydew) and fibre neps. It appears that the seed-coat fragments represent a high percentage of the total, the fibre neps only represent a low percentage.

KEY-WORDS: yarn, imperfections, seed-coat fragments, fibre neps, honeydews.

Introduction

Counting the imperfections (neps, fragments) contained in the fibre is usually done on the webb just after the carding operation. They can also be counted on the yarn itself with various electronic devices which detect all the imperfections classified under the term of neps, but it is impossible to differentiate the ones that are caused by tangled fibres (the fibre neps) from the other defects.

Today's research is aimed at producing thinner, more resistant yarns. This orientation must be analysed in detail,

at the technological level, in order to provide the geneticist with elements in the choice of new varieties. We have made a study of the yarn in order to identify the imperfections and classify them into seed-coat fragments, various fragments (vegetable fragments and honeydew), fibre neps (see photographs in Figure 1). The results obtained are therefore more detailed and will provide in the future a better understanding of the influence of factors like environment, ginning etc.

Method and Results

Forty-three varieties of cotton, several of which had been cultivated in various locations, were spun in 27 tex with the help of the Shirley Platt micro-spinning apparatus.

Identification and counting of the various imperfections.

Method

The GGP, IPI USTER regulator was used, together with the «imperfector selector» apparatus (USTER news, 1965). On this apparatus, each yarn first underwent the usual global analysis (NEPST), followed by a detailed analysis to identify the various imperfections: seed-coat fragments (NC), various fragments such as honeydew and plant matter (ND), and fibre neps (NF).

The method consists in two operations.

The yarn is unwound during a given period of time, at the speed of 25 meters per minute. The sensitiveness corresponds to standard settings: 50%-3-3. The yarn is then recovered by an added metallic cylinder that is set in motion by the rollers of the yarn. The total number of neps is recorded (NEPST).

Then, the yarn wound round the cylinder goes to the upper part of the apparatus and is guided into the «imperfector selector» device which stops it at every imperfection encountered. Each imperfection is then examined in detail with the help of a magnifying glass and under a strong lighting. The various imperfections are recorded according to their categories : NC, ND, NF. The total CDF is compared to the global result obtained during the first operation.

Results

The results are given in Fig. 2 and 3 and can be appreciated as follows.

The total number of neps (NEPST) appearing on the USTER meter are well correlated ($r=0.969$) with the total number of CDF imperfections obtained during the visual analysis, using the «imperfector selector» (Fig. 2). The NC are extremely well correlated with the NEPST ($r=0.975$), as well as with the CDF ($r=0.989$). The NF have a weak correlation with the NEPST ($r=0.519$).

The results show that on the examined cottons, the significant increase of CDF is mainly due to the seed-coat fragments (Fig. 3). The percentages of the various imperfections vary from 70% to 90% for the seed-coat fragments and only 10% to 25% for the fibre neps, according to the importance of CDF. In this study, since the miscellaneous fragments being rare, between 1% and 5%, they have not been represented on Figure 3.

For the varieties that had been cultivated in different sites, the deviations between NEPST are more or less significant (Fig. 4). A site influence therefore appears for the seed-coat fragments characteristic.

Identifying and counting the fragments.

At the same time, we have tried to appreciate faster and differently the seed-coat fragments and other elements by using two colours for the traditional black plate that is used to examine the yarn. One of the plate sides remains black while the other is white.

We use the black side to examine the yarn, as in the traditional method. On the other hand, the white side has a grid to facilitate counting the seed-coat fragments. A photocopy or photograph of this second side clearly shows this type of imperfection (Fig. 5). The miscellaneous fragments representing a small percentage are not differentiated.

Through this method, the counting is relatively easy and accurate. It is possible to classify the seed-coat fragments according to their size and thus to make a more precise comparison of the cotton samples. Using photocopies makes the storage easier thus facilitating further studies and comparisons.

In routine studies, comparisons with standard studies done previously replace the countings (Fig. 5). These comparisons allow for a more instantaneous appreciation of the importance of yarn imperfections. We have retained four degrees here: A no load, B light load, C average load, D heavy load.

A study is being conducted to compare the results obtained on the plate with those obtained with the USTER, at various degrees of sensitivity.

Conclusion

So far the imperfections or «neps» have been globally recorded by electronic apparatuses. Our study shows that it is necessary to appreciate each type of imperfection separately for, if the value of «total neps» is representative of

the number of seed-coat fragments, it can give an erroneous indication of the number of fibre neps.

Thus, breeders should be wary when interpreting

global uncorrected results concerning imperfections on a yarn. A detailed identification is necessary since today, with the creation of thinner, more resistant new varieties it is necessary to be able to quantify each type of imperfection as they are detrimental to achieving a top quality finished product. The results obtained show very wide dif-

ferences between varieties and the influence of the growing site. The study of the identification of imperfections at the various levels of yarn production is being pursued on the output webb, on the slives, on the yarn, and we take into account other characteristics such as: fineness, maturity, seed-index, ginning, etc.

N.B. The author of the photographs is T. Erwin of the Laboratory of Entomology of the GERDAT-CIRAD, Montpellier, France.

Identificación y recuento de las diversas imperfecciones encontradas en el hilo de algodón

R. Frydrych y J. Gutknecht

Resumen

El estudio evidencia de las diferentes imperfecciones encontradas en el hilo, determinadas con un aparato electrónico al cual hemos juntado un dispositivo que permite visualizar el hilo analizado. Las imperfecciones están integradas por residuos de

cáscaras y residuos diversos (vegetales y melazas) así como de neps fibras. Resulta que los residuos de cáscaras representan un elevado porcentaje de las imperfecciones totales, situándose a un nivel escaso los neps fibras.

PALABRAS CLAVE : hilo, imperfecciones, residuos de cáscaras, neps, melazas imperfecciones.

Evaluation de la résistance du fil à partir des caractéristiques technologiques de la fibre

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Résumé

A partir des principales caractéristiques technologiques des fibres telles que longueur SL 50 %, micronaire, ténacité au stélomètre, il a été établi une formule d'évaluation de la résistance

d'un fil de 20 tex, à l'aide du dynamomètre fil à fil Uster. L'équation obtenue est la suivante :

$$R = 0,666 \text{ SL } 50 - 0,878 \text{ IM} + 0,459 \text{ ténacité stélomètre} - 0,345$$

MOTS-CLES : coton, filature à anneaux, résistance du fil, caractéristiques des fibres, *Gossypium hirsutum*.

Introduction

Les sélectionneurs et filateurs ont toujours souhaité pouvoir estimer la ténacité du fil à partir des caractéristiques technologiques de la fibre (EL SOURADI *et al.*, 1974 ; HAFEZ OSMAN, 1978 ; PRICE, 1983). Le sélectionneur,

afin de pouvoir évaluer très tôt la résistance des filés alors qu'il ne possède que peu de fibres, le filateur afin de connaître le type de fil qu'il pourra produire avec un coton de moindre prix.

Matériels et méthodes

Le laboratoire IRCT de technologie de la fibre analyse chaque année des milliers d'échantillons de coton suivant les méthodes classiques. Les caractéristiques de la fibre le plus fréquemment mesurées sont la longueur (fibrographe 530), la ténacité et l'allongement (stélomètre), le micronaire, la finesse et la maturité (IIC/shirley). Elles interviennent plus ou moins fortement dans les formules d'évaluation de la ténacité du fil, comme le montre une étude déjà réalisée sur des fils de 27 tex (GUTKNECHT, 1984).

Chaque année, le laboratoire de microfilature file et analyse plus de 500 cotons à l'aide d'une microfilature à

anneaux Shirley-Platt. Les résistances des filés sont mesurées au dynamomètre fil à fil Uster CRL, à 60 % d'humidité relative et 22° C.

Pour l'évaluation de la résistance du fil, cette étude porte sur 122 cotons du genre *Gossypium hirsutum* provenant de zones de productions diverses telles que Mali, Cameroun, Burkina Faso, Bénin, Togo, Paraguay. Ces cotons ont subi un égrenage à la scie. Après détermination des caractéristiques des fibres, ils ont été filés pour obtenir un fil de 20 tex.

Résultats, conclusion

Les principales variables intervenant dans la résistance du fil sont récapitulées dans le tableau 1 et quelques distributions de celles-ci présentées dans la figure 1. La longueur SL 2,5 % (*medium staple*) varie de 26,1 mm à 31,2 mm, la SL 50 % de 11,2 mm à 15,6 mm, la ténacité stélométrique de 18,7 g/tex à 26,4 g/tex. Cette gamme de caractéristiques représente bien la variabilité des cotons *G. hirsutum* analysés à l'IRCT.

Les corrélations simples entre la ténacité du fil et les principales variables du fil (tabl. 2) nous montrent l'importance de certaines caractéristiques comme la ténacité au stélomètre et la longueur SL 50 %. Toutefois, il ne peut être fait de prévision de ténacité suffisamment précise avec une seule d'entre elles ; plusieurs variables sont nécessaires.

Lors de l'analyse statistique, nous avons sélectionné celles du tableau 2, par régression pas à pas, au risque 5% (probabilités à l'introduction et à l'élimination). L'équation

qui donne la meilleure explication $R^2=0,818$ et d'utilisation simple est la suivante :
 Résistance du fil = 0,666 SL 50 - 0,878 IM + 0,459 ténacité stél. - 0,345

TABLEAU 1
Distribution des principales variables pour 122 cotons.
Distribution of the main variables for 122 cottons.

Caractéristiques	Minimale	Maximale	Moyenne	Ecart type
Fibres				
Longueur SL 2,5 % 2,5 mm	26,1	31,2	28,18	1,20
Longueur SL 50 % 50 mm	11,2	15,6	13,3	0,77
Uniformité %	42,5	50,4	47,20	1,66
Micronaire, indice	29,3	4,88	4,09	0,31
MR, indice	0,705	0,99	0,90	0,05
Finesse H mtex	122	209	169	12,04
Finesse standard Hs mtex	150	239	188	16,05
Ténacité stélomètre 1/8" g/tex	18,7	26,4	22,3	1,53
Allongement %	4,5	7,5	5,8	0,66
Ténacité fil à fil				
Uster CN/tex	12,45	17,8	15,17	1,06
Allongement Uster %	5	7,3	6,14	0,53

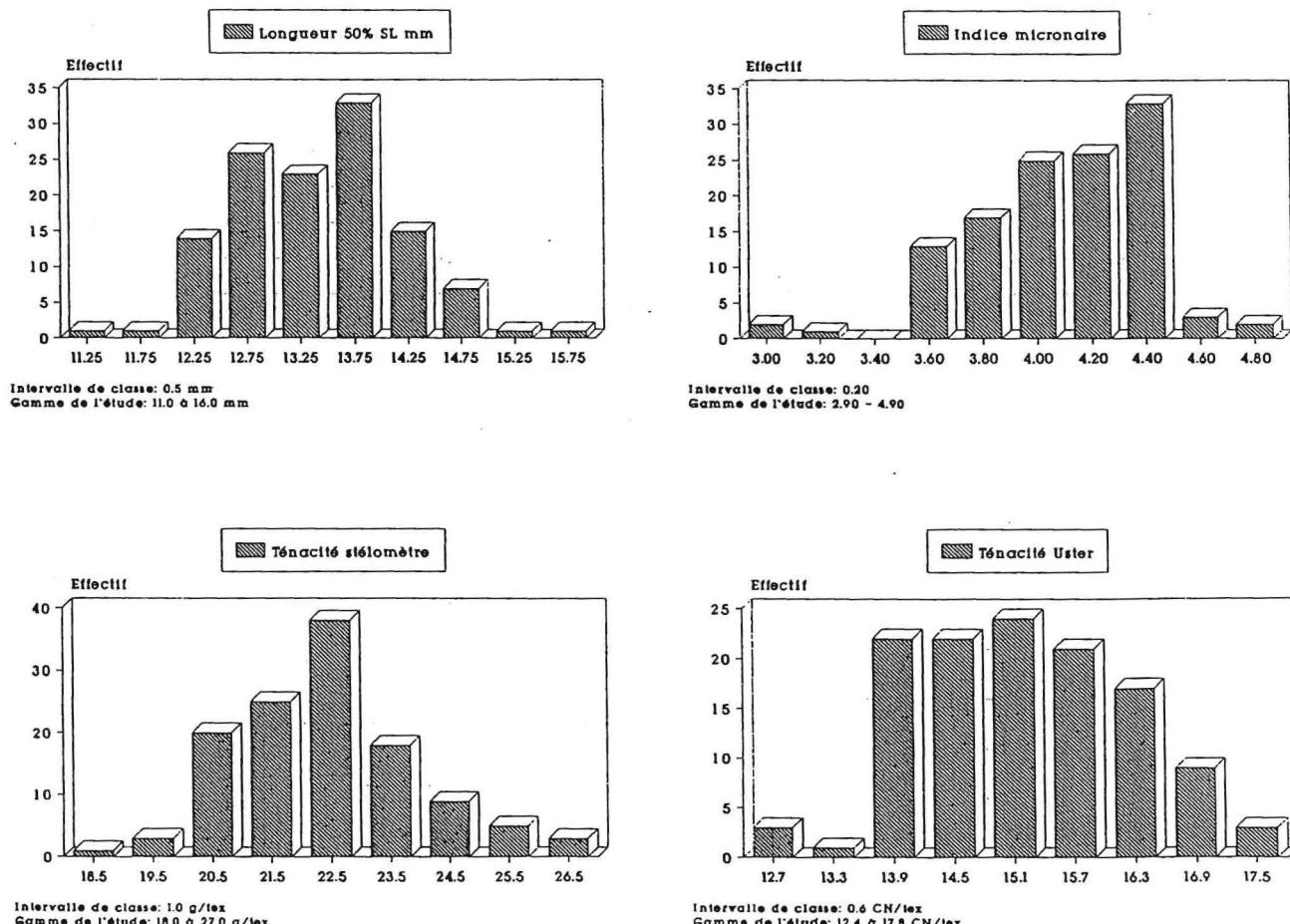


Figure 1
Distribution des caractéristiques de la fibre et du fil.
Distribution of fibre and yarn characteristics.

Le graphe de la figure 2 représente les écarts entre les résistances obtenues à l'Uster et celles calculées avec la formule de prévision.

Pour vérifier cette formule de prévision du fil, 20 cotonns de provenances diverses (Togo, Sénégal, Mali, Madagascar)

ont été testés dans les mêmes conditions. Les résultats comparatifs, entre les résistances obtenues au dynamomètre Uster et les prévisions du fil à partir des caractéristiques de fibres sélectionnées (SL 50 %, IM, stélomètre) nous indiquent une bonne corrélation entre les estimations et les résultats Uster : $R = 0,97$.

TABLEAU 2
Corrélations simples entre ténacité du fil et les principales variables des fibres.
Simple correlations between yarn tenacity and the main fibre variables.

Variables indépendantes	Ténacité du fil Uster R
Longueur SL 2,5 %	0,50
Longueur SL 50 %	0,56
Uniformité	0,33
Micronaire	- 0,16
M R	0,26
Finesse H	- 0,40
Ténacité stélomètre	0,76
Allongement	- 0,44

Le seuil de signification à $P = 0,05$ est de 0,178

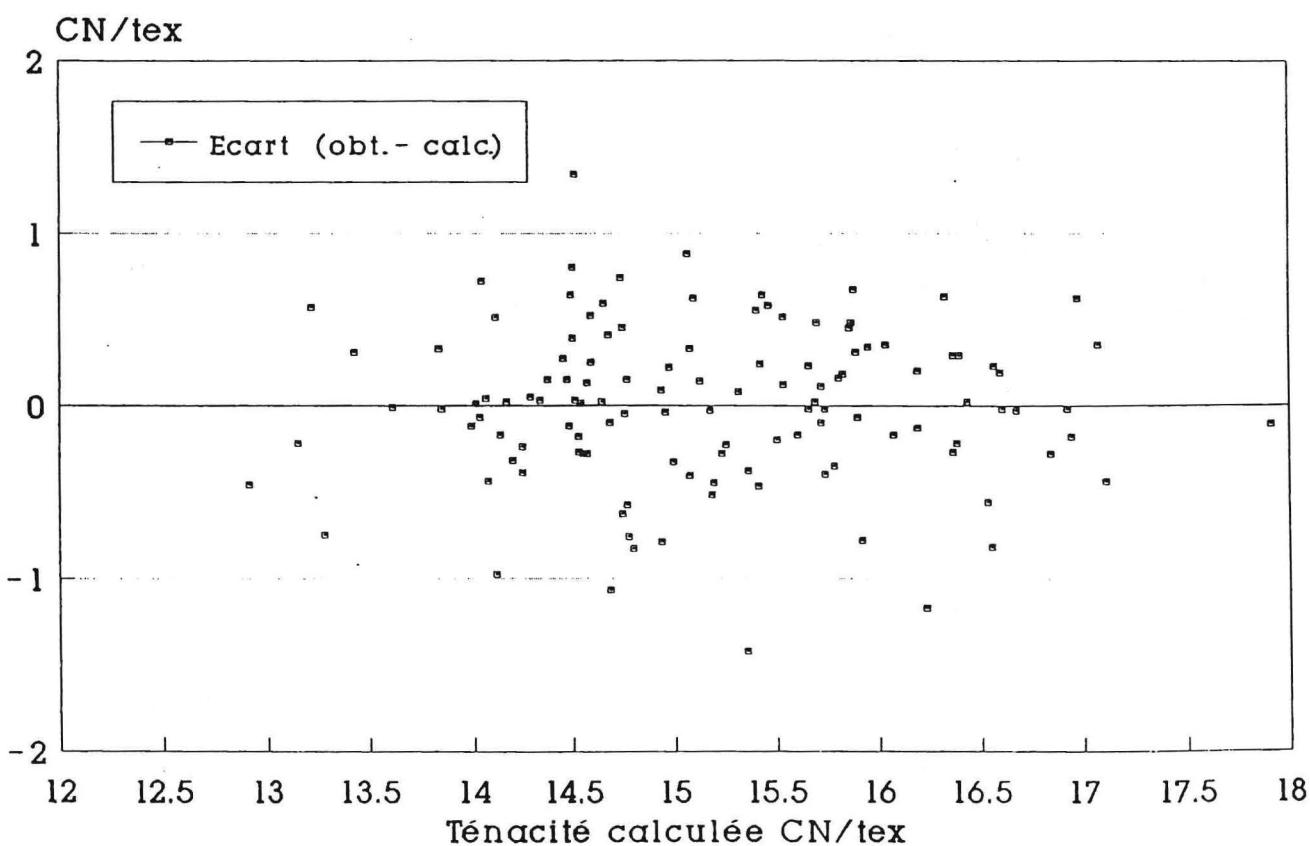


Figure 2
Comparaison entre les ténacités obtenues à l'Uster et les ténacités calculées.
Comparison of Uster and calculated tenacity values.

En conclusion, à partir de trois paramètres technologiques des fibres, cette étude nous permet d'évaluer la

résistance fil à fil d'un filé pour un titre de 20 tex, sur des cotonns testés au laboratoire de microfilature de l'IRCT.

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Evaluation of yarn strength from the technological characteristics of fibre

R. Frydrych

Summary

The main technological characteristics of fibre, such as SL 50%, micronaire reading and stelometer strength, have been used as the basis for a formula for the evaluation of a 20 tex yarn using

a single-yarn strength Uster tester. The following equation was obtained:

$$R = 0.666 \text{ SL } 50 - 0.878 \text{ MI} + 0.459 \text{ stelometer strength} - 0.345$$

KEY WORDS: ring spinning, cotton, yarn strength, fibre characteristics, *Gossypium hirsutum*.

Introduction

Breeders and spinners have always wished to be able to measure yarn tenacity using the technological characteristics of the fibre (EL SOURADI *et al.*, 1974; HAFEZ OSMAN, 1978; PRICE, 1983). Breeders need to

judge the potential strength of spun yarn at a very early stage when only a little fibre is available, and spinners want to know what type of yarn they can produce with the lowest priced cotton.

Materials and methods

The IRCT fibre technology laboratory uses conventional methods to analyse thousands of cotton samples each year. The most frequently measured fibre characteristics are length (530 fibrograph), strength and elongation

(stelometer), micronaire, finesse and maturity (IIC/Shirley). They are used to varying degrees in yarn tenacity assessment formulae, as has been shown by 27 tex yarn research (GUTKNECHT, 1984).

The microspinning laboratory spins and analyses over 500 cottons using a Shirley-Platt ring microspinning apparatus. Yarn strengths are measured using a single-yarn strength Uster tester at 60% relative humidity and 22°C.

This study on the assessment of yarn strength was performed on 122 *Gossypium hirsutum* cottons from various production zones such as Mali, Cameroon, Burkina Faso, Benin, Togo and Paraguay. The cottons were saw-ginned. Fibre characteristics were determined and fibres were spun to obtain 20 tex yarn.

Results and conclusion

The main variables in yarn strength are summarised in Table 1; several distributions are shown in Figure 1. SL 2.5% (the medium staple) varies from 26.1 mm to 31.2 mm, SL 50% varies from 11.2 mm to 15.6 mm and stelometer tenacity varies from 18.7 g/tex to 26.4 g/tex. This range of characteristics is a good reflection of the variability of *G. hirsutum* cottons analysed by IRCT.

The simple correlations between yarn tenacity and the main yarn variables (Table 2) show the importance of certain characteristics such as stelometer tenacity and SL 50%. However, no sufficiently accurate tenacity forecast can be made with a single one of them; several variables are required.

Those of Table 2 were selected during statistical analysis using stepwise regression with 5% probable error (at introduction and elimination). The equation which gave the best explanation was $R^2 = 0.818$ and simple use is as follows:

$$\text{Yarn strength} = 0.666 \text{ SL 50} - 0.878 \text{ MI} + 0.459 \text{ stelometer strength} - 0.345$$

The graph in Figure 2 shows the deviations between Uster strengths and those calculated using the forecasting formula. This yarn forecast formula was verified using 20 cottons of various origins (Togo, Senegal, Mali, Madagascar) tested under the same conditions. The comparative results of Uster dynamometer strength and yarn forecasts using the fibre characteristics selected (SL 50%, MI, stelometer) revealed good correlation between the estimates and the results of Uster measurements: $R = 0.97$.

In conclusion, this study makes it possible to use three technological fibre characteristics to assess the strength of 20 tex spun yarn for cottons tested in the IRCT microspinning laboratory.

Evaluación de la resistencia del hilo a partir de las características tecnológicas de la fibra

R. Frydrych

Resumen

A partir de las principales características de la fibra tales como la longitud SL 50%, el índice micronario y la tenacidad al Stelometer, se determinó una fórmula de evaluación de la resistencia de un hilo de 20 tex mediante el dinamómetro hilo por hilo Uster.

La ecuación conseguida es la siguiente :

$$R = 0,666 \text{ SL 50} - 0,878 \text{ IM} + 0,459 \text{ tenacidad Stelometer} - 0,345$$

PALABRAS CLAVES : hiladura de anillos, algodón, resistencia hilo, características fibras, *Gossypium hirsutum*.

Evaluation de la résistance du fil à partir des caractéristiques technologiques de la fibre obtenues sur HVI

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Résumé

A partir des caractéristiques technologiques de la fibre obtenues sur la chaîne HVI de Zellweger Uster, il a été établi une formule d'évaluation de la résistance fil à fil, pour un filé de 20 tex réalisé en filature à anneaux. Les mesures de résistance du fil ont été effectuées à l'aide du dynamomètre fil à fil Dynamat d'Uster. L'équation obtenue est la suivante :

Ténacité du fil cN/tex = 1,053 x SL50 - 1,622 x IM + 0,318 x ténacité HVI + 0,505
SL50 = longueur *span length* 50 % en mm ;
IM = indice micronaire ;
Ténacité HVI = ténacité HVI en g/tex (étalonnage avec *International Calibration Cotton Standards*).

MOTS-CLÉS : coton, fibre, fil, filature à anneaux, résistance du fil, HVI, FMT III.

Introduction

Pour déterminer les caractéristiques physiques de la fibre de coton, l'utilisation d'appareils de mesure rapide ou "high volume instrument" (HVI) se développe actuellement dans le monde entier. L'objectif est de déterminer les caractéristiques technologiques des fibres de coton de chaque balle, pour l'ensemble de la production cotonnière.

Les sélectionneurs et les filateurs ont toujours souhaité pouvoir estimer la ténacité du fil à partir des caractéristiques technologiques de la fibre (EL SOURADI *et al.*, 1974 ; PRICE, 1983 ; GUTKNECHT 1984). Le sélectionneur a besoin de critères précoce de sélection pour évaluer la résistance des filés ; le filateur doit acheter des balles de coton qui correspondent au fil qu'il doit produire.

Au CIRAD-CA, les sélectionneurs utilisaient ces dernières années les formules d'évaluations de la résistance du fil pour un titre de 27 tex (GUTKNECHT, 1984) ou de 20 tex (FRYDRYCH, 1991). Ces formules étaient établies à partir des caractéristiques technologiques des fibres obtenues avec divers appareils : le stélomètre pour la ténacité (g/tex), le FMT1 pour l'indice micronaire IM, la maturité et la finesse, et le fibrographe 530 pour les longueurs.

Le laboratoire de technologie cotonnière utilise depuis 2 ans, une chaîne de mesure Zellweger-Uster 910B pour déterminer les caractéristiques des fibres des échantillons provenant de programmes d'amélioration variétale.

Matériels et méthodes

Analyse de la fibre

Les longueurs et la ténacité sont mesurées à l'aide de la chaîne Zellweger Uster 910B (logiciel version 2.03), étalonnée par les standards ICCS (*International Calibration Cotton Standards*).

Les cotons sont ouverts et mélangés à la main avant le panage à la chaîne : six mesures sont effectuées par coton.

La mesure de l'indice micronaire, de la maturité et de la finesse est réalisée au FMT III de Shirley Developments Limited. Comme il n'existe pas de standards internationaux d'étalonnage, nous utilisons ceux de l'ICCS (International Calibration Cotton Standards), évalués dans notre laboratoire au FMT IB, comme référence pour calculer le facteur de correction de l'indice micronaire, de la maturité et de la finesse.

La méthode d'analyse de la fibre comprend :

- le mélange et le nettoyage de la fibre à l'aide du préparateur SDL ;
- deux mesures par coton.

Toutes les mesures des caractéristiques technologiques des fibres ont été faites à $65 \pm 2\%$ d'humidité relative et $22 \pm 1^\circ\text{C}$, après 24 heures de conditionnement.

Analyse du fil

Avant la filature, les cotons sont mélangés sur une ouvreuse, puis filés avec une microfilature à anneaux Shirley Platt (titre 20 tex). Les conditions ambiantes de fabrication des fils sont de 22°C et de 50 % d'humidité relative.

Les résistances des fils sont mesurées au dynamomètre fil à fil Uster CRL (80 casses) à 65 % d'humidité relative $\pm 2\%$ et $21 \pm 1^\circ\text{C}$.

L'évaluation de la résistance du fil à partir des caractéristiques des fibres porte sur 91 cotons de l'espèce *Gossypium hirsutum*. Ces cotons, qui ont subi un égrenage à la scie, proviennent de zones de productions diverses, telles que le Burkina Fasso, le Bénin, le Togo et le Mali.

Résultats et discussion

Les principales variables intervenant dans la résistance du fil sont récapitulées dans le tableau 1, et quelques distributions de celles-ci présentées dans la figure 1. La longueur *span length* (SL) 2,5 % varie de 26,4 à 30,5 mm, la SL 50% de 12,9 à 16,3 mm, l'indice micronaire de 3,5 à 4,8 et la ténacité HVI de 18,8 à 26,7 g/tex. Cette gamme de caractéristiques représente bien la variabilité des cotons *Gossypium hirsutum* qui sont analysés pour les programmes d'amélioration variétale.

Les corrélations simples entre la ténacité du fil et les principales caractéristiques de la fibre (tabl. 2) sont toutes statistiquement significatives à l'exception de l'allongement. Prises individuellement, ces variables ne peuvent fournir une prévision satisfaisante de la ténacité du fil ; plusieurs d'entre elles doivent intervenir pour l'expliquer. L'analyse par régression multiple pas à pas, au risque $\alpha = 5\%$ (probabilités à l'introduction et à l'élimination) sur toutes les variables fibre mesurées (tabl. 2) permet d'obtenir l'équation suivante :

$$\text{Ténacité du fil en cN/tex} = 1,053 \times \text{SL50} - 1,622 \times \text{IM} + 0,318 \times \text{ténacité HVI} + 0,505$$

$$100 \times R^2 = 81,2\%$$

SL50, longueur *span length* 50 % en mm

IM, indice micronaire

Ténacité HVI, ténacité HVI en g/tex (étalonnage avec *International Calibration Cotton Standards*).

Les écarts entre les ténacités du fil obtenues à l'Uster et les ténacités calculées sont représentés (fig. 2).

La formule a été vérifiée sur une gamme de 20 cotons en provenance du Paraguay, de Madagascar et du Sénégal. Ils ont été testés dans les mêmes conditions. Le coefficient de corrélation entre les résistances obtenues au dynamomètre fil à fil et les prévisions calculées à partir des caractéristiques de fibres sélectionnées (SL 50%, IM, ténacité) est de :

$$R = 0,904$$

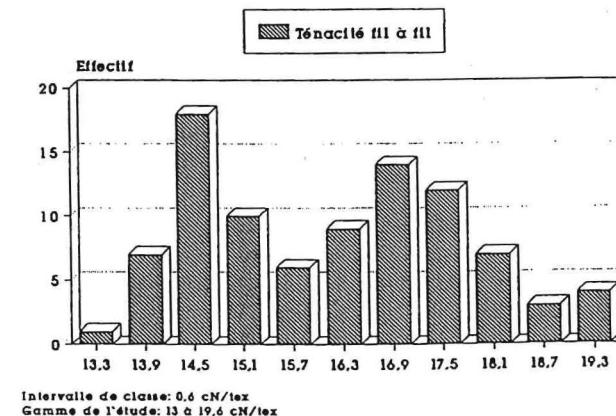
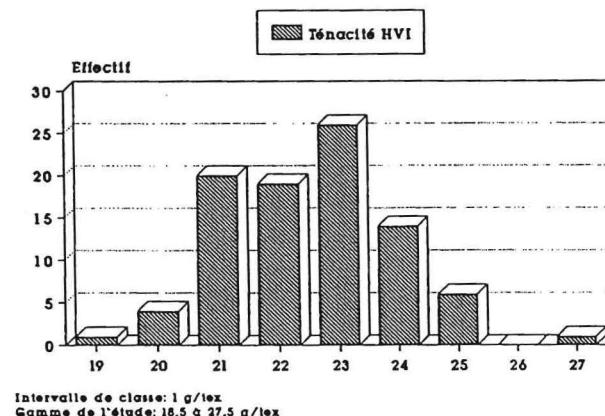
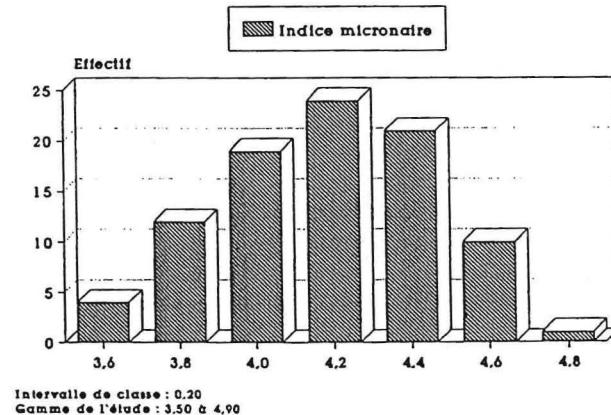
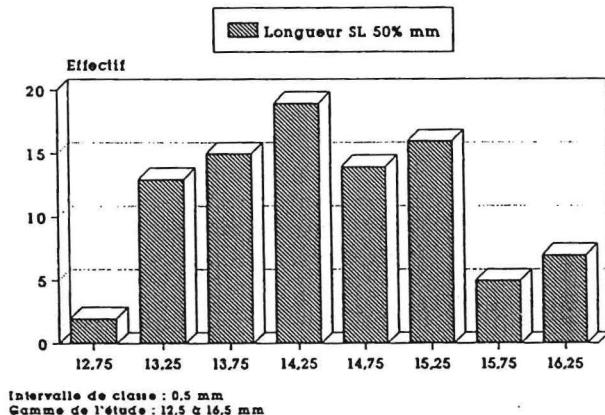
TABLEAU 1
Principaux paramètres statistiques des caractéristiques technologiques des 91 cotons.
Main statistical parameters for the technological characteristics of the 91 cottons.

Caractéristiques	Minimum	Maximum	Moyenne	Ecart type
Fibres				
Longueur SL 2,5 %	26,4	30,5	28,83	0,98
Longueur SL 50 %	12,9	16,3	14,41	0,91
Micronaire, indice	3,5	4,8	4,11	0,28
<i>Maturity ratio</i>	0,78	1,06	0,92	0,05
Finesse H (mtex)	144	190	167	9,67
Finesse standard Hs (mtex)	155	211	181	13,14
Ténacité (g/tex)	18,8	26,7	22,45	1,38
Allongement (%)	5,0	6,1	5,46	0,24
Fil				
Ténacité fil à fil (cN/tex)	13,15	19,24	16,15	1,54
Allongement (%)	5,6	7,7	6,57	0,39

TABLEAU 2
Corrélations entre les caractéristiques technologiques des fibres et la ténacité du fil
(filature à anneaux 20 tex).
Correlations between technological fibre characteristics and yarn strength (using a 20 tex ring spinning).

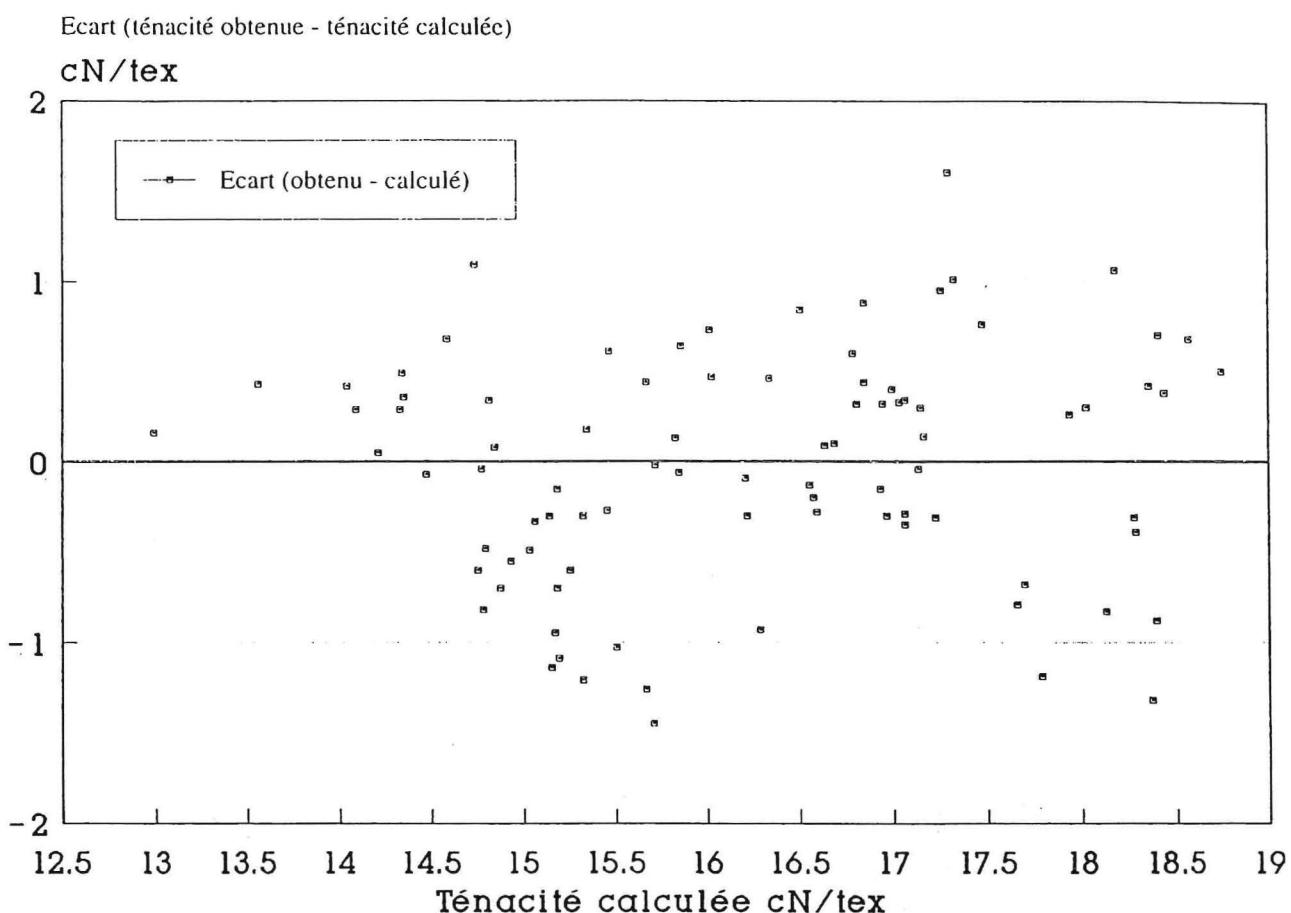
Variables indépendantes	Ténacité du fil Uster R
Longueur SL 2,5 %	0,59 ***
Longueur SL 50 %	0,77 ***
Uniformité	0,67 ***
Micronaire	- 0,46 ***
<i>Maturity ratio</i>	- 0,36 ***
Finesse H	- 0,36 ***
Ténacité	0,67 ***
Allongement	- 0,13 n. s.

Le seuil de signification à P = 0,05 est de 0,205

**Figure 1**

Distribution de quelques caractéristiques de la fibre et du fil : longueur SL 50 % (mm), indice micronaire, ténacité HVI et ténacité fil à fil.

Distribution of some fibre and yarn characteristics : 50 % SL (mm), micronaire, HVI strength and single end yarn strength.

**Figure 2****Comparaison entre les ténacités obtenues à l'Uster et les ténacités calculées.****Comparison of the strengths obtained on the Uster and calculated strengths.**

En conclusion, il est possible d'obtenir une prévision satisfaisante de la ténacité du fil 20 tex (filature à anneaux) à partir de la longueur 50% *span length*, de la ténacité, mesurées à l'aide du module HVIZUS 910B, et de l'indice

micronaire mesuré au FMT III. Les mêmes paramètres avaient également été sélectionnés pour la prévision de la résistance du fil à partir du fibrographe 530, du stélomètre et du FMT IB.

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Yarn strength evaluation based on technological fibre characteristics obtained on HVI

R. Frydrych, J.-P. Gourlot

Abstract

Based on the technological fibre characteristics determined on the Zellweger Uster HVI line, a formula was established for evaluating single end yarn strength for a 20 tex yarn spun on a ring spinning. The yarn strength measurements used were made using an Uster Dynamat single end yarn dynamometer. The equation obtained is as follows:

Yarn strength cN/tex = 1.053 x SL50 - 1.622 x IM + 0.318 x HVI strength + 0.505
SL50, 50% span length in mm
IM, micronaire
HVI strength, HVI fibre strength in g/tex (calibration with International Calibration Cotton Standards).

KEYWORDS: cotton, fibre, yarn, ring spinning, yarn strength, HVI, FMT III.

Introduction

To determine the physical characteristics of cotton fibre, the use of rapid measurement or high volume instruments (HVI) is becoming increasingly common worldwide. The aim is to determine the technological fibre characteristics of the cotton fibres in each bale for cotton production as a whole.

Breeders and spinners have always wanted to be able to estimate yarn strength based on technological fibre characteristics (EL SOURADI *et al.*, 1974; PRICE, 1983; GUTKNECHT, 1984). Breeders need early selection criteria for evaluating yarn strength; spinners have to buy bales of cotton that correspond to the yarn they have to produce.

At CIRAD-CA in recent years, breeders have been using formulae for evaluating 27 tex (GUTKNECHT, 1984) or 20 tex yarn (FRYDRYCH, 1991). These formulae were established based on fibre characteristics determined using various instruments: the stelometer for tenacity (g/tex), the FMT1 for micronaire (IM), maturity and fineness and the 530 fibrograph for lengths.

For two years, the cotton technology laboratory has been using a Zellweger Uster 910B measurement line to analyze the fibre characteristics of samples taken from its varietal improvement programmes.

Material and methods

Fibre analysis

Lengths and strength were measured using a Zellweger Uster 910B line (software version 2.03), calibrated according to ICCS (International Cotton Calibration Standards). The cottons were opened and mixed by hand before measurement; six measurements were made per cotton.

Micronaire, maturity and fineness were measured using a Shirley Developments Ltd. FMT III. As there are no international calibration standards, we used the ICCS,

evaluated in our laboratory on an FMT IB, as a reference to calculate the micronaire, maturity and fineness correction factor.

The fibre analysis method involves:

- mixing and cleaning the fibre using an SDL preparer;
- two measurements per cotton.

All the technological fibre characteristics were measured at $65 \pm 2\%$ relative humidity at $22 \pm 1^\circ\text{C}$, after 24 hours' conditioning.

Yarn analysis

Before spinning, the cottons were mixed on an opener, then spun on a Shirley-Platt ring microspinner (20 tex). Ambient spinning conditions were 22°C and 50% relative humidity. Yarn strength was measured on an Uster CRL yarn by yarn dynamometer (80 breakages) at 65% relative humidity ± 2% and at 21 ± 1°C.

The evaluation of yarn strength based on fibre characteristics involved 91 *Gossypium hirsutum* species cottons. These cottons, ginned on a saw-type ginner, came from various production zones such as Burkina Faso, Benin, Togo and Mali.

Results and discussion

The main variables involved in yarn strength are given in table 1, and different distributions in figure 1. The 2.5% span length (SL) varied from 26.4 to 30.5 mm, 50% SL from 12.9 to 16.3 mm, micronaire from 3.5 to 4.8 and HVI tenacity from 18.8 to 26.7 g/tex. This range of characteristics clearly represents the variability of the *Gossypium hirsutum* cottons analyzed for varietal improvement programmes.

The simple correlations between yarn strength and the main fibre characteristics (table 2) were all statistically significant, exception for elongation. Taken individually, these variables do not provide a satisfactory prediction of yarn strength; several are required to provide a full explanation. A step by step multiple regression analysis, at a risk level of $\alpha = 5\%$ (probability on introduction and elimination) on all the fibre variables measured (table 2) led to the following equation:

$$\text{Yarn strength in cN/tex} = 1.053 \times \text{SL 50} - 1.622 \times \text{IM} + 0.318 \times \text{HVI strength} + 0.505$$

$$100 \times R^2 = 81.2 \%$$

SL 50, 50% span length in mm

IM, micronaire index

HVI strength, HVI fibre strength in g/tex (calibration with International Calibration Cotton Standards).

The deviations between the strength values obtained on the Uster line and the calculated strength values are shown in figure 2.

The formula was checked on a range of 20 cottons from Paraguay, Madagascar and Senegal, tested under the same conditions. The coefficient of correlation between the strength values obtained with a yarn by yarn dynamometer and the predictions calculated based on selected fibre characteristics (50% SL, IM, strength) is:

$$R = 0.904$$

In conclusion, a satisfactory prediction of 20 tex fibre tenacity (spun on a ring spinning) can be achieved taking 50% span length and fibre strength measured using a ZUS 910B HVI apparatus, and the micronaire measured on an FMT III. The same parameters have also been selected to predict yarn strength using the 530 fibrograph, stelometer and FMT IB.

Evaluación de la resistencia del hilo a partir de las características tecnológicas de la fibra obtenidas en HVI

R. Frydrych, J.-P. Gourlot

Resumen

A partir de las características tecnológicas de la fibra obtenidas en la cadena HVI de Zellweger Uster, se ha establecido una fórmula de evaluación de la resistencia hilo a hilo, para un hilado de 20 tex realizado en hiladura de anillos. Las medidas de resistencia del hilo se han realizado con un dinamómetro hilo a hilo Dynamat de Uster. La ecuación obtenida es la siguiente:

Tenacidad del hilo cN/tex = 1,053 x SL50 - 1,622 x IM + 0,318 x tenacidad HVI + 0,505
 SL50: 50% de la longitud «span length» en mm.
 IM: índice micronaire.
 Tenacidad HVI : tenacidad HVI en g/tex (calibración con International Calibration Cotton Standards)

PALABRAS CLAVE: algodón, fibra, hilo, hiladura de anillos, resistencia del hilo, HVI, FMT III.

Effet de l'humidité relative sur les résultats obtenus au thermodétecteur

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Frydrych et Héquet : laboratoire de technologie cotonnière
Gozé : unité de recherche biométrie et informatique
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Résumé

Le thermodétecteur permet de mesurer le potentiel de collage des cotons pollués par les miellats d'insectes. Pour obtenir des résultats fiables et comparables entre utilisateurs, il convient d'utiliser cet appareil dans des conditions précises d'humidité relative ambiante. Celle-ci doit être comprise entre 55 et 65 %, soit une teneur en humidité du coton située entre 6,8 et 8 %.

MOTS-CLES : coton, collage, miellat, thermodétecteur, humidité relative.

Lorsque l'humidité ambiante est inférieure à 55 %, il faut conditionner les échantillons de coton dans une enceinte spéciale, afin d'avoir une humidité suffisante pour réaliser le test.

Généralités

Depuis les années 1980, avec l'apparition des cotons collants, de nombreuses recherches ont été entreprises pour mettre au point une méthode de détection et de mesure du potentiel de collage des cotons. Le problème est complexe comme le rapporte la littérature spécialisée (HECTOR et HODKINSON, 1989), car le collage peut-être dû à plusieurs facteurs tels que les débris d'amandes, traces d'huile, sucres physiologiques (cas signalés aux Etats-Unis) et sucres entomologiques. Actuellement ce sont ces derniers qui provoquent les incidents les plus graves en filature. Différentes méthodes de détection sont disponibles : les tests chimiques, à la minicarde ou au thermodétecteur (GUTKNECHT *et al.*, 1988).

Le test au thermodétecteur est actuellement utilisé dans le monde entier, par des laboratoires de recherche et des industriels. Cet appareil fournit des résultats quantitatifs, aisément exploitables et en bonne corrélation avec ceux de la carderie de laboratoire (FRYDRYCH, 1986). Il suffit de compter les billes de miellats avec fibres qui se sont déposées sur le support en aluminium. Le tableau 1 montre que le nombre de points collants n'est pas limité. Cela permet de mesurer l'importance de la pollution, même dans les cas de très forts collages, et ainsi de différencier les cotons.

L'étude qui suit montre l'effet des conditions hygrométriques sur les résultats obtenus au thermodétecteur ; elle

détermine la plage d'humidité relative ambiante pour obtenir des mesures justes et les plus précises possibles.

L'humidité relative est une fonction de la température de l'air et de la masse de vapeur d'eau qu'il contient. Elle a une action sur le collage des cotons, ce phénomène est observé principalement au stade de la carderie. Il a été d'ailleurs confirmé par une étude (réalisée au laboratoire de technologie cotonnière du CIRAD-CA) de l'effet de l'humidité relative sur le collage des cotons à la carderie de laboratoire ; cette étude portait sur une gamme de cotons représentant un éventail complet de potentiels de collage : «non collant», «légèrement collant», «moyennement collant», «fortement collant» et «très fortement collant» (GUTKNECHT *et al.*, 1986). Elle a montré que les dépôts de miellat sur les cylindres en pression sont d'autant plus nombreux que le degré de collage initial est important, et que l'humidité relative du local est élevée. Pour une humidité relative située à environ 30 %, le coton ne colle pas quel que soit le potentiel de collage de la fibre. C'est pourquoi la valeur discriminante de 55 % a été choisie pour les tests à la carderie de laboratoire.

Pour les mêmes raisons, il était nécessaire de préciser pour les tests au thermodétecteur l'effet de l'humidité ambiante du local sur les dépôts de miellats qui se font sur les supports en aluminium.

TABLEAU 1
Définition des niveaux de collage.
Definition of stickiness levels.

Niveau de collage	Nombre de points collants	Définition du potentiel de collage
A	0 - 2	Non collant
B	3 - 16	Légèrement collant
C	17 - 32	Moyennement collant
D	33 - 53	Fortement collant
E	> 54	Très fortement collant

Réponse du collage à l'humidité relative

Onze lots de cotons de type *G. hirsutum*, provenant d'Afrique et représentant une gamme complète de collage («légèrement collant» à «très fortement collant»), ont été analysés au thermodétecteur IRCT-RF13 à différents niveaux d'humidité relative (H.R.) soit 35, 45, 55, 65 et 75 %, à une température constante de 22° C.

L'enceinte (FG 49) à conditionner les échantillons de coton, dont l'utilisation est recommandée en l'absence de local conditionné à 55 % (GUTKNECHT et FRYDRYCH, 1988), fournit un 6e niveau d'humidité relative (E 65 %). L'humidité relative à l'intérieur de l'enceinte a été réglée à 65 %, alors que celle du local se situait à 35 %.

Pour chaque lot, une masse de 50 g de fibre a été mélangée dans une ouvreuse de laboratoire. Pour chaque humidité, trois répétitions ont été réalisées. Les échantillons ont été testés au thermodétecteur suivant la méthode préconisée : un échantillon de 2,5 g, mis sous forme de nappe à l'aide du nappeur manuel, est placé entre deux feuilles d'aluminium. Cette préparation, déposée sur le plateau inférieur du thermodétecteur, subit une première pression à chaud, pendant 12 s, et une seconde pression à

froid pendant 2 min. La préparation est ensuite laissée au repos pendant une heure, avant la lecture des points collants situés sur les supports inférieur et supérieur en aluminium. On note la somme des points collants lus sur les deux feuilles d'aluminium enveloppant la nappe. Les conditions d'humidité relative du local lors de la lecture sont les mêmes que pendant le test.

Pour les essais effectués avec l'enceinte à conditionner, l'humidité relative du local est amenée à 35 %. Chaque échantillon de 2,5 g est mis sous forme de nappe, puis placé dans l'enceinte réglée à 65 % d'H.R. (E 65 %). Le déroulement de l'essai au thermodétecteur est le même que précédemment.

Nous supposons ici que l'humidité agit sur le nombre de points collants en le multipliant par une constante indépendante du coton utilisé. Si on appelle $Y(c,h)$ le collage obtenu pour le coton c et l'humidité relative h , et si on définit la mesure faite à 60 % d'humidité relative comme mesure de référence Y_{60} , on a :

$$\begin{aligned} Y(c,h) &= Y(c,60) \times K(h) \\ \text{soit} \quad Y(c,h) &= Y_{60}(c) \times K(h) \quad (1) \end{aligned}$$

TABLEAU 2
Variations du collage mesuré en fonction de l'humidité, pour 11 lots de coton.
Analyse de variance.
*Variations in the stickiness of eleven batches of cotton measured depending on humidity.
Analysis of variance.*

Facteur	Somme de carrés	D.d.l.	F	Test F
Coton	4398	10	176,21	***
Humidité	848	5	67,93	***
Coton x humidité	142	50	1,14	N.s.
Résidu	329	197		

Significatif pour $P = 1\%$
Significant for $P = 1\%$

On peut ramener ce modèle multiplicatif à un modèle additif par transformation logarithmique. Une pondération doit alors être appliquée aux données pour tenir compte de leur variabilité proportionnelle à leur moyenne. Dans l'échelle des logarithmes, la pondération doit être

proportionnelle à la moyenne obtenue dans l'échelle originale.

L'analyse de variance conduite suivant ce principe ne montre pas d'interaction (tabl. 2), on peut donc accepter le

modèle (1). Cette analyse montre également des variations importantes du nombre de points collants en fonction de l'humidité.

Les moyennes des potentiels de collage déterminées par humidité relative et leurs intervalles de confiance à 95 % montrent que la détection est maximale pour les humidités

relatives de 55 et 65 % (tabl. 3 et fig. 1). La mesure du collage est comparable pour les échantillons conditionnés dans l'enceinte et pour ceux laissés en atmosphère ambiante de 55 ou 65 % d'H.R. L'intervalle de confiance à 95 % de la différence relative est [- 6,4 %, + 12,7 %]. La mesure du collage sur des échantillons conditionnés dans l'enceinte peut donc être considérée comme correcte.

TABLEAU 3

Moyennes des collages obtenues par lot de coton et par humidité relative.
Stickiness means obtained per cotton batch and relative humidity value.

Coton	H.R., avec enceinte (%)		H.R., sans enceinte (%)			
	35	35	45	55	65	75
1	13,2 (2,58)	5,8 (1,75)	8,5 (2,14)	21,1 (3,05)	16,3 (2,79)	6,4 (1,86)
2	21,8 (3,08)	8,6 (2,15)	17,8 (2,88)	26,7 (3,28)	26,0 (3,26)	7,7 (2,04)
3	95,8 (4,56)	33,9 (3,52)	66,5 (4,20)	101,5 (4,62)	91,8 (4,52)	35,0 (3,55)
4	20,1 (3,00)	11,3 (2,43)	17,3 (2,85)	23,9 (3,17)	28,1 (3,34)	4,9 (1,60)
5	168,2 (5,13)	93,9 (4,54)	115,9 (4,75)	157,7 (5,06)	167,8 (5,12)	60,2 (4,10)
6	49,8 (3,91)	19,4 (2,97)	38,5 (3,65)	67,1 (4,21)	65,8 (4,19)	27,7 (3,32)
7	22,7 (3,12)	10,3 (2,33)	14,2 (2,65)	26,6 (3,28)	29,6 (3,39)	11,1 (2,41)
8	42,4 (3,75)	15,8 (2,76)	32,2 (3,47)	38,8 (3,66)	37,6 (3,63)	19,6 (2,97)
9	63,2 (4,15)	13,0 (2,57)	30,2 (3,41)	51,2 (3,94)	52,9 (3,97)	30,8 (3,43)
10	2,5 (0,90)	1,6 (0,46)	5,2 (1,66)	3,6 (1,27)	6,5 (1,87)	2,3 (0,83)
11	39,9 (3,69)	21,0 (3,04)	22,7 (3,12)	31,0 (3,43)	37,5 (3,63)	20,8 (3,03)
Moyenne pondérée	70,04 (4,249)	33,52 (3,512)	46,62 (3,842)	67,97 (4,219)	68,44 (4,226)	27,44 (3,312)
Intervalle de confiance	64,90 (4,173)	29,90 (3,398)	42,51 (3,750)	62,99 (4,143)	63,49 (4,151)	24,44 (3,196)
	75,57 (4,325)	37,57 (3,626)	51,13 (3,334)	73,33 (4,295)	73,78 (4,301)	30,81 (3,428)

Les valeurs entre parenthèses sont les moyennes pondérées des logarithmes des collages avec lesquelles l'analyse de variance a été faite. Le poids de chaque résultat élémentaire est la moyenne du collage pour la même combinaison coton x humidité. Les valeurs hors parenthèses sont retransformées dans l'échelle initiale.

The values in brackets are the means weighted with the stickiness logarithms with which the analysis of variance was carried out.

The weight of each elementary result is the mean of the stickiness for the same cotton x relative humidity combination.

The values outside brackets have been retransformed to the initial scale.

Plage d'utilisation du thermodétecteur

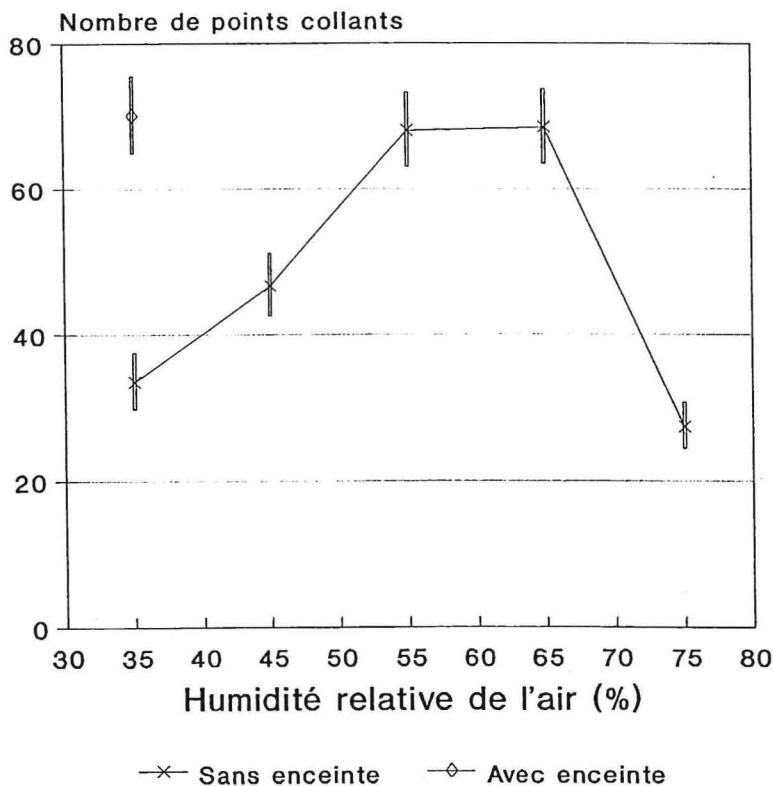
Une question se pose encore : la mesure du collage est-elle bien stable entre 55 et 65 % d'humidité relative ?

Pour y répondre, les mesures aux humidités 55, 60 et 65 % d'H.R. ont été comparées sur trois cotons, en suivant le même dispositif que précédemment mais avec 20 répétitions (fig. 1). L'analyse de variance, suivant les mêmes principes que précédemment ne montre aucune variation significative dans cette plage d'humidité (tabl. 4). Les moyennes pondérées par humidité relative sont très pro-

ches les unes des autres (tabl. 5). Les intervalles de confiance à 95 % sur les différences relatives à la mesure à 60 % d'H.R. sont :

[- 6,7 % ; + 2,7 %] pour la mesure à 55 % d'H.R. ;
 [- 7,3 % ; + 2,1 %] pour la mesure à 65 % d'H.R.

Le thermodétecteur est donc utilisable entre 55 et 65 % d'humidité relative, sans influence notable sur le résultat du collage.

**Figure 1****Influence de l'humidité ambiante sur la mesure du collage.***Effect of relative humidity on stickiness measurement.***TABLEAU 4****Variation du collage mesuré en fonction de l'humidité relative sur 3 lots de coton. Analyse de variance.***Variation in stickiness measured in three batches of cotton depending on relative humidity. Analysis of variance.*

Facteur	Somme des carrés	D.d.l.	F	Test F
Coton	2166	2	976,03	***
Humidité	1,01	2	0,46	N.s.
Coton x humidité	6,45	4	1,45	N.s.
Résidu	190	171		

Significatif pour P = 1 %
Significant for P = 1 %**TABLEAU 5****Moyennes des collages obtenues par lot de coton et par humidité relative.***Means of stickiness obtained per cotton batch and relative humidity value.*

Coton	Humidité relative (%)		
	55	60	65
1	25,41 (3,235)	26,75 (3,287)	25,54 (3,240)
2	58,98 (4,077)	57,57 (4,053)	61,41 (4,118)
3	94,09 (4,544)	97,92 (4,584)	91,83 (4,520)
Moyenne pondérée	66,83 (4,202)	68,27 (4,224)	66,44 (4,196)

Les valeurs entre parenthèses sont les moyennes pondérées des logarithmes des collages.

Le poids de chaque résultat élémentaire est la moyenne du collage obtenu pour la même combinaison coton x humidité.

Les valeurs hors parenthèses sont retransformées dans l'échelle initiale.

*The values in brackets are the means weighted with the stickiness logarithms.**The weight of each elementary result in the stickiness mean obtained for the same cotton x relative humidity combination.**The values outside brackets have been retransformed to the initial scale.*

Conclusion

Afin d'obtenir des résultats fiables et comparables entre utilisateurs, cette étude montre qu'il convient de réaliser les tests dans un local dont l'hygrométrie est comprise entre 55 et 65 % d'H.R., soit une teneur en humidité du

coton de 6,8 à 8 %. Lorsque l'humidité ambiante est inférieure à 55 %, les échantillons de coton seront amenés à l'humidité adéquate dans l'enceinte à conditionner.

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Effect of relative humidity on the results obtained with the thermodetector

R. Frydrych, E. Gozé, E. Héquet

Abstract

The thermodetector is used to measure the stickiness potential of cottons contaminated by insect honeydew. To obtain reliable results comparable between users, the thermodetector should be used under specific relative humidity conditions - between 55 and 65% - i.e. a cotton moisture content of between 6.8 and 8%.

When relative humidity is less than 55%, the cotton samples should be conditioned in a special chamber to ensure sufficient humidity for the test to be carried out.

KEYWORDS: cotton, stickiness, honeydew, thermodetector, relative humidity.

General points

With the appearance of sticky cottons, considerable research has been carried out since the 1980s to develop a method of detecting the stickiness potential of cottons. The problem is complex, as indicated in the specialized literature (HECTOR and HODKINSON, 1989), since stickiness may be due to several factors, such as kernel debris, traces

of oil, sugars of physiological origin (cases reported in the United States) and sugars of insect origin. The latter currently cause the most serious incidents in spinning. Various detection methods are available: chemical tests, minicarding or the thermodetector (GUTKNECHT *et al.*, 1988).

The thermodetector is now used worldwide by research laboratories and industrialists. This equipment gives easily usable quantitative results that correlate well with those obtained with a laboratory card (FRYDRYCH, 1986). The operation consists simply of counting honeydew droplets with fibres deposited on a sheet of aluminium foil. Table 1 shows that the number of points is unlimited, the extent of contamination can thus be measured even in very sticky cotton, thereby enabling cottons to be differentiated.

The study described below shows the effect of relative humidity on the results obtained with the thermodetector and determines the relative humidity limits for obtaining the most accurate measurements possible.

Relative humidity is dependent upon air temperature and the mass of water vapour contained in the air. It has an effect on cotton stickiness, which is primarily observed at

the carding stage. Moreover, a study carried out in the CIRAD-CA Cotton Technology Laboratory confirmed the effect of relative humidity on cotton stickiness on the laboratory card; this study involved a wide variety of cottons with a complete range of stickiness potentials: «non-sticky», «slightly sticky», «moderately sticky», «very sticky» and «extremely sticky» (GUTKNECHT *et al.*, 1986). The study showed that the higher the initial degree of stickiness and the higher the relative humidity in the room, the more numerous the honeydew deposits on the pressure rollers. Relative humidity of around 30% gave cotton that did not stick regardless of the stickiness potential of the fibre. Thus, the discriminating value of 55% was chosen for carding tests in the laboratory.

For the same reasons, it was necessary to determine the effect of the relative humidity in the room on honeydew deposits on the thermodetector sheets of aluminium foil.

Stickiness response to relative humidity

Eleven batches of *G. hirsutum* type cottons from Africa, representing a complete stickiness range (from «slightly sticky» to «extremely sticky»), were analyzed on an IRCT-RF13 thermodetector at different relative humidity (RH) levels, i.e. 35, 45, 55, 65 and 75% at a constant temperature of 22°C.

The cotton sample conditioning chamber (FG 49), whose use is recommended in the absence of a room regulated at 55% (GUTKNECHT and FRYDRYCH, 1988), provided a 6th relative humidity level (E 65%). The relative humidity inside the chamber was set at 65%, whereas that of the room was 35%.

A 50 g sample of fibre from each batch was mixed in a laboratory opener. For each humidity level, three replicates were made up. The samples were tested on the thermodetector following the recommended method: a 2.5 g sample, pulled into a web using a manual teasel, was placed between two sheets of aluminium foil and then laid on the lower platen of the thermodetector, where it underwent an initial hot press for 12 s and a second ambient press for 2 min. The preparation was then left to rest for an hour before counting the sticky points on the upper and lower sheets of aluminium foil. The numbers of sticky points on the two sheets of aluminium were added together. The relative humidity conditions in the room remained the same throughout the test.

For the trials carried out with the conditioning chamber, the relative humidity in the room was maintained at 35%. Each 2.5 g sample was pulled into a web, then placed in the chamber set at 65% RH (E 65%). Testing on the thermodetector was the same as above.

It is assumed here that humidity affects the number of sticky points, multiplying it by a constant independent of

the cotton used. If we take $Y(c, h)$ as the stickiness obtained for a cotton c and relative humidity h , and if the measurement taken at 60% relative humidity is defined as the reference measurement Y_{60} , we obtain:

$$\begin{aligned} Y(c, h) &= Y(c, 60) \times K(h) \\ \text{i.e. } Y(c, h) &= Y_{60}(c) \times K(h) \end{aligned} \quad (1)$$

This multiplicative model can be reduced to an additive model by log transformation. The data then have to be weighted to take into account their variability proportional to their mean.

In the scale of logarithms, weighting must be proportional to the mean obtained in the original scale.

The analysis of variance carried out according to this principle does not reveal any interaction (table 2), hence the model can be accepted (1). This analysis also reveals substantial variations in the number of sticky points depending on humidity.

The means of the stickiness potentials determined according to the relative humidity and their confidence intervals 95% show that detection is maximum for a relative humidity of 55 to 65% (table 3 and figure 1). Stickiness measurement is comparable for the samples conditioned in the chamber and for those left in the ambient atmosphere of 55 to 65% RH. The 95% confidence interval of the relative difference is [-6.4%, +12.7%]. Measurement of the stickiness of samples conditioned in the chamber can therefore be considered correct.

Thermodetector operating range

One further question remains: is stickiness measurement stable between 55 and 65% relative humidity?

To answer this question, measurements at 55, 60 and 65% RH were compared for three cottons using the same procedure as above, but with 20 replicates (figure 1). An analysis of variance, following the same procedure as above, revealed no significant variation within this relative humidity range (table 4). The weighted means per humidity value were very similar to each other (table 5). The 95%

confidence intervals for the differences relative to the measurement at 60% RH were:

[-6.7% ; +2.7%] for measurement at 55% RH
[-7.3% ; +2.1%] for measurement at 65% RH

The thermodetector can therefore be used between 55 and 65% relative humidity with no notable effect on stickiness results.

Conclusion

This study showed that a room with relative humidity between 55 and 65%, i.e. a cotton moisture content of 6.8 to 8%, should be used in order to obtain reliable results

comparable between users. When the relative humidity is below 55%, the moisture content of the cotton sample should be appropriately adjusted in a conditioning chamber.

Efecto de la humedad relativa en los resultados obtenidos con el termodetector

R. Frydrych, E. Gozé, E. Héquet

Resumen

El termodetector permite medir el potencial de encolado de los algodones contaminados por los mielatos de insectos. Para obtener resultados fiables y comparables entre usuarios, cabe utilizar este aparato en condiciones precisas de humedad relativa ambiente, la cual debe estar comprendida entre el 55 y el 65 por ciento, es decir

un contenido de humedad del algodón situado entre el 6,8 y el 8 por ciento.

Cuando la humedad ambiente es inferior al 55 por ciento, hay que colocar las muestras de algodón en un recinto especial con objeto de tener una humedad suficiente para realizar la prueba.

PALABRAS CLAVE: algodón, encolado, mielato, termodetector, humedad relativa.

Incidence du stockage sur l'évolution du potentiel de collage des cotons

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Résumé

Afin de préciser l'éventuelle incidence du stockage sur l'évolution du potentiel de collage d'origine entomologique des cotons, deux études ont été mises en oeuvre. La première a été réalisée sur dix-neuf cotons stockés pendant deux ans et demi dans des conditions stables d'humidité relative et de température (55 à 60% d'humidité relative et de 21 à 23°C). La seconde sur vingt et un

cotons stockés pendant la même durée dans des conditions ambiantes fluctuantes (30 à 70 % d'humidité relative et 18 à 30°C). Contrairement à une idée couramment répandue, aucune diminution significative du potentiel de collage, mesuré au thermodétecteur, n'a pu être mise en évidence.

MOTS-CLÉS : coton, collage, miellats, thermodétecteur, humidité relative, stockage.

Généralités

Depuis quelques années, l'on note une quantité croissante de cotons collants sur le marché international. Toute la filière coton est concernée, du producteur au filateur. Le producteur, car le coton pollué se vend avec une décote, le filateur à cause des perturbations entraînées par l'utilisation des cotons collants.

Les cotons contiennent différentes sortes de matières étrangères qui peuvent induire, en filature, des perturbations par le collage des fibres sur des organes en pression ou par encrassement des rotors des open-end par exemple (MARQUIÉ *et al.*, 1983). Mais parmi les matières étrangères que l'on trouve traditionnellement (débris d'amandes, traces d'huile...), celles qui provoquent les problèmes de collage les plus sérieux en production sont sans nul doute les miellats d'insectes. Ces miellats sont sécrétés essentiellement par deux homoptères, le puceron *Aphis gossypii* et la mouche blanche *Bemisia tabaci* (HECTOR et HODKINSON, 1989).

Depuis le début des années 80, le laboratoire de technologie cotonnière du CIRAD-CA a réalisé de nombreuses recherches sur les cotons collants concernant la compréhension du phénomène (BOURÉLY, 1980), sa détection (GUTKNECHT *et al.*, 1988), la suppression de la cause ou

encore les remèdes à apporter pour en diminuer les effets. Une mesure du potentiel de collage a été mise au point sur le principe de la méthode de thermodétection (FRYDRYCH, 1986). Un appareil a été développé. Il est actuellement utilisé dans de nombreux pays, aussi bien par les chercheurs (GOZÉ, 1990 ; YAO, 1992) que par les sociétés commerciales et les filateurs.

Dans le domaine de la suppression du collage, les recherches continuent, aussi bien au stade des techniques culturales qu'à celui de l'égrenage et de la filature. A notre connaissance, aucune solution n'est actuellement totalement efficace. En ce qui concerne les techniques culturales, la récolte précoce et rapide, pour éviter aux capsules ouvertes d'être souillées, semble être la plus efficace. En filature, certains palliatifs sont utilisés : mélange de cotons, baisse de l'humidité relative dans l'usine, additifs de type lubrifiant et lavage.

D'autre part, certains filateurs stockent également leurs cotons dans l'espoir d'une diminution de leur pouvoir collant. Dans quelle mesure cette technique permet-elle de réduire le potentiel de collage des cotons ? C'est cet aspect de la lutte pour la neutralisation du collage en filature que nous traitons ici.

Méthode et discussion

En avril 1988, sur une large gamme de coton, des mesures du potentiel collant ont été réalisées. Après deux ans et demi de stockage, en octobre 1990, les mêmes coton ont subi de nouvelles mesures dans des conditions similaires.

Deux types de stockage ont été testés. Le premier sur 19 échantillons de coton, d'un poids de 40 g chacun, roulés dans des sachets en papier et placés dans une atmosphère conditionnée considérée comme stable ; c'est-à-dire une atmosphère comprise entre 55 et 60 % d'humidité relative (HR) et une température de 21 à 23°C. Le second sur 21 autres coton stockés dans un local non conditionné, dont l'humidité relative a fluctué entre 30 et 70 % d'HR et la température entre 18 et 30°C.

Les tests de collage ont été effectués sur le thermodétecteur IRCT-RF 13 à $58 \pm 2\%$ d'HR et 22 ± 1°C. Le mode opératoire est le suivant : une nappe de coton de 2,5 g, préparée à l'aide d'un nappeur manuel, est prise en sandwich entre deux feuilles d'aluminium ; cette préparation déposée sur le plateau du thermodétecteur, subit une pression à chaud pendant 12 s, puis une pression à froid pendant 2 min. La préparation est alors mise au repos pendant 1 h. Enfin, sont comptabilisés les points collants avec fibres adhérant au support d'aluminium. Trois répétitions par coton ont été effectuées. Le tableau I donne, en fonction du nombre de points collants, l'équivalence en niveau de collage.

TABLEAU I
Définition des niveaux de collage.
Definition of stickiness levels.

Niveau	Nombre de points collants	Potentiel de collage des coton
A	0 - 2	Non collant
B	3 - 16	Légèrement collant
C	17 - 32	Moyennement collant
D	33 - 53	Fortement collant
E	> 54	Très fortement collant

Stockage en conditions stables

Dans le cas du lot stocké en conditions stables, les 19 coton représentent une gamme de collage allant de 0 à près de 150 points collants (tabl. 2). Avec le thermodétecteur, il est conseillé de réaliser 3 répétitions par échantillon, pour obtenir une estimation précise du niveau de collage. Une analyse de régression linéaire au sens des moindres carrés a été appliquée sur les moyennes des trois répétitions par échantillon avant et après stockage, soit 19 couples de données.

La figure 1 indique clairement une relation étroite entre les niveaux de collage avant et après stockage. L'analyse statistique a été réalisée sur les données transformées en racine carrée pour en stabiliser les variances. Le coefficient de détermination R^2 est de 0,958. L'équation de régression est :

$$\sqrt{\text{nombre de points collants 1990}} = 0,961 \times \sqrt{\text{nombre de points collants 1988}} + 0,168$$

Un test au risque $\alpha = 5\%$ indique que l'ordonnée à

l'origine n'est pas statistiquement différente de 0. De plus, l'intervalle de confiance sur la pente est de [0,858 ; 1,064]. Elle n'est pas statistiquement différente de 1.

Nous pouvons estimer que le stockage en conditions stables (55 à 60 % d'HR et 21 à 23°C) n'a pas d'incidence sur le potentiel de collage des coton.

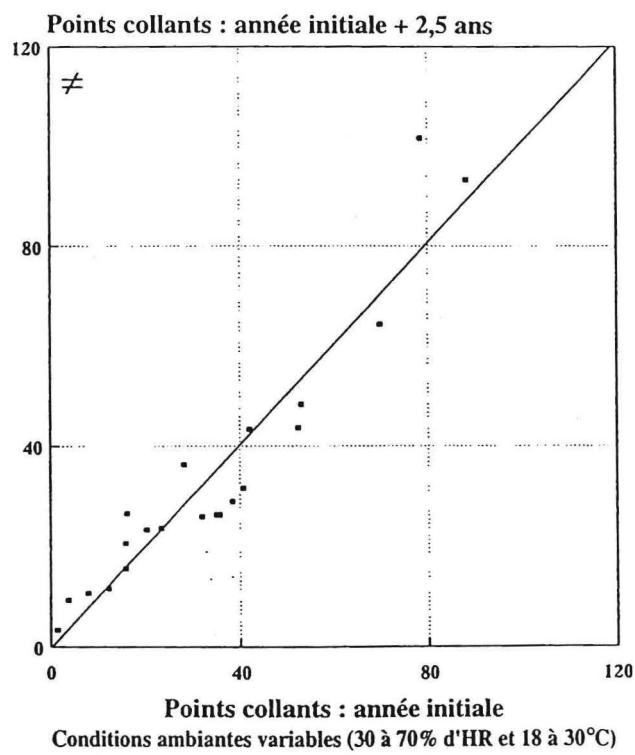
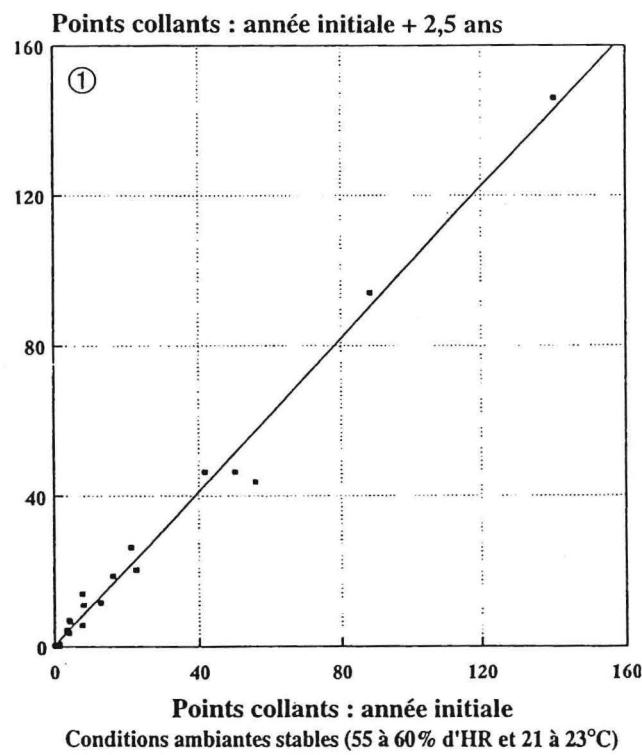
Stockage en conditions de température et d'hygrométrie fluctuantes

Le second type de stockage a été effectué sur 21 coton. Le tableau 2 montre la gamme de collage (de légèrement à très fortement collant). L'analyse statistique appliquée est la même que précédemment. Le graphe de la figure 2 indique une relation linéaire entre les niveaux de collage avant et après stockage. L'analyse statistique a été réalisée sur les données transformées en racine carrée pour en stabiliser les variances. Le coefficient de détermination R^2 est de 0,903. L'équation de la droite de régression est :

$$\sqrt{\text{nombre de points collants 1990}} = 0,892 \times \sqrt{\text{nombre de points collants 1988}} - 0,648$$

TABLEAU 2
Principaux paramètres statistiques obtenus sur la moyenne des trois tests de collage par coton.
Main statistical parameters obtained for the mean of three stickiness tests per cotton.

Conditions de stockage (nombre de cotons)	Moyenne	Minimum	Maximum	Ecart-type
Conditions stables				
Stockage initial (19)	27,75	0	140	36,31
Stockage pendant 2,5 ans (19)	26,68	0,33	146	37,17
Conditions fluctuantes				
Stockage initial (21)	33,86	1,33	88,33	23,92
Stockage pendant 2,5 ans (21)	34,06	3,33	93,33	25,50



Figures 1 et 2

Effet du stockage en conditions ambiantes stables (1) ou variables (2) sur le potentiel de collage.

Effect of storage under stable conditions (1) or variable conditions (2) on stickiness potential.

Un test au risque $\alpha = 0,05$ montre que l'ordonnée à l'origine n'est pas différente de 0. De plus l'intervalle de confiance de la pente est de [0,752 ; 1,032]. Elle n'est pas statistiquement différente de 1.

Ce type de stockage ne semble pas avoir d'incidence sur le potentiel de collage des cotons. Si une évolution du collage existait, elle serait certainement très modeste et donc sans intérêt pour le filateur.

Conclusion

Sur une gamme de cotons pollués par des miellats d'insectes et stockés pendant une période de plus de deux ans en conditions d'humidité relative et de température diverses, on n'a pas pu mettre en évidence une évolution significative du potentiel de collage des cotons mesuré au thermodétecteur.

Cette étude montre que les miellats présents dans les masses de coton le restent quel que soit le type de stockage en conditions stables ou variables. Ces résultats confirment ce que nous avions constaté lors de précédents tests réalisés à la carte de laboratoire sur des cotons très collants (résultats non publiés). Il semble donc inutile de conserver

des cotons pollués par des miellats d'insectes dans l'espérance de voir leur potentiel collant diminuer au cours du stockage. Il serait néanmoins nécessaire de vérifier si dans des conditions de stockage extrêmes (très forte humidité relative par exemple) ou en présence d'une activité biologique (champignons, bactéries...) on assiste à une évolution du potentiel de collage des cotons.

L'absence d'effet des deux types de stockage permet d'envisager la fabrication de cotons standards stables au

cours du temps. Un étalonnage des thermodétecteurs avec des cotons standards doit donc être possible. Ceci permettrait de corriger l'effet environnement (effets laborantin, machine, etc.) et donc de comparer valablement les résultats obtenus par différents laboratoires. Dans cette hypothèse, la standardisation de la méthode de mesure par thermodétection et sa reconnaissance comme méthode de référence pour l'évaluation du potentiel de collage des cotons est parfaitement envisageable.

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Effect of storage on cotton stickiness potential

R. Frydrych, E. Héquet, M. Vialle

Abstract

Two studies were carried out to determine the effect, if any, of storage on cotton stickiness potential of entomological origin. The first involved nineteen cottons stored for two and a half years at stable relative humidity and temperature (55 to 60% relative humidity and between 21 and 23°C). The second covered

twenty-one cottons stored for the same period under unstable conditions (between 30 and 70% relative humidity and 18 to 30°C). Contrary to common belief, no significant reduction was observed in stickiness potential, measured on a thermodector.

KEYWORDS: cotton, stickiness, honeydew, thermodector, relative humidity, storage.

Background

In recent years, there has been an increase in the amount of sticky cotton on the international market. The whole of the cotton sector is concerned by this problem, from producer to spinner. Producers, as contaminated cotton sells for less; spinners due to the problems created by using sticky cottons.

Cotton contains different types of foreign matters that can cause problems when spinning, for example due to fibres sticking to press parts or the clogging of open end turbines (MARQUIÉ *et al.*, 1983). Of the foreign matters traditionally found (kernel debris, traces of oil, etc.), by far

the most serious problems are caused by insect honeydew, primarily secreted by two homopteran species, the aphid *Aphis gossypii* and the white fly *Bemisia tabaci* (HECTOR and HODKINSON, 1989).

Since the early 1980s, the CIRAD-CA Cotton Technology Laboratory has carried out extensive research on sticky cottons in an attempt to explain the phenomenon (BOURÉLY, 1980), detect it (GUTKNECHT *et al.*, 1988) and suppress the causes or remedy the effects. A stickiness potential measurement method was developed based on the thermodetection principle (FRYDRYCH, 1986) and a measurement instrument designed. It is currently used in numerous countries by researchers (GOZÉ, 1990; YAO, 1992), commercial companies and spinners.

Method and discussion

In April 1988, the stickiness potential of a wide range of cottons was measured. After two and a half years' storage, in October 1990, the same cottons underwent further measurements under similar conditions. Two types of storage were tested:

- the first on 19 cotton samples, each weighing 40 g, rolled up in paper bags and placed in a controlled atmosphere considered stable, i.e. at between 55 and 60% relative humidity (RH) and at a temperature of between 21 and 23°C.
- the second on 21 other cottons stored under non-controlled conditions, at between 30 and 70% relative humidity and at a temperature of between 18 and 30°C.

The stickiness tests were carried out on an IRCT-RF13 thermodetector, at $58 \pm 2\%$ RH and $22 \pm 1^\circ\text{C}$. The operating procedure was as follows: a web of cotton weighing 2.5 g, prepared using a manual opener was sandwiched between two sheets of aluminium foil. This sandwich, placed on the thermodetector platen, was hot pressed for 12 s, then cold pressed for 2 min. The cotton web was set aside for 1 hr. The number of sticky points with fibres sticking to the aluminium foil was then counted, and there were three replicates per cotton. Table 1 compares the stickiness levels for these cottons.

Storage under stable conditions

For the batch stored under stable conditions, the 19 cottons had a stickiness range of between 0 and almost 150 sticky points (table 2). It is advisable to carry out three replicates per sample with the thermodetector to obtain an accurate estimate of stickiness levels. A least square linear regression analysis was carried out on the mean of the three replicates for each sample before and after storage, i.e. 19 pairs of figures.

Figure 1 clearly shows that there is a close link between stickiness levels before and after storage. A statistical analysis was carried out on the data, transformed into

Research is continuing into ways of suppressing stickiness, ranging from crop techniques to the ginning and spinning stages. As far as we know, there is no totally effective solution as yet. Crop techniques and early and rapid harvesting to prevent open bolls being contaminated seem to be the most effective. In spinning, certain palliative steps are taken: mixing cottons, reducing relative humidity at the mill, lubricant type additives and washing. Some spinners also store their cottons in the hope of reducing their stickiness. How far can this technique reduce cotton stickiness potential? This study looks at this aspect in the fight to neutralize stickiness and its effects on spinning.

square roots to stabilize their variance. The coefficient of determination R^2 was 0.958. The regression equation was as follows:

$$\sqrt{\text{number of sticky points 1990}} = 0.961 \times \sqrt{\text{number of sticky points 1988}} + 0.168$$

A test at risk $\alpha = 5\%$ showed that the original ordinate was not statistically different from 0. Furthermore, the confidence interval on the slope was [0.858 ; 1.064], hence not statistically different from 1.

We can therefore estimate that storage under stable conditions (from 55 to 60% RH and 21 to 23°C) has no effect on cotton stickiness potential.

Storage under fluctuating temperature and relative humidity conditions

The second type of storage involved 21 cottons. Table 2 shows the range of stickiness (from slight to very high). The statistical analysis carried out was the same as above. The graph in figure 2 shows a linear relationship between stickiness levels before and after storage. A statistical analysis was carried out on the data transformed into square roots to stabilize their variance. The coefficient of determination R^2 was 0.903. The regression curve equation was as follows:

$$\sqrt{\text{number of sticky points 1990}} = 0.892 \times \sqrt{\text{number of sticky points 1988}} - 0.648$$

A test at risk $\alpha = 0.05$ showed that the original ordinate was not different from 0. Furthermore, the confidence interval for the slope was [0.752 ; 1.032], hence not statistically different from 1.

This type of storage (30 to 70% RH and 18 to 30°C) does not therefore seem to have any effect on cotton stickiness potential. Even if there were some change in stickiness, it would be extremely slight, hence of no value for spinners.

Influence de la teneur en eau et de la température de l'air sur les tests de collage des cotons à la minicarde de laboratoire

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RÉSUMÉ

Le test de collage à la minicarde a été utilisé pour l'étude du comportement de deux séries de cotons collants sous l'influence de diverses conditions atmosphériques en faisant varier la teneur en eau (humidité absolue) et la température. La teneur en eau a une action positive et forte sur le collage et la température une action négative mais moins prononcée que celle due à une aug-

mentation de l'humidité absolue. L'humidité relative (HR %), qui n'est autre qu'une combinaison de teneur en eau et température, a une action positive sur le degré de collage. Cet effet sera d'autant plus marqué que les cotons auront un potentiel de collage plus élevé.

MOTS CLÉS : fibre, collage, test carte laboratoire, température, humidité relative.

INTRODUCTION

Les cotons contenant une substance collante dont l'origine probable serait les sécrétions d'insectes sont de plus en plus répandus sur le marché international, alors qu'il y a quelques années ils étaient seulement originaires d'un petit nombre de pays.

Ces types de coton entraînent des perturbations graves en filature, à tel point que certains industriels refusent désormais de se fournir en matière première provenant des pays réputés produire des cotons « collants ».

En filature classique, les perturbations apparaissent au niveau des cardes, puis sur les cylindres de pression et les cannelés des bancs d'étrage, où elles se manifestent par des points collants et des enroulements de la fibre. L'état des bancs à broche et des continus à filer nécessite des nettoyages fréquents du fait des dépôts.

En filature open-end, la présence de points collants sur les parois des turbines provoque de nombreuses casses et donne un fil irrégulier.

Il résulte de ces perturbations une importante baisse de rendement des usines de filature. Le phénomène ayant pris une telle ampleur, la Fédération Internationale des Industries Textiles (I.T.M.F.) a créé une commission chargée d'étudier des méthodes susceptibles de déterminer le degré de « collage » d'un coton. Plusieurs méthodes chimiques ont été utilisées pour essayer de déterminer le degré de collage. Elles reposent généralement sur la détection des sucres originaires des sécrétions d'insectes et présents sur la fibre, mais il faut convenir qu'elles ne sont ni très précises ni très fiables. De plus, la relation entre la présence de ces sucres et le phénomène de collage en filature industrielle n'a jamais été définie avec précision.

Une méthode mécanique d'appreciation du collage d'un coton à l'aide d'une minicarde de laboratoire est également utilisée. Elle consiste à apprécier le degré de collage par l'observation des phénomènes de collage et d'enroulements du voile de cardé passant entre le tambour de réception et le cylindre de pression. Il est admis qu'il existe une bonne relation entre les phénomènes observés à la minicarde et ce qui se passe en usine, sans que cela ait été cependant démontré de manière rigoureuse jusqu'à ce jour.

Le présent travail a pour objet de définir les conditions de quantité d'eau dans l'air et de température auxquelles on doit s'astreindre pour effectuer des essais valables et reproductibles à la minicarde. Il prétend également indiquer aux filateurs les limites des valeurs du conditionnement de l'air dans lesquelles ils devront travailler pour réduire sinon éliminer les perturbations liées aux cotons collants.

MATÉRIEL ET MÉTHODES

Les cotons étudiés proviennent de différents pays africains et sont utilisés seuls ou en mélange de façon à obtenir des potentiels de collage différents, allant du non collant au très collant.

La minicarde utilisée fait partie de l'unité de microfilature du laboratoire qui sert à étudier les cotons de

l'I.R.C.T. La fibre nettoyée, se présentant sous forme de voile, est recueillie sur un tambour qui supporte un cylindre de pression. C'est sur ce cylindre qu'est apprécié le degré de collage.

L'évaluation du degré de collage à la minicarde s'effectue selon l'échelle suivante :

Degree		Critère d'appréciation
Descriptif	Chiffre	
0	1	Aucune trace de collage.
0/+	2	Quelques points qui pourraient être du collage. Le voile a tendance à coller sur le cylindre de pression, mais ne s'enroule pas.
+	3	Traces de collage nettes, mais le coton ne s'enroule pas forcément. Quand il s'enroule, c'est après un temps généralement long (après 1 minute ou plus).
+ / + +	4	Traces de collage assez nombreuses, le coton s'enroule après un temps assez long (de l'ordre de 1 minute).
+ +	5	NOMBREUSES traces de collage, le coton a tendance à s'enrouler assez vite, temps de l'ordre d'une 1/2 minute.
+ + / + +	6	NOMBREUSES traces de collage, le coton s'enroule très vite.
+ + +	7	Collage immédiat et enroulement presque immédiat.

Il peut sembler que les critères retenus ne soient pas très précis. En fait, à l'usage, on s'aperçoit qu'il est aisément de distinguer les différents degrés ci-dessus définis.

L'échantillon testé pèse 10 grammes. Il est présenté au cylindre d'alimentation sous forme de nappe de 11 × 22 cm. Le temps de passage à la carte est de l'ordre de 2 minutes et demi. Entre chaque échantillon testé, le tambour et le cylindre de pression sont nettoyés à l'eau pure puis séchés à l'air chaud. Les chapeaux de carte sont nettoyés après le passage de 3 échantillons.

Les mesures de température et d'humidité relative sont effectuées à l'aide d'un psychromètre à ventilation à thermomètres sec et humide. L'utilisation d'un abaque spécial nous a permis de calculer la teneur en eau exprimée en grammes d'eau par kilogramme d'air sec appelée aussi humidité absolue. Un tel abaque, sur lequel est indiquée la plage des températures et des teneurs en eau dans laquelle nous avons travaillé, est représenté par la figure 1.

Deux expérimentations ont été réalisées, une première avec un nombre réduit de cotons devant donner des indications pour en faire une seconde plus complète.

Première expérimentation

Quatre cotons de potentiels de collage différents sont étudiés en faisant varier les conditions atmosphériques à l'intérieur du laboratoire pour arriver aux situations théoriques mentionnées dans le tableau 1.

Chaque coton est testé 3 fois dans chacune des conditions, soit un total de 120 tests à la minicarte.

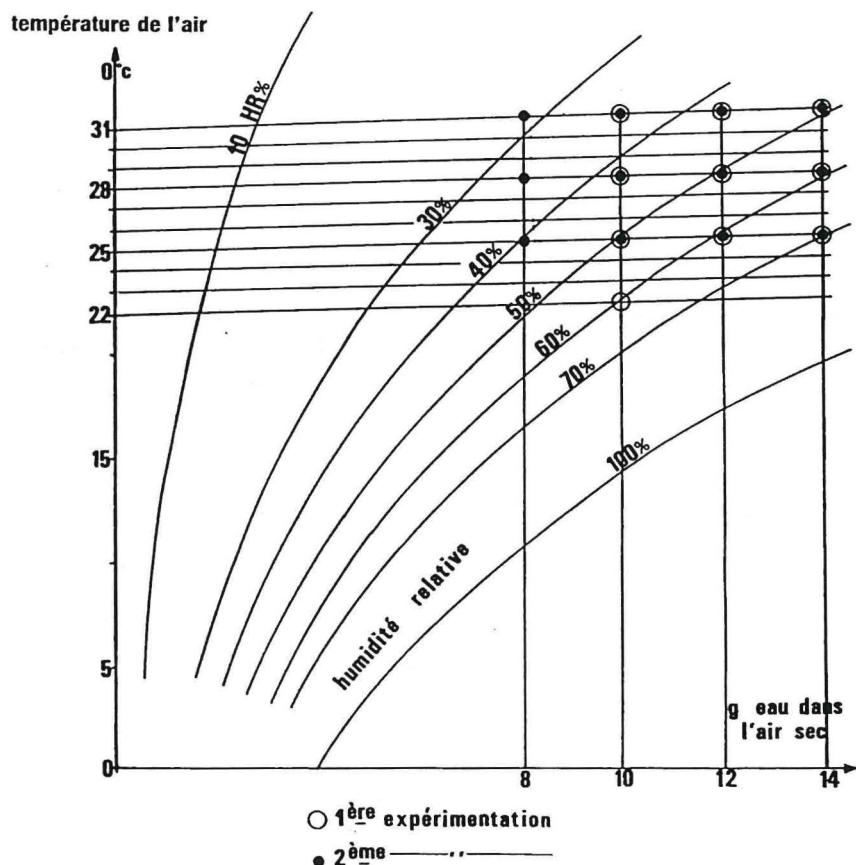


Figure 1

Choix des conditions atmosphériques.
Choice of atmospheric conditions.

TABLEAU 1

Situations théoriques de température et d'humidité relative de la première expérimentation.
Theoretical situations of temperature and relative humidity of the first experiment.

Quantité d'eau en grammes par kg d'air sec	Température de l'air (°C)	Humidité relative (%)
10 grammes	22	60
	25	50
	28	42,5
	31	35
	25	60
	28	50
12 grammes	31	42,5
	25	70
	28	59
14 grammes	31	50
	25	
	28	

TABLEAU 2

Situations théoriques de température et d'humidité relative de la seconde expérimentation.
Theoretical situations of temperature and relative humidity of the second experiment.

Quantité d'eau en grammes par kg d'air sec	Température de l'air (°C)	Humidité relative %
8 grammes	25	40
	28	34
	31	28,5
	25	50
	28	42,5
	31	35
10 grammes	25	60
	28	50
	31	42,5
12 grammes	25	70
	28	59
	31	50
14 grammes	25	
	28	
	31	

Seconde expérimentation

Pour cette seconde étude, on a augmenté à 13 le nombre de coton à tester et on a essayé d'obtenir les conditions climatiques indiquées dans le tableau 2.

Chacun des cotons a été testé 3 fois dans chacune des 12 conditions, ce qui représente 468 tests de collage. Comme on le verra plus loin, il a été parfois difficile d'obtenir exactement ce conditionnement théorique mais on s'en est beaucoup rapproché.

RÉSULTATS ET DISCUSSION

Première expérimentation

Les conditions expérimentales et les résultats obtenus sont réunis dans le tableau 3. On constate d'abord que les conditions d'humidité absolue (teneur en eau de l'air), de température et d'humidité relative observées durant les essais sont très voisines des valeurs théoriques recherchées.

Dans la dernière colonne du tableau, on trouve la valeur moyenne de tous les degrés de collage obtenus pour 3 cotons (le 4^e coton étant un témoin non collant) dans toutes les con-

ditions d'humidité absolue et de température. Le traitement 10 g eau et 31 °C, ayant donné des chiffres aberrants, n'est pas pris en compte.

L'effet du poids d'eau dans l'air et de la température sur le degré de collage a été analysé par la méthode de régression multiple pour chacun des 3 cotons retenus. Le degré moyen de collage dans toutes les conditions de l'expérimentation de chaque coton a été calculé ; il peut être assimilé à ce que nous appellerons le potentiel de collage d'un coton. Ces

TABLEAU 3
Résultats moyens des tests de collage à la minicard obtenus pour 3 cotons (3 répétitions)
dans différentes conditions d'humidité absolue et de température.
Mean results of the minicard stickiness tests obtained for 3 cottons (3 replications)
at various conditions of absolute humidity and temperature.

Humidité absolue g eau/kg air	Température °C		Humidité relative %		Résultats moyens de collage de 3 cotons (3 rép.)	
	Théor.	Obs.	Théor.	Obs.		
10	10,0	22	22	60	60	4,8
	9,8	25	25	50	49,5	4,2
	9,5	28	27,5	42,5	42,0	2,7
12	12,0	25	25	60	60	5,2
	11,5	28	27,8	50	49	3,3
	11,5	31	31,5	42,5	40	2,9
14	14,3	25	25,3	70	70	5,3
	14,0	28	28,0	59	59	5,3
	14,1	31	30,8	50	50	4,2

TABLEAU 4
Effet de l'humidité absolue et de la température sur le degré de collage de 3 cotons.
Incidence of absolute humidity and temperature on the degree of stickiness of 3 cottons.

Réf. coton	Grade moyen de collage	Equation de régression multiple	Coefficient corrélation multiple R	Coefficient détermination $R^2 \times 100$
A1	3,3	$S = 0,612 (\text{H}_2\text{O}) - 0,259 (\text{T}^\circ) + 7,361$	0,788	62,1
C1	4,2	$S = 0,553 (\text{H}_2\text{O}) - 0,310 (\text{T}^\circ) + 6,032$	0,841	70,7
B1	4,7	$S = 0,625 (\text{H}_2\text{O}) - 0,295 (\text{T}^\circ) + 5,465$	0,892	79,6

avec S = degré de collage
 H_2O = poids d'eau en g/kg d'air sec
 T° = température de l'air en °C.

TABLEAU 5
Matrice de corrélation pour les 3 cotons.
Matrix of correlation for the 3 cottons.

Variable	H_2O	T°
Collage A1	0,346	- 0,659
Collage C1	0,525	- 0,440
Collage B1	0,680	- 0,489

TABLEAU 6
Équations de régression.
Regression equations.

Réf. coton	Degré de collage moyen	Équations de régression	Coefficient de corrélation r	Coefficient de détermination $r^2 \times 100$
A1	3,3	$S = 0,0785 (\text{HR} \%) - 0,737$	0,759	57,6
C1	4,2	$S = 0,1164 (\text{HR} \%) - 1,982$	0,845	71,4
B1	4,7	$S = 0,1247 (\text{HR} \%) - 1,741$	0,864	74,6

avec S = degré de collage
 $\text{HR} \%$ = humidité relative en %.

valeurs ainsi que les équations de régressions multiples, les coefficients de corrélation et de détermination (variance expliquée) sont rassemblés dans le tableau 4. La matrice de corrélation entre humidité absolue et température pour les 3 cotons collants est donnée dans le tableau 5.

On constate que le degré de collage est bien expliqué (de 62 à 80 %) par les 2 paramètres utilisés. Les équations de régression et la matrice de corrélation montrent que l'humidité absolue a une influence positive sur le degré de collage alors que la température a un effet négatif. A poids d'eau constant dans l'air, plus la température augmente, moins les cotons collent.

L'humidité relative est la résultante de la combinaison de l'humidité absolue et de la température de l'air. Ses variations permettent également, à un pourcentage un peu moins élevé, d'expliquer les variations du collage d'un coton. Les équations de régression simple obtenues figurent dans le tableau 6.

Une représentation graphique de ces observations est donnée par la figure 2, qui résume l'influence sur le collage en fonction :

- de l'humidité relative pour les 3 cotons ;
- du poids d'eau pour 3 températures différentes (25, 28, 31 °C) ;
- de la température pour 3 niveaux de poids d'eau dans l'air (10, 12 et 14 g par kg d'air sec).

Seconde expérimentation

Suite aux observations faites lors de la première expérimentation, on a préparé 13 cotons pour cette étude, en mélangeant pour certains, des cotons collants de grades différents entre eux afin d'augmenter la gamme de potentiel de collage nul à fort. On a porté dans le tableau 7 les résultats moyens des tests de collage pour les différentes conditions d'humidité de l'air et de température.

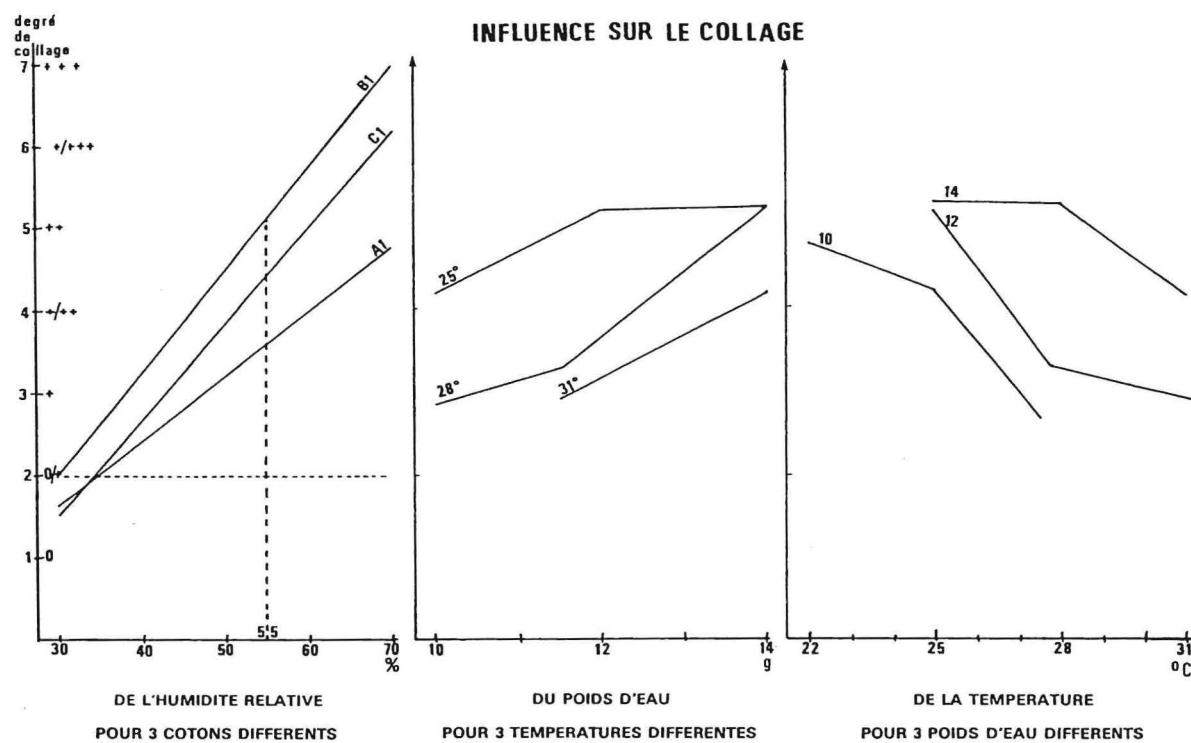


Figure 2

Première expérience.

First experimentation.

TABLEAU 7

Résultats moyens des tests de collage à la minicarte obtenus pour 13 cotons (3 répétitions) dans différentes conditions d'humidité absolue et de température.

Mean results of the minicard stickiness tests obtained for 13 cottons (3 replications) at various conditions of absolute humidity and temperature.

Humidité absolue g eau/kg air		Température °C		Humidité relative %		Résultats moyens de collage de 13 cotons (3 rép.)
Théor.	Obs.	Théor.	Obs.	Théor.	Obs.	
8	7,8	25	25,1	40	39,8	1,7
	8,5	28	28,1	34	35,0	1,6
	8,5	31	30,8	28	31,0	1,3
10	9,8	25	25,1	50	48,2	3,5
	10,0	28	28,3	42	42,2	1,6
	9,7	31	30,2	35	36,2	1,7
12	12,3	25	25,5	60	59,7	4,5
	11,8	28	28,4	50	47,8	3,6
	12,4	31	30,5	42,5	45,0	2,3
14	14,5	25	25,5	70	70,0	5,2
	14,4	28	28,5	59	58,0	4,7
	13,7	31	31,3	50	49,5	3,7

On remarque qu'ont été pratiquement obtenues les conditions théoriques d'environnement que l'on s'était fixées. Seul le taux d'humidité relative recherché de 28 % n'a pas été atteint. Celle-ci a donc varié de 31 % à 70 %.

Les résultats enregistrés permettent de réaliser le graphique 3 montrant d'abord l'influence de l'humidité relative sur le collage. Chaque point, représentant le potentiel de collage, a été obtenu en faisant la moyenne des 3 répétitions

de chacun des 13 cotons testés. Les valeurs du degré de collage augmentent en fonction de l'accroissement de l'humidité relative selon l'équation de régression suivante :

$$\text{Degré de collage (S)} = 0,1167 (\text{HR} \%) - 2,520$$

avec un coefficient de corrélation $r = 0,949$ et un pourcentage de la variation expliquée de 90 %.

* On peut expliquer les effets du poids de l'eau dans l'air et de la température sur le degré de collage à partir de la formule suivante :

$$\text{Degré de collage (S)} = 0,520 (\text{H}_2\text{O}) - 0,263 (\text{T}^\circ) + 4,559$$

avec H_2O = poids d'eau en g/kg d'air sec

T° = température de l'air en °C.

Le coefficient de corrélation multiple R est égal à 0,957 et 91,5 % de la variance sont expliqués.

La matrice de corrélation (tabl. 8) permet de montrer que le poids d'eau dans l'air a plus d'influence que la température sur le degré de collage. On notera par ailleurs que ces deux influences sont opposées.

Le graphique 3 montre également l'effet du poids d'eau dans l'air pour 3 niveaux de température (25, 28, 31 °C) ainsi que l'effet de la température pour 4 niveaux de poids d'eau dans l'air (8, 19, 12, 14 g par kg d'air sec).

L'effet de l'humidité relative de l'air sur le collage de 12 cotons (le treizième n'ayant pratiquement pas collé tout au long de l'expérimentation) a été traduit en équation de régression, les formules étant réunies dans le tableau 9.

TABLEAU 8
Matrice de corrélation.
Correlation matrix.

	Degré de collage	Poids d'eau dans l'air
Poids d'eau dans l'air	0,8511	1,000
Température de l'air	- 0,3704	0,0761

On constate que, pour chacun des cotons, le degré de collage augmente en fonction de l'humidité relative (coefficients de corrélation positifs et significatifs). Par ailleurs, l'augmentation est plus marquée avec les cotons ayant un potentiel de collage élevé (voir pentes des équations de régression).

Les cotons de potentiel de collage voisin ont été regroupés par 2 ou 3 ce qui permet de passer à un total de 5 groupes distincts. De nouvelles équations de régression ont pu être calculées et sont présentées dans le tableau 10.

TABLEAU 9
Equations de régression du collage des 12 cotons.
Regression equations of the stickiness of 12 cottons.

Réf. coton	Degré de collage moyen	Equations de régression	Coefficient		Test* Durbin-Watson
			corrélation r	détermination $r^2 \times 100$	
C25	1,9	$S = 0,0622 (\text{HR} \%) - 0,969$	0,767	58,8	0,99
B25	2,1	$S = 0,081 (\text{HR} \%) - 1,659$	0,853	72,8	1,07
B50	2,3	$S = 0,1349 (\text{HR} \%) - 3,988$	0,906	82,1	1,27
C50	2,6	$S = 0,1025 (\text{HR} \%) - 2,248$	0,829	68,7	1,13
B75	2,7	$S = 0,1294 (\text{HR} \%) - 3,371$	0,871	75,9	1,58
C75	2,9	$S = 0,0979 (\text{HR} \%) - 1,697$	0,743	55,3	0,81
B+	2,9	$S = 0,1552 (\text{HR} \%) - 4,387$	0,917	84,2	1,59
C++	3,1	$S = 0,118 (\text{HR} \%) - 2,473$	0,907	82,2	1,58
D25	3,5	$S = 0,1331 (\text{HR} \%) - 2,765$	0,802	64,3	1,15
D50	3,9	$S = 0,1433 (\text{HR} \%) - 2,853$	0,761	58,0	0,97
D75	4,6	$S = 0,1644 (\text{HR} \%) - 3,150$	0,819	67,1	1,03
D+++	4,8	$S = 0,1775 (\text{HR} \%) - 3,540$	0,834	69,6	0,32

avec S = degré de collage

H_2O = poids d'eau.

* Le test de DURBIN-WATSON peut être compris entre 0 et 4. Lorsqu'il est voisin de 2, il indique l'indépendance des erreurs ; lorsqu'il tend vers 0, il indique une corrélation positive entre les résidus ordonnés et lorsqu'il tend vers 4, une corrélation négative.

* The DURBIN-WATSON'S Test may range from 0 to 4. When it is close to 2, it indicates error independence. When it tends towards 0, it indicates a positive correlation between ordinate remainders, and a negative correlation when it tends towards 4.

TABLEAU 10
Equations de régression du collage de 5 groupes de coton.
Regression equations of the stickiness of 5 groups of cotton.

Réf. coton groupes	Degré de collage moyen	Equations de régression (S = degré de collage)	Coefficient	
			régression r	détermination $r^2 \times 100$
A(C25 + B25)	2,0	$S = 0,0716 (\text{HR} \%) - 1,314$	0,879	77,3
B(B50 + C50 + B75)	2,5	$S = 0,1223 (\text{HR} \%) - 3,202$	0,944	89,1
C(C75 + (B+) + (C++))	2,9	$S = 0,1237 (\text{HR} \%) - 2,852$	0,943	88,9
D(D25 + D50)	3,7	$S = 0,1382 (\text{HR} \%) - 2,809$	0,802	64,3
E(D75 + D+++)	4,7	$S = 0,1709 (\text{HR} \%) - 3,345$	0,853	72,8

Major research carried out by the IRCT on the origin and detection of sticky cottons *

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General points

The stickiness of cottons is due to a pollution of the fiber caused by the sugar dejections secreted by two homoptera, an aphid, *Aphis gossypii* (GLOV) and the aleurode *Bemisia tabaci* (GENN).

These sugary substances are called «entomological sugars» as opposed to the sugars normally contained in the fiber, which are designated as «physiological sugars».

The way sugars form a deposit, at first in the cotton boll, then, after infestation by the *Bemisia* and *Aphis* parasites, on the fiber itself, after boll maturation is a phenomenon that is now better known.

These observations result in particular from the research directed by IRCT, according to which several types of sugars can be distinguished.

- 1 — On the fiber inside the boll: physiological sugars and physiological polyols
- 2 — following infestation of the fibers by the parasites, after maturation of the boll: entomological sugars and enzymatic degradation sugars.

Table 1 shows the sequence in which glucides deposit on cotton fibers.

TABLE I
The sequence in which glucides deposit on cotton fibers.

Inside the boll	After infestation by <i>Bemisia</i> or (and) <i>Aphis</i>	After a long stay in the field
Physiological sugars:	Entomological sugars:	Enzymatic degradation sugars:
Fructose	Fructose	Trehalose
Glucose	Glucose	Cellobiose
	Saccharose	Maltose
	Melezitose	
	Fructomaltose	
Physiological polyols:		Enzymatic degradation polyols:
Glycerol		Glycerol
Erythritol		Arabitol
Inositol		Mannitol

(According to BELA TALPAY 1963)

«Physiological» sugars, which are mostly reducing sugars (glucose and fructose) can be detected by simple and qualitative chemical methods (PERKINS method and FEHLING-MASSAT and BENEDICT tests). These sugars do not cause any stickiness.

The «entomological» sugars, which are made up of reducing sugars, non-reducing sugars and polyols (alcohol function sugars), can only be measured by means of more complex analysis methods, i.e. thin-layer chromatography, gas chromatography, etc. These are the sugars mainly responsible for stickiness.

It is a mistake to think that a simple chemical test will give indications on the stickiness potential of a cotton and tests designed to reveal the presence of reducing sugars are likely to give disappointing results.

On the other hand, a mechanical test carried out with a Shirley miniature card is a good indicator of the degree of stickiness. The results of this test, which has been developed by IRCT, are considered to be fairly reliable, although their correlation with fiber behavior during spinning has not been rigorously established. At present, it is the only existing reliable test and it has been recommended by the ITMF work group on honeydew.

* Article published in English in «Cotton production, harvesting and ginning with special emphasis on fiber quality», papers from a technical seminar at the 46th Plenary Meeting of the ICAC, Brussels, Belgium, October 1987, 19-31.

Over the past few years, IRCT has undertaken investigations to clarify the evolution of insect honeydew deposits on plants in the field by studying in particular the efficiency of insecticide sprayings and the influence of crop frequency, after boll maturation, on the degree of stickiness.

Data analysis was used to attempt to explain stickiness as estimated with a minicard test, by the overall study of chemical tests and analyses rather than, as is generally

the case, by their isolated use.

The influence of the ambient hygrometric conditions and of the cotton blends on the stickiness potential was defined by rigorous experiments.

Finally, IRCT has just developed a new method of stickiness evaluation : thermodetection, which, since it is more efficient, will soon replace all the other tests.

This paper presents the results of these experiments.

Attempt at explaining stickiness by data analysis of chemical tests

The method chosen were principal component analysis (PCA), segmentation by maximization of the variance difference between groups and segmentation by correlations.

The variables selected for this study were the following: chemical tests of reducing sugars, pH and total dry extract after soaking the fiber in water, sugar content by thin-layer chromatography. One more variable was added, colorimetry before and after heating. Stickiness by minicard test was evaluated according to 7 degrees. 57 cottons were used for experimenting the three methods.

Principal component analysis

PCA is one of the basic methods of data analysis, commonly used to describe tables of quantitative data because the information contained is well displayed. This method is also good for classifying a group of individuals to obtain a partition of this group into classes of related elements.

The first 3 axes created by diagonalization of the correlation matrix sum up 84.4% of the information, while 59.8% are summed up in axis 1 alone (Fig.1, p.4). All the variables are well represented on axis 1 (Table 2) especially the total dry extract (TDE), the Benedict test (BET), the post-heating yellowness degree (+BP) and the saccharose, as well as a created variable, the pH/total dry extract ratio (pH/TDE). It is also on this axis that the minicard test is best represented; it can therefore be deduced that axis 1 is the axis of stickiness and that the variables which are well represented on it contribute to the creation of stickiness.

The individuals classified by increasing order and represented in surface 1-2 are evenly distributed along axis 1. The study shows that it is fairly easy to characterize the extreme grades of stickiness. On the other hand, the identification of moderate grades is very uncertain.

Abbreviations of the variables in Figure 1

PH :	pH
EST :	total dry extract
TBE :	BENEDICT test
RDP :	reflectance after oven drying
+ BP :	post oven drying yellowness index
GLU :	glucose
SAC :	saccharose
PH/EST:	pH/total dry extract relation
TCM:	minicard test

Quantitative segmentation by maximization on the variance difference between groups.

With this method, the explanatory variables have to be previously divided into classes. Segmentation is done by selecting the partition, in two classes on one variable, which maximizes the variance between classes in relation to the variance within classes. This operation is repeated on the two sub-groups until classes are formed which are small enough or have no significant relation with stickiness.

The variables which make the first segmentations possible are pH and total dry extract as well as glucose. Next come the post-heating colorimetry tests and tests indicating the presence of sugars, which incidentally behave in complete contradiction to all expectations. Sugar contents themselves intervene last and show groups of stickiness which do not differ much from one another (Fig.2, p.5).

Abbreviations of variables in Figure 2

RDP :	Reflectance after oven drying
+BP :	Yellowness degree + b after oven drying
EST :	Total dry extract
PH :	pH
FRU :	Fructose
GLU :	Glucose
SAC :	Saccharose
MEL :	Melezitose
TBE:	BENEDICT test
FEMA:	FEHLING test

For this study, the stickiness classes range from 0 to 6.

With this method it is fairly easy to distinguish very sticky cottons from unsticky ones, but the identification of moderately sticky cottons remains largely uncertain.

Segmentation by correlations.

In order to segment, the variable which presents the best correlation with the minicard test was selected. A classification was made on this variable, and the population was divided into two groups of stickiness values as different as possible. For each group, the variable presenting the best correlation with the minicard test was found and segmentation went on as above, until the correlation with the minicard test became insignificant.

Table 2 gives the initials selected for each variable and their correlations with stickiness on the original population.

During segmentation, it appeared that the pH and total dry extract variables were best correlated with the minicard test and would therefore be most useful for detecting sticky cottons. The BENEDICT test and the +b (yellowness degree) (Fig. 3, p.6) come next. For this study the minicard stickiness degrees range from 1 to 7.

This data analysis method, like the two previous ones, makes the distinction between unsticky and very sticky cottons possible but remains uncertain when moderately sticky cottons are involved.

Efficiency of insecticide treatments and influence of crop frequency on stickiness

Reasons for the appearance of sticky cottons

Over the past ten years, the sticky cotton phenomenon has become most alarming. By identifying the changes that have taken place during this period, we can try and discover the reasons for this problem.

Prior to 1980, in the African producing countries, insecticide protection was provided by organophosphorous compounds which, in general, proved to be very good aphicides. With these active products used throughout the crop year, the aphis population could be controlled so that no pollution of this homoptera could be developed or observed, even at the end of the crop year. In 1980, the use of synthetic pyrethroids became a common agricultural practice. These new active products, which have largely improved the control of carpophagous caterpillars, unfortunately have the inconvenience of being inefficient with aphis, aleurodes and acarida. In order to avoid this type of problem, pyrethroid-organophosphorous associations have been used in spraying programs, by alternating both products. However, among the organophosphorous compounds selected, the low toxicity-towards-humans criteria was given priority over efficiency against *Aphis*.

TABLE 2
Calculated correlations on the whole population

Explanatory variables		Correlation coefficient with the variable to be explained (minicard test)	Significance
pH/dry extract	PH/EST	-0.488	**
Total dry extract	EST	0.432	**
pH	PH	-0.376	**
Glucose	GLU	0.356	**
Fructose	FRU	0.281	*
BENEDICT test	TBE	0.269	*
Thin layer melezitose	MEL	0.249	NS
FEHLING test	FEMA	0.244	NS
Post oven drying Rd%	RDP	-0.234	NS
Saccharose	SAC	0.229	NS
post oven drying +b	+BP	0.206	NS
Pre oven drying Rd%	RDAET	-0.098	NS
Pre oven drying + b	+BAET	0.094	NS

** 1% Significant * 5% Significant

General conclusions on explaining stickiness by data analysis

These experiments point out the importance of pH and total dry extract in detecting stickiness. However, the role of tests on reducing sugars and the role of the sugars themselves have not been clearly defined by the present research.

Moreover, these methods are very complex and, from a practical point of view, difficult to use.

The use of the organophosphorous products selected, which were not aphicides, can therefore be blamed for the persistence of cotton stickiness. However, it would be wrong to believe that this problem results only from the choice of insecticides. Other factors have undoubtedly contributed to increase it.

Reduced pluviometry, since the beginning of the eighties, has been observed in the African producing countries and this change has perhaps favoured the pullulation of some insects. Populations of aleurodes are known to overrun the cotton crops in large numbers at the end of the crop year, when the dry season begins. The earlier dry season might also be a factor contributing to intensify the stickiness phenomenon.

Applying balanced mineral fertilization strengthened by nitrogen complements on cotton sown too late is certainly responsible for aggravating the problem. Often, at the end of the crop year a profuse vegetation can still be observed on the cotton plots, which probably contributes to maintain and develop *A. gossypii* and *B. tabaci* populations.

Furthermore, there is a tendency to harvest later and later, and over too long a period of time. This situation can be explained by various factors: increase of yield, extension of cotton fields by the farmer. The seed cotton thus remains exposed to the dejections of the two homoptera for a longer time and this condition obviously worsens the problem of sticky cottons.

Finally, the evolution of spinning techniques, new equipment and increased spinning speed have undoubtedly made the problem a lot worse than it would have been without these technical changes.

Action of insecticide treatments on stickiness

IRCT researchers have developed special tests to check the efficiency of insecticide protection and the influence of harvesting dates on stickiness.

The dynamism of the insect populations responsible for the stickiness makes the realization and interpretation of such tests very difficult.

In all the tests mentioned below, the degrees of fiber stickiness have been measured according to a scale created by IRCT to be found in the annex (cf. p.24). Degree 1 indicated no stickiness and degree 7 that there is maximum stickiness.

Trial carried out in Touboro, Cameroon in 1982-83

In this trial, three levels of fertilization (no fertilization, fertilization, reinforced fertilization) were compared under three levels of phytosanitary protection (no spraying, spraying every 14 days, spraying every 7 days). The insecticides used were Decis (pyrethroid) and Hostathion (organophosphorous). The normal fertilizer formula consisted of 200 kg/ha of 14 - 23 - 15 - 6 - 1, while the strengthened fertilizer was the same plus 5 tons/ha of cattle pen soil.

The results of the stickiness trial are shown in Table 3.

TABLE 3
Results of the minicard stickiness tests in the 1982-83 Touboro trial.

Objects	Stickiness degree
No spraying	T1 without fertilizer 3.3 T2 normal fertilizer 3.8 T3 reinforced fertilizer 4.0
Spraying every 14 days	T1 1.0 T2 1.8 T3 1.5
Spraying every 7 days	T1 1.8 T2 1.0 T3 1.5

The conclusions are:

- . whether applied at 14 or 7 days, insecticide sprayings almost completely eliminated stickiness ;
- . in the case of the unsprayed objects, the increase of the fertilizer dose resulted in an increase of the stickiness degree.

Trial carried out in Maroua, Cameroon, in 1983-84

In this special test for Aphis control, one unsprayed control was compared with 4 product formulas:

- A- 5 applications of cypermethrin (pyrethroid) every 15 days;
- B- 5 applications of cypermethrin + profenofos (organophosphorous) every 15 days;
- C- 5 applications of cypermethrin + profenofos (the latter doubled at the last treatment) every 15 days;
- D- 6 applications of cypermethrin + profenofos every 15 days.

The first applications took place on August 5, at the beginning of flowering and the last (6th) on October 19, at the beginning of harvesting which lasted until December 30.

TABLE 4
Results of the Minicard stickiness tests in the 1983-84 Maroua trial.

Harvesting date	Oct.15	Oct. 30	Nov. 15	Nov. 30	Dec. 15	Dec. 30
Unsprayed control	3.5	4.5	5.0	5.5	7.0	7.0
A treatment	3.5	4.5	4.0	-	5.5	6.0
B treatment	3.0	2.0	3.0	5.5	5.5	6.5
C treatment	2.5	1.5	2.5	5.0	6.0	7.0
D treatment	2.0	2.0	3.5	5.0	5.5	6.0

Table 4 summarizes the results of the minicard stickiness tests obtained for different sprayings at different harvesting dates. Fig. 4 (p.8) shows the graphic representation of these results.

Interesting conclusions can be drawn from these experiments.

. The unsprayed control plot had a fairly high degree of stickiness from the first harvest date. It then increased until it reached maximum stickiness in December, at the time of the last harvest.

. Treatment A, with the sole protection of a pyrethroid gave results similar to the previous test. This product had no effect on Aphis.

For treatments B, C and D, where an organophosphorous was associated with a pyrethroid, protection against *Aphis* seemed efficient until November 15, that is about one month after the last insecticide spraying of the object which was protected for the longest time (D). It is to be noted that doubling the amount of organophosphorous (C) seemed to give better results than an additional spraying (D). No remanence was observed for any of the objects after one month.

Observation plots in Chad in 1984-85.

On several plots in various places, the following objects were compared.

A- Control plot protected against insects.

B- Standard treatment with 5 applications every 15 days consisting of:

- . for the first three, deltamethrin-triazophos,
- . for the last two, deltamethrin-dimethoate (powerful aphicide).

C- Maximum treatment with a total of 14 applications, consisting of:

- . for the first 7, deltamethrin-triazophos,
- . for the last 7, deltamethrin-dimethoate.

Table 5 shows the results of the minicard stickiness tests obtained by the different objects.

TABLE 5
Results of the stickiness test carried out in Tchad in 1984-85

Protection level	Places		
	Bebedja	Bekamba	Poudouye
A - unprotected	1.8	5	5
B - standard	1.3	4	2
C - maximum	1.3	3	2

In Bebedja, the infestation by *Aphis* was probably very low and no difference was noticed.

In Bekamba, the standard treatment did not provide very good protection. Maximum protection was slightly better.

In Poudouye, the standard and maximum protection were identical and gave good results.

Sticky cotton trials in Burkina Faso in 1985-86

This trial, which compared 4 objects, was aimed at controlling *B. tabaci* and *A. gossypii* populations through complementary insecticide sprayings applied at the end of the vegetative cycle.

— Object A : 4 sprayings with sumicidin profenofos (organophosphorous).

— Object B : object A + 2 additional sprayings with omethoate (organophosphorous).

— Object C : object A + 5 additional treatments with omethoate.

— Object D : object A + 10 additional treatments with omethoate.

For objects C and D, protection continued beyond the first harvest date. Each object was harvested at 5 different dates (Nov. 1, Dec. 1, Jan. 1, Feb. 1, March 1) in order to leave the cotton exposed to parasite attacks over an increasingly long period.

Table 6 shows the results of the minicard tests obtained for the different objects at different harvest dates.

TABLE 6
Results of the stickiness tests in the 1984-85 Burkina Faso trial.

Treatments	Harvesting date				
	1-11	1-12	1-1	1-2	1-3
A : 4 sumicidin-profenofos sprayings	2.0	3	4.7	3.7	4.7
B : A + 2 omethoate sprayings	1.7	3	2.0	3.7	3.3
C : A + 5 omethoate sprayings	1.3	3	1.7	3.0	3.0
D : A + 10 omethoate sprayings	1.3	1	1.3	3.0	2.7

Figure 5 (p. 10) shows the graphic representation of these results.

A - 4 sumicidin-profenofos sprayings ended Sept. 20.

B - 4 + 2 omethoate sprayings ended Oct. 20.

C - A + 5 omethoate sprayings ended Dec. 5.

D - A + 10 omethoate sprayings ended Feb. 20.

The conclusions which can be drawn from this trial follow, although they were not always very clear.

. When the sprayings were suspended, insect populations developed and stickiness increased. Nevertheless, the two additional omethoate sprayings seemed to have a retarding effect on the population and therefore on the increase of stickiness.

. It appeared that continuing sprayings after the beginning of the harvest (object C and D) protected cotton, all the better if they were numerous.

The general conclusions of the various trials, even though they are not always in agreement with each other are:

. that product selection is decisive in the control of *Aphis* and *Bemisia*;

. that product remanence is limited and at best it never seems to exceed one month. It is therefore of prime importance for the protection of the fiber that harvesting be carried out as fast as possible.

ANNEX - Estimating degrees of stickiness with the minicard test

Level of card stickiness		Definition of card Stickness
Grade	Degree	
0	1	No trace of stickiness
0/+	2	A few spots which could be stickiness: the web tends to stick to the cylinders but does not roll up.
+	3	Clear stickiness traces, but the cotton does not necessarily roll up; when it does, it is after a long time, more than one minute.
+/++	4	Fairly numerous stickiness traces, cotton rolls up after about one minute.
++	5	Numerous traces of stickiness, cotton tends to roll up quite quickly, in about half a minute.
++/+++	6	Numerous traces of stickiness, cotton rolls up very quickly.
+++	7	Immediate stickiness and almost instantaneous rolling up.

Influence of hygrometric conditions and cotton blends on the stickiness potential

The experiments carried out by IRCT aim at defining the conditions of temperature and water content in the air which must be respected in order to conduct efficient and reproducible minicard tests. They are also designed to give mill owners indications on the limits of air values in which they should work to decrease, if not eliminate disruptions due to sticky cottons. In what proportion can sticky cottons be added to a blend without causing a problem? That is also what we have attempted to define.

Influence of water content and air temperature on cotton stickiness tests with a laboratory minicard.

In this experiment, the air temperature conditions were made to vary from 22 to 31 degrees centigrade and the water quantity, in grams per kilogram of dry air, from 8 to 14 which produced a relative humidity ranging from 28.5% to 70%. Cottons with different stickiness potentials have been submitted to the minicard test and studied in these various conditions.

The results obtained show that the degree of stickiness of a cotton estimated by means of these tests depends on three factors: its stickiness potential, the water content and the air temperature.

The relative humidity of the air, which is just a combination of water content and temperature, has a positive effect on the degree of stickiness. The experiment established that the effect is more obvious with sticky cottons having a higher initial stickiness potential.

Calculations have determined the regression equations which give the stickiness degree as a function of relative humidity for cotton groups with different stickiness potentials. The results are summarized in Table 7 which shows the average stickiness degree of cotton (potential value), the stickiness equation and what these equations signify.

Figure 6 (p. 11) is the graphic representation of the equations in Table 7.

TABLE 7
Regression equations of the stickiness of 5 groups of cotton

Groups of cottons	Average stickiness	Regression equation (y = Degree of stickiness)	Coefficient	
			Regression	Determination x 100
A	2.0	y = 0.0716 (HR %) - 1.314	0.879	77.3
B	2.5	y = 0.1223 (HR %) - 3.202	0.944	89.1
C	2.9	y = 0.1237 (HR %) - 2.852	0.943	88.9
D	3.7	y = 0.1382 (HR %) - 2.809	0.802	64.3
E	4.7	y = 0.1709 (HR %) - 3.345	0.853	72.8

It was verified that the results of stickiness obtained with regression equations including water weight and temperature were identical to those given by equations involving relative humidity only. With the same relative humidity obtained by different temperature and water content conditions, a given cottontype will have exactly the same stickiness degree.

A well defined relative humidity test should be chosen for the tests. If RH% is too low, that is around 35%, practically no cotton will stick, whatever its potential may be. On the other hand, if relative humidity is too high, over 60-65%, even cottons with average potentials will have a maximum degree of stickiness.

We proposed to select the value of 55% RH for the tests, since it seemed the most discriminative to us.

Study of minicard stickiness on sticky and unsticky cotton blends.

This study was especially devised to help cotton users solve the problems related to stickiness in spinning mills.

First experiment

Three cottons with different stickiness potentials were mixed in variable proportions with an unsticky cotton. Stickiness was then checked with minicard tests in different relative humidity conditions.

The selected proportions of sticky cotton in the blends were 75%, 50%, 25% and 0%, and the blends were studied at 28.5-35% RH, 40-42.5% RH, and 50, 60 and 70% RH.

The regression equations obtained for each blend are grouped in Table 8.

TABLE 8
Regression equations giving the stickiness degree at different RH, for blends of non sticky and sticky cottons.

Relative humidity %	Regression equation $y = \text{stickiness degree}$	Correlation Coeff R	Significance
28.5 to 35	$y = 1,2889 - 0,0027 \% A$	- 0.2009	NS
40 to 42.5	$y = 1,5607 - 0,003 \% A$	- 0.2077	NS
50	$y = 3,2444 - 0,0173 \% A$	- 0.6797	**
60	$y = 5,5333 - 0,03666 \% A$	- 0.8720	**
70	$y = 6,8389 - 0,0442 \% A$	- 0.7748	**
Blend of A Cottons (non sticky) and C (sticky)			
28.5 to 35	$y = 1,9556 - 0,009 \% A$	- 0.4241	**
40 to 42.5	$y = 2,1810 - 0,0104 \% A$	- 0.5074	**
50	$y = 3,4667 - 0,0196 \% A$	- 0.7404	**
60	$y = 4,8667 - 0,0307 \% A$	- 0.8510	**
70	$y = 6,4722 - 0,0455 \% A$	- 0.8232	**
Blend of A cottons (non sticky) and D (sticky)			
28.5 to 35	$y = 2,2 - 0,008 \% A$	- 0.3800	**
40 to 42.5	$y = 3,3139 - 0,0219 \% A$	- 0.7135	**
50	$y = 7,5778 - 0,0533 \% A$	- 0.8168	**
60	$y = 7,8333 - 0,0473 \% A$	- 0.8056	**
70	$y = 7,7611 - 0,0518 \% A$	- 0.8834	**

They represent, for the different relative humidity levels of the experiments, the formulas which give the stickiness degree at different RH for blends of sticky and non sticky cottons.

Figures 7, 8, 9 (p. 13) show the graphic representation of the results for each blend. These results are given in Table 9.

Determination of stickiness in blends depends on the stickiness potential of the sticky cotton, on the decreasing proportion of this same cotton in the blend and on the relative humidity of ambient air.

For a 25% proportion of sticky cotton, stickiness can only be eliminated at low relative humidity, up to 50%, and this is not even completely true for the cotton which was initially the stickiest.

TABLE 9
Study of minicard stickiness for blends of non sticky (A) and sticky (A or B or C) cottons.

Proportion of sticky cotton	Relative humidity				
	28.5-35%	40-42.5%	50%	60%	70%
Cotton blends A (non sticky) and B (sticky)					
100 %	1.3	1.4	3.0	6.0	6.3
75 %	1.2	1.6	3.0	5.0	6.3
50 %	1.0	1.4	2.3	3.7	4.0
25 %	1.2	1.4	2.4	3.2	5.0
0 %	1.0	1.2	1.1	1.5	1.3
Cotton blends A (non sticky) and C (sticky)					
100 %	1.8	2.0	3.3	4.5	6.0
75 %	1.9	2.2	2.8	4.5	5.0
50 %	1.7	1.6	2.9	3.3	5.7
25 %	1.1	1.4	2.3	2.8	3.0
0 %	1.0	1.2	1.1	1.5	1.3
Cotton blends A (non sticky) and D (sticky)					
100 %	1.9	3.3	6.9	7.0	7.0
75 %	2.1	2.9	6.4	6.7	7.0
50 %	2.1	1.9	5.4	6.3	5.3
25 %	1.8	1.9	4.7	5.8	5.0
0 %	1.0	1.2	1.1	1.5	1.3

These results seemed insufficient, so we decided to undertake a second series of tests to clarify them.

Second experiment

Three cottons with different stickiness potentials were mixed in variable proportions (20%, 15%, 10%, 5%) with an unsticky cotton. Stickiness in these blends was checked with a minicard test carried out at a constant relative humidity (55%). The results are shown in the following Table 10 (p. 14)

Graphic representation of these results is given in Figure 10.

The two cottons with the lowest stickiness potential can reach a 20% proportion in the blend for the phenomenon to disappear, while the stickiest cannot exceed 5%.

Conclusions of this study

It appears that the results obtained could be of interest to mill owners in helping them to manufacture blends using sticky cottons.

TABLE 10
Minicard stickiness of different cotton blends.

Proportion of sticky cotton	Different blends studied		
	A + B	A + C	A + D
100%	6.3	3.0	4.7
20%	3.7	2.0	2.7
15%	3.7	1.5	1.7
10%	3.0	1.5	2.3
5%	2.0	1.5	2.0
0%	1.0	1.0	1.0

A = unsticky cotton
B, C, D = sticky cottons

In order to avoid the appearance of the phenomenon, the ambient working conditions, relative humidity of the air and stickiness potential of the cotton should be taken into account in the manufacturing of the blends. These conditions are clearly shown in the various graphs included in this paper.

Determination of the stickiness potential of cottons with a thermodetector

The following section explains the principle of thermodetection of stickiness (annex 1 and 2, p. 29 and 30).

A cotton web is placed between two aluminium sheets, and the whole is laid on the bottom plate of a

heating press especially modified for this study. Pressure is exerted on the top of the heating plate of the press for a very short time, a few seconds, at a temperature exceeding 100 degrees. A second pressure is exerted with no heat for a relatively long time, a few minutes, after which the

preparation is left to settle for one hour. Detection of the stickiness degree can then be undertaken. The cotton web is removed from the aluminium sheets and only the sticky spots which, with a few fibers have a strong adherence, remain. Then these spots merely have to be counted to discover the intensity of cotton stickiness.

In order to determine the value of the results given by thermodetection, a correlation was established between this method and the results obtained by the minicard test which is presently recognized as the most reliable. For this experiment, 51 cottons with different stickiness potentials were used. The best adjustment is in the form $Y = a + b \sqrt{x}$ and the regression equation found is:

degree of minicard stickiness

$$= 0.324 + 0.802 \sqrt{\text{number of sticky spots by thermodetection}}$$

The correlation coefficient $r = 0.974$ is highly significant and this relation explains 94.8% of the variance. Figure 11 shows a cross projection of the results of this study (p. 15.)

The thermodetection method described above is therefore very well correlated with the laboratory card test. The latter is a very costly test which can only be carried out in a perfectly conditioned atmosphere, which is not the case for thermodetection.

This method will make it possible for a larger number of users to estimate the stickiness phenomenon. This is the reason why IRCT-CIRAD technical management services have financed the manufacturing of this heating press and associated equipment (manual blender; conditioning box for 30 samples). This press, under the reference RF13, has the advantages of a simple design, low cost and no maintenance. It will become a valuable tool for studying cotton stickiness.

It will enable development companies to obtain information on sticky cottons and spinners to estimate the degree of fiber stickiness before processing is started in the mill.

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-
- Les analyses chimiques ont été effectuées par le laboratoire de chimie de l'IRCT, avec la collaboration de Mmes MARQUIÉ C. et VIALETTES V.
- Les analyses mécaniques de collage furent effectuées par le laboratoire de microfilature de l'IRCT.
- Les analyses de données ont été effectuées avec l'aide du service de biométrie de l'IRCT.

Thermodetector IRCT - RF 13

A tool indispensable to researchers as well as mill owners... detects sticky cottons and indicates their degree of stickiness.

Principle

The test shall be carried out in a room with a relative humidity of 55 %. A 2,5 g cotton web prepared with the F2 lapper is sandwiched between two aluminium sheets and placed into the thermodetector ; the whole thing is then submitted to a determined amount of heat and pressure for a few seconds.

In order to find out the degree of stickiness, all there is to do is count the spots adhering to the aluminium supports and compare the number obtained with the reference table : light, average or high stickiness.

If the required ambient conditions are impossible to create in the space chosen, the cotton samples can and should be conditioned and maintained in the right state with the FG 49 conditioning box (see option).

Advantages

- Quick, reliable quantitative test
- Compact maintenance - free equipment
- Supports can be reused for later readings

Characteristics

IRCT - RF 13 Thermodetector

Weight	: 47 kg
Dimensions L x H x D	: 80 x 40 x 80 cm
Voltage	: 220 V - 50 Hz

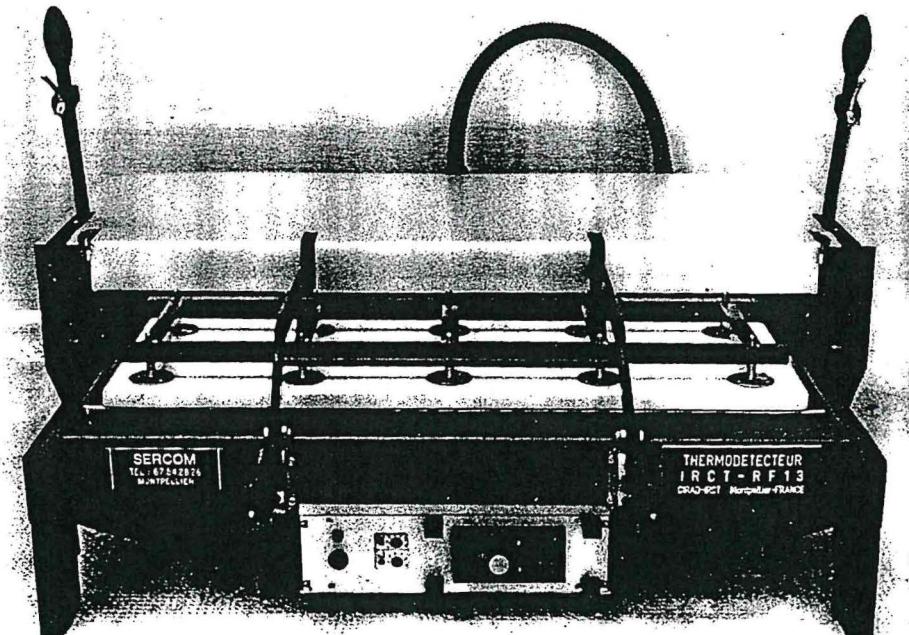
F2 Lapper

Fitting	: stripper
Weight	: 1,3 kg
Dimensions L x H x D	: 57 x 5 x 25 cm

Option

FG 49 Conditioning box for 20 samples

Weight	: 22 kg
Dimensions L x H x D	: 80 x 55 x 30 cm
Voltage	: 220 V - 50 Hz



CIRAD - IRCT, BP 5035 - 34032 MONTPELLIER CEDEX, FRANCE - TELEPHONE : 67.61.58.00
TELEX : 480 762 F - TELEFAX 67 52 06 25

Conditioning box FG 49 S

Objective :

When thermodetector stickiness tests for cotton specimens are carried out in a location where the relative humidity is below recommended standards (50 % to 65 %), preliminary humidifying of specimens is essential.

Using the FG 49 box, specimens may be brought to and maintained at a chosen humidity level. The apparatus can not condition at a humidity level which is lower than that of the operating location.

Principle :

A ventilator mounted on the end of the box circulates humidified air ; two other ventilators stabilize the humidity which is regulated by an electronic probe.

This principle enables a rapid increase of humidity, continuous ventilation, and consequently an accelerated conditioning (1 hour), with no condensation on the walls.

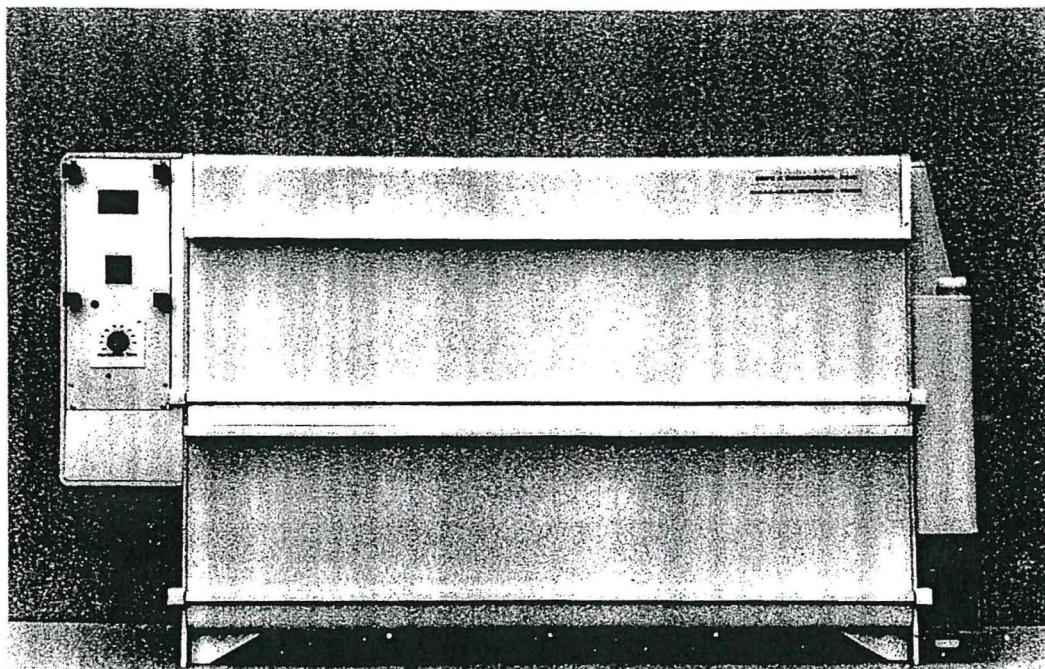
Two compartments provide a potential maximum storage for about 40 cotton specimens.

Advantages :

- rapid conditioning, stable at + or - 3 %
- compact
- almost maintenance-free
- convenient

Specifications :

— Power	: 60 W
— Weight	: 20 kg
— Dimensions L x H x D	: 96 x 56 x 30 cm
— Voltage	: 220 V - 50 Hz



Notes brèves

Brief notes

L'enceinte à conditionner FG 49, pour humidifier le coton avant le test de collage au thermodétecteur

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RÉSUMÉ

Lorsque les tests de collage des fibres au thermodétecteur IRCT RF13 doivent être effectués dans un local où l'humidité relative est inférieure aux normes recommandées (50 % à 65 % H.R.), il est indispensable d'humidifier, au préalable, les échantillons.

A cet effet, le laboratoire de Technologie de l'IRCT a conçu et fait réaliser l'enceinte à conditionner FG 49. Pour les essais,

l'humidité relative est portée à 62 %, à l'aide d'un système simple de recyclage d'air humidifié ; cette valeur est maintenue stable ($62 \pm 2\%$), grâce à une sonde électronique.

Des essais, effectués à partir de coton auparavant desséchés à l'étuve à 0 % d'humidité, montrent qu'un délai relativement bref (35 mn) suffit pour qu'un coton mis sous forme de nappe, atteigne son équilibre hygroscopique.

MOTS CLÉS : enceinte, humidificateur, coton, fibre, collage.

DESCRIPTION DE L'ENCEINTE

L'enceinte (fig. 1), de dimensions $80 \times 55 \times 30$ cm (L × H × P), est équipée de deux ventilateurs. Le rôle du premier est d'entraîner une circulation d'air humidifié ; cet air est recyclé et se réhumidifie en passant à travers une toile de coton qui trempe dans un bac contenant de l'eau. La sélection de l'humidité s'effectue à l'aide du bouton de l'humidistat ; elle est régulée par une sonde électronique. Lorsque l'humidité a atteint une valeur proche de celle

désirée, le premier ventilateur s'arrête ; le second entre en fonctionnement pour la stabiliser, en aspirant l'air ambiant du local. C'est pourquoi, cet appareil ne peut conditionner à une humidité inférieure à celle du local où il se trouve.

Par enregistrement avec un hygromètre à cheveux, nous avons vérifié que l'humidité relative dans l'enceinte reste stable ($\pm 2\%$), dans les conditions de température et d'humidité de notre local (fig. 2).

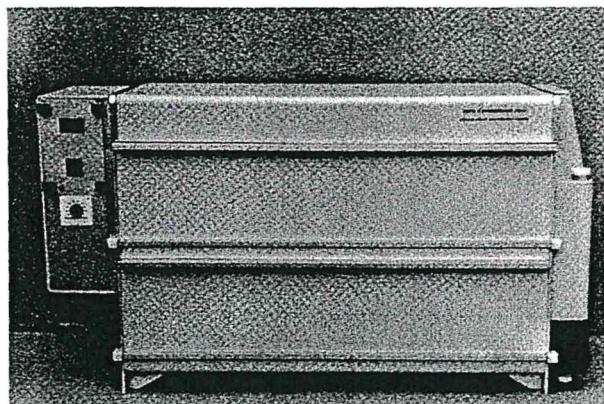


Figure 1

L'enceinte à conditionner FG 49.

FG 49 conditioning box.

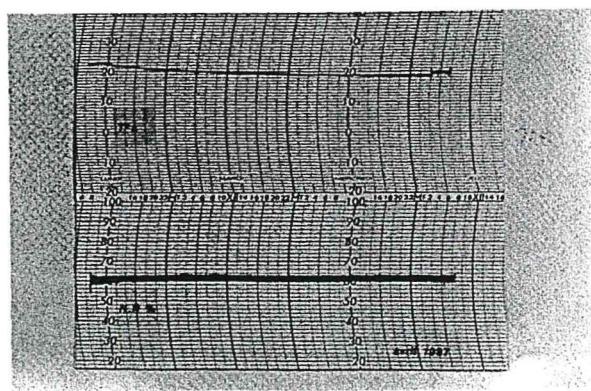


Figure 2

L'humidité et la température enregistrées à l'intérieur de l'enceinte.

Humidity and temperature recorded inside the box.

PRÉPARATION DES ÉCHANTILLONS DE COTON

Avant d'être testés, les échantillons ont été desséchés dans une étuve. Puis, ils ont été mis soit sous forme de boule ou

bien de nappe (tabl. 1); cette dernière a été roulée dans une grille, type moustiquaire (fig. 3).

TABLEAU 1

Caractéristiques des échantillons de coton à humidifier.

Characteristics of the cotton specimens to be humidified.

Echantillon	Forme	Poids g	Teneur initiale en humidité %
a	boule	10	0
b	—	3	0
c	nappe de 16 × 55 cm,	3	0
d	—	3	6

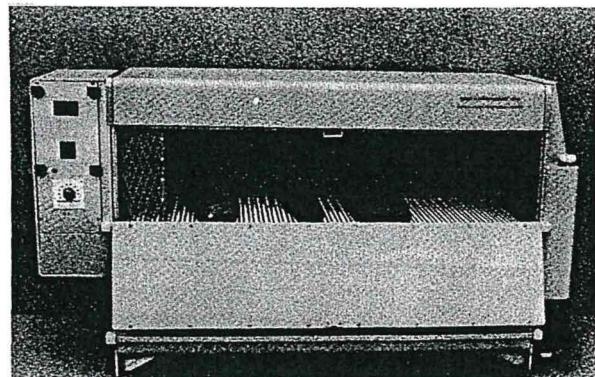


Figure 3

Enceinte contenant les échantillons de coton disposés en nappe et roulés dans une grille.

Box containing cotton specimens, arranged in a sheet form and rolled in a grid.

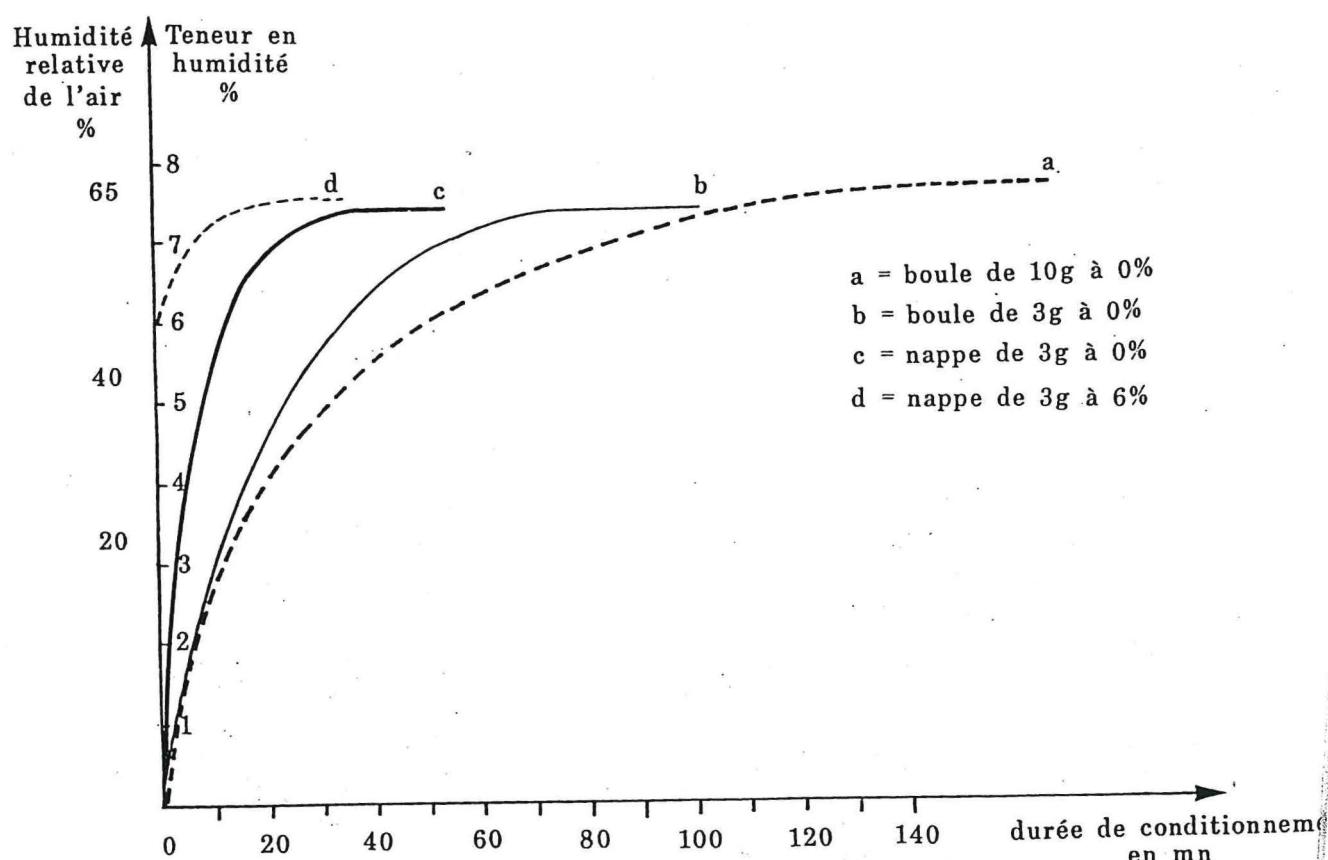


Figure 4

Prise d'humidité en fonction du temps, pour des échantillons de coton placés dans l'enceinte à 62 % H.R.

Humidity measured according to the delay for the cotton specimens placed in the box at 62 % R.H.

RÉSULTATS

Nous avons déterminé le temps nécessaire pour que les échantillons de coton, préalablement desséchés puis placés dans l'enceinte à 62 % H.R., atteignent l'équilibre hygroscopique.

La teneur en humidité du coton, déterminée successivement dans le temps, est exprimée par le rapport du poids d'eau contenu dans l'échantillon sur le poids de l'échantillon humide :

$$\text{Teneur en humidité de l'échantillon \%} = \frac{\text{poids humide} - \text{poids sec}}{\text{poids humide}} \times 100$$

La prise d'humidité des divers échantillons, en fonction du temps, est représentée dans la figure 4. On constate, que le délai nécessaire pour atteindre l'équilibre hygroscopique, est le plus court pour ceux placés sous forme de nappe, roulée dans une grille. Cette présentation est donc à conseiller pour le conditionnement des cotons dans l'enceinte FG 49.

CONCLUSION

Cette enceinte permet un conditionnement rapide des échantillons de coton avant d'effectuer le test de collage du thermodétecteur. Cette utilisation n'est d'ailleurs pas exclu-

sive. De plus, l'enceinte est peu encombrante et ne nécessite pratiquement aucun entretien particulier. Pour tous renseignements, s'adresser à la Division de Technologie de l'IRCT.

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The FG 49 conditioning box for humidifying cotton before the thermodetector stickiness test

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SUMMARY

When fibre stickiness tests, carried out with the IRCT RF13 thermodetector, have to be undertaken in a premises where the relative humidity is below the recommended standards (50 % to 65 % R.H.), it is essential to previously humidify the specimens.

To this purpose, the IRCT Technology laboratory has conceived and had made the FG 49 conditioning box. For the tests, the relative humidity is brought up to 62 %, by using a simple system

for recycling humidified air; this value is maintained at a stable level ($62 \pm 2\%$), thanks to an electronic probe.

Tests undertaken on cotton which has been previously dried out to 0 % humidity in an incubator show that a relatively brief delay (35 mn) is sufficient for cotton arranged in a sheet form to reach hygroscopic equilibrium.

KEY WORDS : box, humidifier, cotton, fibre, stickiness.

DESCRIPTION OF THE BOX

The box (Figure 1), whose dimensions are $80 \times 55 \times 30$ cm (L \times H \times D), is equipped with two ventilators. The role of the first one is to make humidified air circulate; this air is recycled and rehumidified when it passes through a cotton cloth which soaks in a tray containing water. The thermostat switch is used to select humidity which is regulated by an electronic probe. When humidity reaches a value approaching that desired, the first ventilator stops running; the

second then becomes operational in order to stabilize it by sucking up the ambient air of the premises. This is why this apparatus can only condition at a higher humidity rate than that in the premises where it is located.

Through recording with a hair hygrometer, we verified that relative humidity in the box remains stable ($\pm 2\%$) in the temperature and humidity conditions of our premises (Figure 2).

PREPARING THE COTTON SPECIMENS

Prior to testing, the specimens were dried out in an incubator. Then, they were either rolled in a ball or spread

out in a sheet form (Table 1); the latter were rolled in a mosquito net type grid (Figure 3).

RESULTS

We determined the time necessary for previously dried out cotton specimens, which were then placed in the box at R.H. 62 %, to reach hygroscopic equilibrium.

Cotton's moisture content, successively determined over a period of time, is represented by the relationship between the weight of water contained in the specimens to the weight of the wet specimen.

$$\text{Moisture content \%} = \frac{\text{wet weight} - \text{dry weight}}{\text{wet weight}} \times 100$$

Measuring the different specimens' humidity according to the delay is represented in Figure 4. It was noted that the delay to reach hygroscopic equilibrium, is shorter for the sheet form specimens which were rolled in a grid. This presentation is therefore advisable for conditioning cottons in the FG 49 box.

CONCLUSION

This box allows for a rapid conditioning of cotton specimens prior to carrying out the thermodetector stickiness test. Moreover, this usage is not exclusive. Additionally, the box

is not cumbersome and does not require any maintenance. For further information, please apply to IRCT Division de Technologie (Technology Division).

El recinto de acondicionamiento FG 49 para humedecer el algodón antes del test de pegamiento con el termodetector

RESUMEN

Cuando los tests de pegamiento de las fibras con el termodetector IRCT RF13 han de efectuarse en un local donde la humedad relativa es inferior a las normas recomendadas (desde un 50 % hasta un 65 % H.R.), resulta imprescindible humedecer previamente las muestras.

Con este fin, el laboratorio de Tecnología del IRCT ha diseñado y mandado hacer el recinto de acondicionamiento FG 49. Para las pruebas, la humedad relativa es llevada a un

62 %, mediante un sistema sencillo de reciclaje de aire humidificado; dicho valor es mantenido estable ($62 \pm 2\%$) gracias a una sonda electrónica.

Unas pruebas, efectuadas con algodones desecados antes en la estufa hasta un 0 % de humedad, demuestran que basta con un plazo relativamente breve (35 minutos) para que el algodón dispuesto en forma de capa alcance su equilibrio higroscópico.

PALABRAS CLAVE : recinto, humectador, algodón, fibra, pegamiento.

Seed Coat Fragments: The Consequences of Carding and the Impact of Attached Fibers

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ABSTRACT

Seed coat fragments (SCF) are extremely difficult contaminants to remove from cotton fibers because of the fibers attached to them. Literature data suggest that carding is the most effective cleaning step during which a significant proportion of the SCF is eliminated. In the study described here, different detection methods are used to evaluate the ability of carding to clean SCF-contaminated cottons. Variations in SCF number and size distribution are evaluated. The amount of fibers attached to the SCF is measured by image analysis, and it appears to have a significant effect on the ability of the card to remove SCF.

Seed coat fragments are among the most frequently encountered contaminants of cotton fibers. They disrupt the spinning process [16] and decrease the quality of the yarn produced.

SCF can be distinguished from other contaminants of vegetal origin found in cotton fibers by the difficulty encountered in eliminating them during cleaning and fiber preparation operations. This difficulty is explained in the literature [2, 4, 5] by the presence of fibers that remain attached to the SCF after the coat has been torn off or fragmented during ginning or in the lint cleaner.

Various authors [1, 14, 17] claim that postginning cleaning operations conducted with a lint cleaner cause additional fragmentation of the SCF and thus increase their numbers in the fibers. Their total mass and average size are nonetheless fairly small [14]. Furthermore, intensification of this processing, with the intention of eliminating as many SCF as possible and improving the cotton grade, decreases the length of the cotton fibers and increases the proportion of short fibers. This results in decreased yarn evenness and resistance and in increased breaks during spinning [15].

In addition, cleaning operations conducted during opening/cleaning are relatively ineffective against SCF. Since fibers are attached to the SCF, they behave in a manner similar to cotton tufts during beating and in pneumatic flows. According to Frey and Schneider [8], increasing the total trash discarded during opening/cleaning does not result in significant elimination of SCF, but does increase the proportion of good fibers discarded with the trash. In addition, multiplying the cleaning

points, with the intention of extracting more SCF, excessively weakens the fibers and decreases the quality of the resulting yarn.

The last possible point for intentional SCF removal prior to the spinning machine is therefore the card, at least when spinning carded cotton. Before considering the role played by the card in SCF elimination, and to fully appreciate the importance of the attached fibers, it is important to distinguish between two different categories of seed coat fragments: First, the ASTM D2496-80 specification [3] defines SCF as "seed coat fragments torn or cut from mature and/or immature seeds during mechanical processing. They are generally black or dark brown and may or may not show attached fibers or linter". The second definition is related to one of the detection methods used to classify cotton contaminants, *i.e.*, the Zellweger AFIS®. The seed coat fragments detected by this method are those to which fibers are attached and are thus known as seed coat neps (SCN). Large SCF devoid of attached fibers or with only lint attached are placed in the trash category. All contaminants smaller than 500 µm are considered as dust or microdust [4, 13]. According to the same authors, this division of SCF into subcategories is necessary because SCF devoid of attached fibers are more easily removed during spinning. Attention therefore focuses primarily on SCN, which are more difficult to remove because of the attached fibers and are therefore more detrimental to the spinning process and to yarn quality.

In the rest of this work, we distinguish between seed coat fragments (SCF), a generic term covering all debris

TABLE I. Major fiber properties of the nineteen cottons tested (HVI).

No.	Origin	ML, mm	UHML, mm	UI, %	Strength, g/tex	Elongation, %	IM	MR	PM, %	H, m tex	HS, m tex
1	USA	21.50	26.30	81.70	28.40	5.30	4.11	0.85	76.03	179	210
2	USA	22.47	27.50	81.70	27.00	5.10	3.81	0.79	70.22	175	222
3	USA	22.69	28.50	79.60	29.90	5.80	3.81	0.80	71.27	173	216
4	BEN	25.34	30.20	83.90	32.00	5.90	3.71	0.84	75.12	159	189
5	PAR	23.18	28.20	82.20	28.40	5.30	4.11	0.90	80.23	170	188
6	CDI	24.49	29.30	83.60	30.50	5.80	3.91	0.90	80.02	160	177
7	CMR	27.06	31.80	85.10	34.10	6.20	3.51	0.88	78.46	143	162
8	CMR	24.13	29.00	83.20	31.00	6.70	3.81	0.90	79.63	156	174
9	BEN	24.47	29.30	83.50	31.40	5.80	3.81	0.90	80.22	155	171
10	PAR	23.66	27.90	84.80	29.40	5.70	4.71	0.96	84.40	192	200
11	CMR	23.50	28.50	82.30	28.20	6.00	3.90	0.90	81.10	157	172
12	CMR	27.50	32.20	85.30	31.70	6.10	3.80	0.90	80.80	152	167
13	TGO	23.80	28.90	82.50	31.00	5.60	3.30	0.80	72.50	141	173
14	CMR	23.20	28.40	81.80	32.00	5.70	3.20	0.80	70.00	140	178
15	CMR	24.50	29.30	83.50	34.00	6.00	3.70	0.90	78.70	151	171
16	CMR	25.10	30.00	83.60	33.10	6.30	3.60	0.90	77.70	148	169
17	CMR	24.60	29.60	83.10	32.60	6.40	3.80	0.90	76.60	160	186
18	CMR	24.80	29.70	83.50	31.30	6.20	3.90	0.80	74.20	170	204
19	TCD	24.50	29.40	83.20	27.50	6.40	4.20	0.90	78.70	177	200

derived from the coat of the cotton seed, and seed coat neps (SCN), designating exclusively the SCF larger than 500 μm and with attached fibers. This distinction is necessary since the SCF counts given by different detection methods do not correspond to the same set of contaminants.

Jones *et al.* [13] conducted a study to determine the effectiveness of carding in removing SCN detected by AFIS. They discovered that carding removed between 44 and 86% of these contaminants depending on the cotton. By contrast, opening/cleaning operations did not significantly reduce the number of SCN, again detected by AFIS. Baldwin *et al.* [4] reported that carding removed most of the medium and large SCN, and thus significantly cleaned the fiber despite a relative increase in the number of very small SCN.

These results specifically concern SCN because of the detection method used. We have therefore conducted a laboratory-scale study to evaluate the effect of this carding operation on the number and size of all SCF contaminants [3]. We also evaluate the number of fibers attached to the SCF.

Methodology

We used methods based on image analysis to count and characterize the SCF in the fibers (measuring the size and length of attached fibers):

Trashcam: image analysis on fiber web [10–12]: the Trashcam method is able to count and size SCF in the fibers, which are detected and counted by image analysis before and after carding. SCF size is also measured in the course of this analysis. Fiber webs corresponding to

approximately 6 g/m² were prepared on a laboratory opener [9] for precarding analyses and on a mini-card for postcarding analyses. These analyses were conducted on nineteen cottons (Table I) with nine measurement repetitions (nine webs) per cotton. Image acquisition and analysis parameters were calibrated before the test using visual counts as a reference.

In addition to providing a count, the Trashcam SCF detection method also measured different parameters for the contaminants it detected in the fiber web: the gray level color parameters, and the morphological parameters of size measurement by pixel counting and the dimensions ratio (height/width) to filter out contaminants other than SCF possibly present in the fibers after opening, e.g., stem fragments.

Individual SCF image analysis on a black background: measurement of the total length of fibers attached to the SCF. The SCF were removed manually from each of the webs prepared from the nineteen carded cottons, then fixed onto a transparent adhesive plate and scanned for image acquisition. The fibers attached to the SCF were measured using a specific image analysis software package [6], which provides a value for the total length of the fibers attached to the SCF.

AFIS analyses were also conducted before and after carding to determine the number of SCN and to evaluate any phenomena specific to these contaminants. These analyses were conducted under controlled humidity and temperature conditions (65% RH, 22°C). The samples were processed in a randomized order with five repetitions. Standard cottons were tested regularly to verify machine calibration.

Results

CALIBRATING THE TRASHCAM SCF COUNT IN FIBER WEBS

As we already mentioned, the results of the Trashcam SCF counts were calibrated by comparison with visual counts made on about one hundred fiber webs. Figure 1 illustrates the relation between the image analysis count and the visual count (square root transformed). Tests to compare the variances (Table II) showed that these were not significantly different for the two counts.

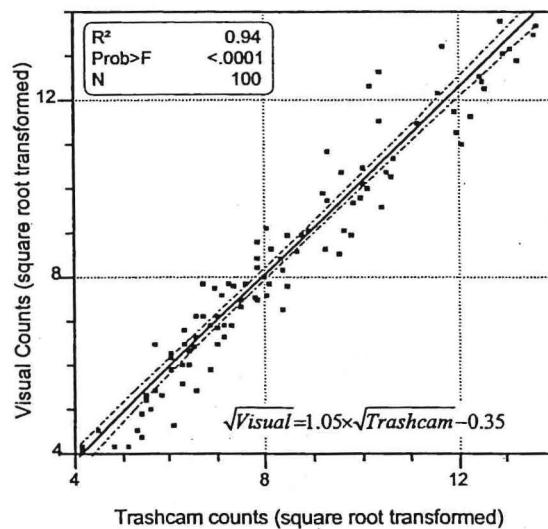


FIGURE 1. Relation between counts established visually and by image analysis on the card web.

TABLE II. Comparison of the variances of the counts established visually and by image analysis.

Test	F Ratio	DF numerator	DF denominator	Prob > F
O'Brien [5]	1.0797	1	198	0.3000
Brown-Forsythe	0.6046	1	198	0.4377
Levene	0.6479	1	198	0.4218

The correlation between the two counts was very highly significant. The estimated slope was not different from unity, and the *y*-intercept was not significant (Table III). According to the confidence intervals, the Trashcam counts were very close to the visual counts. We selected image capture and analysis parameters on the basis of these results and used them in the subsequent analyses of the test webs.

TABLE III. Determination of regression parameters (visual count versus image analysis).

Term	Estimate	Std. error	t Ratio	Prob > |t|	Lower 95%	Upper 95%
Intercept	-0.3502	0.2397	-1.46	0.147	-0.825	0.125
Slope	1.0526	0.0277	37.97	<0.0001	0.997	1.107

MEASURING THE AMOUNT OF ATTACHED FIBERS

The SCF types encountered in the card web varied considerably (Figure 2). The results obtained after characterizing the SCF removed from the card webs showed a great variety of shapes, sizes, and amounts of attached fibers. This diversity results in a variety of behaviors during spinning, and these SCF may therefore have a variable impact on the structure and quality of the yarn produced.

Each SCF illustrated in Figure 2 is accompanied by a value corresponding to its surface area (*S* in mm²) determined by the Trashcam and the total length of the fibers to which it is attached (*L* in mm). These measurements show that a small SCF may be attached to more fibers (in terms of total length) than another that is far larger: we found no significant correlation between *S* and *L* (*R*² = 0.02).

Figure 3 gives ordered sample mean lengths of the fibers attached to the SCF. The mean values varied from 7.6 mm to 33.2 mm depending on the cotton. The number of SCF tested varied from 34 to 210 per web. This analysis showed the presence in the card web of SCF

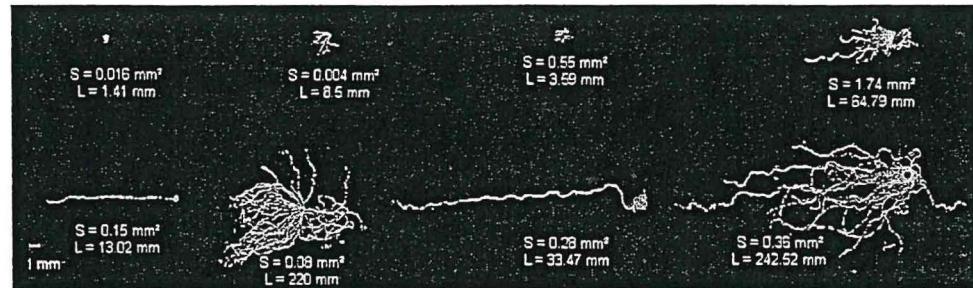


FIGURE 2. Examples of various SCF types encountered in the card web during testing.

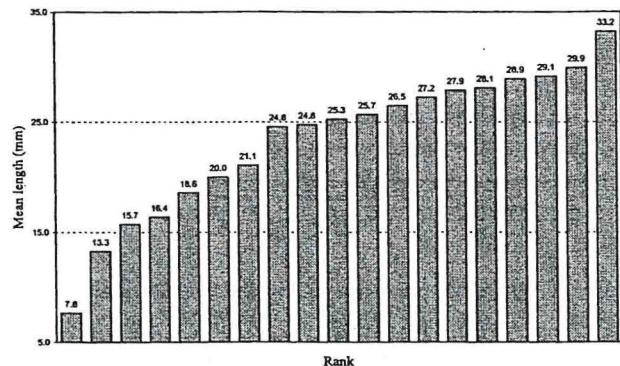


FIGURE 3. Ordered sample mean length of fibers attached to the SCF (measured by image analysis on nineteen cottons).

devoid of fibers or with only short fibers, since approximately 25% of the SCF tested were attached to a total fiber length less than 5 mm.

EFFECT OF CARDING ON SCF IN FIBERS

Our results show that this detection method is able to account for all the SCF present on the fibers and provides measurements of the fragment sizes and the amount of fibers to which they are attached. We were therefore able to investigate the effect of carding on SCF number and size.

In the initial phase of the study, we considered only SCN on the basis of AFIS counts. We considered variations in the total number of SCF as a second step.

CLEANING THE SCN (AFIS)

Figure 4 illustrates the variations noted in the number of SCN detected by AFIS before and after passing through the mini-card. The 95% confidence intervals are also given in the figure. The number of SCN decreased after carding (-40% on average), and the magnitude of this decrease varied from one cotton to another. An analysis of variance (Table IV) showed that the carding effect was very highly significant. We detected no significant interaction between varietal origin and the effect of carding. This result, based on AFIS counts, therefore confirmed that carding removes SCN.

EFFECT OF ATTACHED FIBER LENGTHS ON CLEANING CAPACITY OF CARD

Although the interaction of the carding effect with varietal origin of the cottons was not significant, the relative decrease in the number of SCN due to carding nevertheless varied from one cotton to another (by 12 to 65%). The different cottons would therefore appear to be

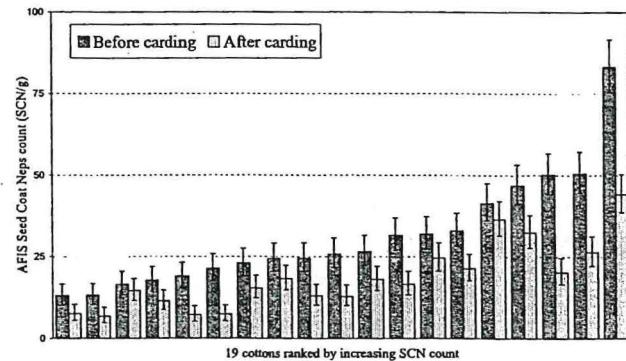


FIGURE 4. Variation in the number of seed coat neps (SCN) after carding.

TABLE IV. Analysis of variance table: variation in the number of SCN after carding.^a

Source	DF	Sum of squares	F Ratio	Prob > F
Variety	18	279.5566	18.037	<0.0001***
Carding	1	72.69535	84.4286	<0.0001***
Variety × card	18	19.37699	1.2503	0.2288 (ns)

^a NS = not significant, * = significant ($\alpha = 0.05$), ** = highly significant ($\alpha = 0.01$), *** = very highly significant ($\alpha = 0.001$).

more or less suitable for SCN removal. Since a quantitative measure of the length of the attached fibers was possible, we could establish the relation between this characteristic and the difficulty encountered when removing SCN.

Figure 5 shows the relation between the length of the fibers attached to the SCF, as estimated by image analysis, and the number of SCN removed by carding, as estimated by AFIS counting. The points show that the proportion of SCN removed by the card was highly dispersed for high values of the total length of attached fibers. Nevertheless, for the range of cottons studied, we detected a highly significant relation between the ability to clean the cotton and the total length of attached fibers, as estimated by our method. Figure 5 shows that more SCN are removed from cottons when the attached fibers are short.

NUMBER OF SCF DETECTED BY IMAGE ANALYSIS

We used the Trashcam image analysis to count and size (in mm^2) the entire range of SCF present in the fibers, including the seed coat neps (SCN) as well as seed coat fragments with only short fibers attached, or no fibers attached at all. Figure 6 shows the counts obtained by image analysis (SCF/g) before and after carding with 95% confidence intervals.

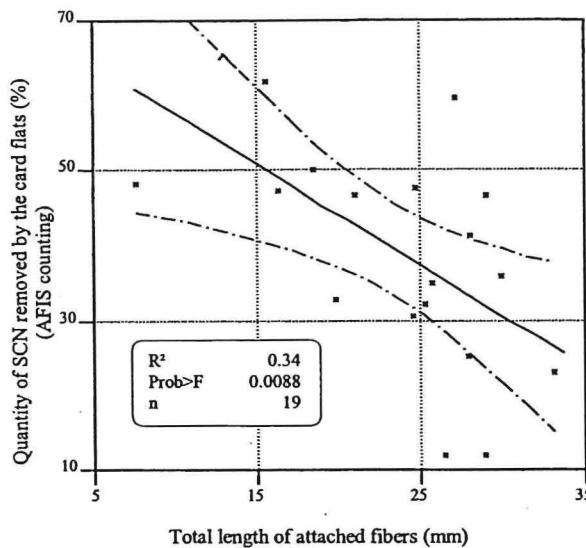


FIGURE 5. Relation between the proportion of SCN removed (AFIS counts) and the length of attached fibers.

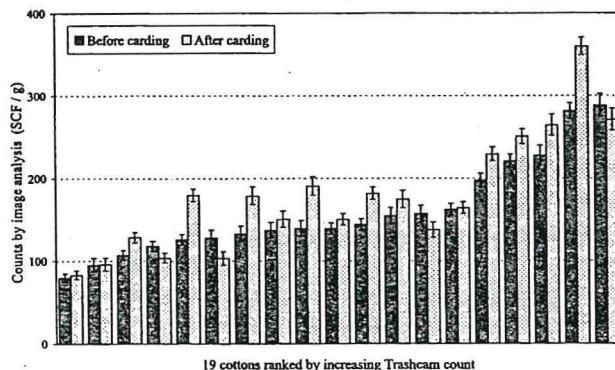


FIGURE 6. Trashcam counts of fiber webs (SCF/g) before and after carding.

As shown in Figure 6, carding did not significantly reduce the number of SCF for most cottons. In fact, certain cottons even showed an increase in the number of SCF. Two factors should be taken into account when analyzing these counting results: the "carding" factor, source of the samples tested (two levels, before and after carding), and the "cotton" factor, nineteen levels.

Since the distribution is not normal and the counting variances are not homogeneous, the data had to be transformed in order to meet the conditions required for analysis of variance. The square root transformation generally used for counts was unable to normalize the residuals. In addition, possible fragmentation of the SCF during passage through the card could add a multiplying character to the effect of this passage on the counting

expectation. A logarithm transformation therefore appeared to be more appropriate to return to an additive model, but this did not stabilize the variances.

We therefore adopted a log-linear model that was perfectly suitable for the conditions prevailing in this experiment, *i.e.*, the Poisson-type character of the counts, assuming that the fibers are adequately mixed for the SCF to be randomly distributed without forming aggregates, which was justified by the multiple fiber mixing steps conducted in the laboratory; the multiplying effect of the carding factor due to possible fragmentation of the SCF; and the variation in the mass of the web tested, which could, in the case of the log-linear model, be taken into account as an additive offset term, instead of adjusting the counts to unit mass. This would permit proper modeling of the effect of web mass variations on both the mean and variance of the counts.

The statistical analysis (Table V) showed a residual deviation that was 2.88-fold greater than the number of degrees of freedom. The experimental results are therefore more widely dispersed than in a Poisson distribution. The variance of the counts is not equal but proportional to their expectancy. This over-dispersion was taken into account in the subsequent tests.

TABLE V. Variation in the number of SCF after carding, log-linear model (type III analysis).

Source	DF	F	Prob > F
Cotton	18	53.6345	0.0001***
Carding (before/after carding)	1	14.2671	0.0002***
Carding \times cotton	18	2.1696	0.0042**

The effect of carding (*i.e.*, the carding factor) on the number of contaminants detected by image analysis (Trashcam) was very highly significant. However, the overall means before and after carding showed, unexpectedly, that the number of SCF had actually increased. In addition, the carding \times cotton interaction was highly significant, indicating that the cottons did not all undergo the same relative variation in SCF count after carding.

SCF SIZING

Examination of SCF sizes measured by image analysis (Trashcam) in the fiber web before and after carding showed that the distribution shifted toward a smaller size (Figure 7). SCF mean size was smaller after carding. In addition, as already mentioned, carding increased the number of SCF, with the magnitude of this increase varying from one cotton to another.

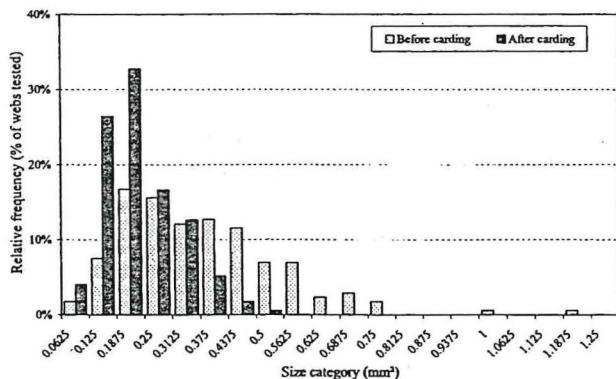


FIGURE 7. Mean SCF surface area obtained by Trashcam (nineteen cottons before and after carding).

This result shows that the SCF were fragmented during fiber passage through the card. This fragmentation is of capital importance in fiber cleaning, since the number of SCF increased postcarding in most of the cottons.

Discussion

Our experimental results strongly depended on the methods used for detection and measurement. As an illustration of this, if only the SCN are considered, *i.e.*, part of the total SCF range in the fibers (SCN = SCF with fibers attached and greater than 500 μm in size), we can state that carding had a cleaning effect, since the number of SCN decreased significantly after carding.

This decrease in the number of SCN was significantly related to the quantity of fibers to which they were attached, since it would appear that the greater the total length of fibers attached to the seed coat fragments, the less easily the card is able to extract these from the fiber mass.

By contrast, the Trashcam took account of the entire SCF range, and its detection of small SCF (200 μm and greater) showed that cleaning by the card was accompanied by marked fragmentation. This increased the number of SCF and shifted the size distribution toward lower values. This fragmentation phenomenon associated with the removal of some of the SCF transformed the surface area distribution in each cotton. This transformation was also the expression of the variation we noted in SCF size and number (considering the variations in the number of SCF in each size category).

Conclusions

We have used two image analysis methods to count and size SCF in fibers and determine the amount of fibers attached to the SCF. The counts obtained by image anal-

ysis correlate very well with the visual counts, *i.e.* are of similar magnitude. We used these methods during micro-spinning tests to determine the effect of carding on SCF.

We made a distinction between SCF (seed coat fragments), which correspond to all coat debris defined by the ASTM specification [3], and SCN (seed coat neps) detected by AFIS, which correspond to the subgroup of SCF larger than 500 μm and with attached fibers.

The measurements of attached fiber length produce results that explain the difference between the cottons for the number of SCN removed by the card, since we have shown that the longer the length of the attached fiber, the lower the capacity of the card to remove the SCN.

The counts corresponding to the total number of SCF in the fibers before and after carding (without any threshold for size or presence or absence of attached fibers) show that SCF removal by the card is accompanied by marked fragmentation. This fragmentation leads to a decrease in SCF size and an overall increase in their number. Some of the SCF resulting from this fragmentation show short attached fibers and some are devoid of fibers.

Studies are ongoing to determine the manner in which these small SCF produced by fragmentation, and hitherto undetected, affect yarn structure. More comprehensive studies should also be able to determine the amount of fibers attached to the SCF (distribution, variability, etc.), to confirm the role played by this parameter in cotton suitability for cleaning, and possibly to determine the disruptions caused by these contaminants in the yarn.

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COMMUNICATIONS

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Communications à congrès avec comité de sélection et publication des actes.

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1994

A High Speed Instrument for Stickiness Measurement¹R. Frydrych, ¹E. Hequet, ²G. Cornuejols¹Cotton technologists and ²Vision engineer respectively¹CIRAD-CA

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Abstract

The stickiness of 66 cottons from different origins was assessed with the thermodetector and the laboratory minicard (as a reference method) and the results compared.

The examination of the results shows that the card-thermodetector relationship is not linear as the card demonstrates a saturation phenomenon for very sticky cottons whereas the thermodetector does not. The thermodetector seems to be a better measuring instrument for stickiness than minicard.

To increase the speed of stickiness measurement, the CIRAD-CA is currently developing a new measuring system where the human element in sample preparation, in the test itself and in counting the sticky points, has been reduced to a minimum. The duration of the test has also been reduced to render the determination of cotton stickiness compatible with the speed of HVI lines.

The High Speed Stickiness Detector would seem to be very promising. We are currently optimizing this new technique and a validation phase using a large number of samples is scheduled for 1994.

Introduction

Over the last few years it has been noted that cottons from various origins induce a stickiness phenomenon during spinning and thus lead to considerable production losses (Hector & Hodkinson, 1989).

Stickiness is primarily due to insect excretions (*Aphis gossypii* and *Bemisia tabaci*), known as honeydew. These are composed of sugars which give the cotton its sticky potential (Bourelly, 1980).

This honeydew is deposited onto the leaves and onto the fibers of open bolls. The ginning process disperses the honeydew droplets in the fiber and, by reducing their size, renders them difficult to detect with the naked eye. The honeydew cause various degrees of disruption during the spinning process. It increases irregularities in sliver and yarn, occasionally leading to yarn breakages, rotor clogging and machine shutdowns (Hequet & Frydrych, 1992).

Preliminary studies have shown that even in countries which suffer particularly from stickiness, a significant proportion of the harvest is uncontaminated. However, because no control system is in place to

determine production stickiness, the entire production is labelled as "sticky cotton" and in consequence is subjected to systematic downgrading.

It is therefore essential that the stickiness of the cotton produced is monitored and evaluated.

It is becoming increasingly important to measure rapidly the sticky potential of cottons before they enter the spinning process as it is possible to reduce these sticky effects by appropriate means: mixing cottons that present different levels of contamination, reducing relative humidity in the premises (Gutknecht & al., 1988) or by various treatments:lubricants, washing, etc.(Perkins, 1993).

Materials and Methods

The card - thermodetector relationship

The existing international test for stickiness is the laboratory minicard. This test only gives qualitative results and the influence of the operator is important. Because of this, the CIRAD-CA has developed the thermodetector to quantitatively determine the stickiness.

The stickiness of 66 cottons from different origins was assessed with the thermodetector and the laboratory minicard (as a reference method) and the results compared.

The cottons' stickiness potential was evaluated using the seven CIRAD grades (table 1).

Tests using the laboratory card were performed at 55% relative humidity and at 21°C. All tests were carried out with 3 replications in a random manner. Relative humidity was checked hourly and was seen to be very stable (RH = 55 + 2%). The card flats, lower waste-collection tray and the grids were cleaned after three cottons i.e. every 30 g, or systematically after very sticky cotton (grade 6-7). Flats were cleaned by metallic wire and the grids using a brush ; the pressure rollers (covered with honeydew) were cleaned with water then dried with a cloth and a hair-dryer for about 10 seconds.

Tests using the thermodetector were performed at 60% relative humidity and 21°C. All tests were carried out with 3 replications in a random manner. The thermodetector technique used combined the effects of heat and pressure. The test sample (2.5 g of fiber) was prepared in the form of a web (54 cm x 16 cm). This was sandwiched between two sheets of aluminium and the preparation subjected to pressure at 80°C for 12 seconds (the heating element being in contact with the upper aluminium sheet). The preparation was then subjected to 2 minutes ambient pressure. The prepared sample is placed on a table for at least 30 minutes before reading off the sticky points. After removal of the web, the sticky potential of the cotton was determined by visually counting the number of fiber points stuck to the upper and lower aluminium sheets.

The thermodetector - high speed stickiness detector relationship

The CIRAD-CA is currently developing a new measuring system where the human element in sample preparation, in the test itself and in counting the sticky points, has been reduced to a minimum. The duration of the test has also been reduced to render the determination of cotton stickiness compatible with the speed of HVI lines.

The new high speed sticky cotton detector prototype is made up of 5 work stations:

- sample preparation
- application of heat and pressure
- application of pressure at ambient temperature
- cleaning the aluminium surface
- counting of the sticky points

The sample and its mounting are transferred automatically between each of these stations. The processing time for each operation is between 20 and 30 seconds, and, as each is independant, it is therefore possible to process several samples simultaneously, which means that a result is obtained at most every 30 seconds.

For the sample preparation, the fiber sample weighs between 3 and 4 grams and has a surface area of about 250 cm². The sample is opened using a mechanical rotor-type opener to obtain a very homogeneous fiber-mounting interface and to allow all types of cotton to be processed (saw or roller ginning). As an example, cottons ginned by roller present a very irregular surface when raw. When opened using a rotor opener the surface in contact with the mounting is comparable to that seen with saw ginned cottons.

The sample is then placed on a strip of aluminium originating from a roll at least 300 meters long. The aluminium is rolled along a conveyor belt which transfers the sample in front of each station. The aluminium strip is rolled up at the other end of the machine.

Pressure is then applied to the sample for 30 seconds while the heating element is in contact with the cotton. The temperature differential between the heated cotton (53°C) and the mounting (21°C) creates a thin layer of steam on the aluminium mounting, which causes the sugar or honeydew drops to be deposited onto the aluminium mounting. The heating element exerts a pressure of about 600 g/cm².

An other pressure is then applied for 30 seconds at ambient temperature immediately after the hot pressure phase. This fixes the sticky points to the aluminium mounting. The same amount of pressure is applied as during the hot-pressure phase.

Our aim was to determine the optimum combination of heating temperature, heating time and pressure at ambient temperature to obtain both excellent sticky point fixation on the sheet and ease of cleaning (elimination of excess fiber and foreign matter). The fiber mass is aspirated and the aluminium sheet then cleaned automatically.

The enumeration of the sticky points is performed by video camera as it scans the sheet. The image is then analyzed by computer. The software used calculates the number of sticky points. The study of cotton stickiness has revealed the presence of different types of honeydew within the fiber which can be analysed by the software. It produces a histogram of the surfaces.

Tests using thermodetector and the high speed stickiness detector (H2SD) were performed at 60% relative humidity and 21°C. Six replications were made with the thermodetector and three replications with the H2SD to compare 37 cottons from different origins.

Results and discussion

The card - thermodetector relationship

The examination of the results shows (figure 1) that the card-thermodetector relationship is not linear as the card demonstrates a saturation phenomenon for very sticky cottons whereas the thermodetector does not. We therefore sought an equation which would take this phenomenon into account, and developed the expression given below :

$$\text{Card} = 7 - 6 * \text{Exp}(-0.026 * \text{Thermo})$$

Calculation of coefficients allows the relationship to be rendered linear and thus the coefficient of determination to be calculated. This coefficient is 88.7%, i.e. an increase of 17% in R^2 in relation to simple linear regression.

The thermodetector would seem to be a better detection method for the stickiness potential of cottons. To correctly mix cottons before spinning, it is necessary to accurately determine the level of stickiness to decide what quantity of sticky cotton should be incorporated into the mix. A cotton with 150 sticky points presents more of a problem than a cotton with 80 sticky points, though both would be of grade 7 on the card. In research, reasoning based on quantitative, not qualitative data is essential and allows more precise statistical methods to be employed. In addition, operator effect is more marked with the minicard.

But the procedure to use the thermodetector requires an operator to prepare a cotton web of precise weight and surface area. He also needs to clean the aluminium sheets and count the sticky points on these sheets. The quality of the measurement is therefore not entirely independent of operator effect. Each test lasts about 5 minutes per replication; 3 replications are recommended per sample in routine testing, the variability of intra-sample stickiness being fairly high.

The thermodetector - high speed stickiness detector relationship

The differences between the new procedure and the thermodetector are:

- The human element is reduced to a minimum.
- The sample, which can be between 3 and 4 g, does not require careful weighing, and this therefore gains precious time.
- The surface area of the sample is reduced.
- The method used to prepare the sample means that 4 times more sticky points are obtained per unit surface area on the aluminium sheet.
- A single side of the sample is in contact with the aluminium.
- The very rapid fixation of the sticky points allows for immediate cleaning whereas a wait of at least 30 minutes was required with the thermodetector.
- Sticky points are counted using an image analyzer.
- The determination of sticky potential is 8 to 10 times faster than with the thermodetector.

For testing the quality of the image analysis 114 cottons from various origins (saw and roller ginning) were compared using visual counting and image analysis of samples tested on the new system (figure 2). The correlation between the two techniques was very good ($100 * R^2 = 98.8\%$).

In addition, 37 cottons from various origins were tested, 6 measurements were made on the thermodetector and 3 repetitions on the new H2SD (High Speed Stickiness Detector) system. Figure 3 shows the excellent correlation between the two measurement systems ($100 * R^2 = 97.8\%$).

The H2SD would seem to be very promising. We are currently optimizing this new technique and a validation phase using a large number of samples is scheduled for 1994.

Acknowledgements

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Table 1. The seven CIRAD card grades

card grade	definition of stickiness
1	no trace of stickiness
2	a few points which could be stickiness
3	clear traces of stickiness, but the cotton does not necessarily wrap around the delivery rollers; if it wraps around, this occurs after more than one minute
4	fairly numerous sticky points, the cotton tends to wrap around the delivery rollers after about one minute
5	numerous sticky points, the cotton tends to wrap around the rollers quite quickly (in about 1/2 minute)
6	numerous traces of stickiness, the cotton wraps around the rollers very quickly
7	immediate sticking and wraps around the rollers almost instantly

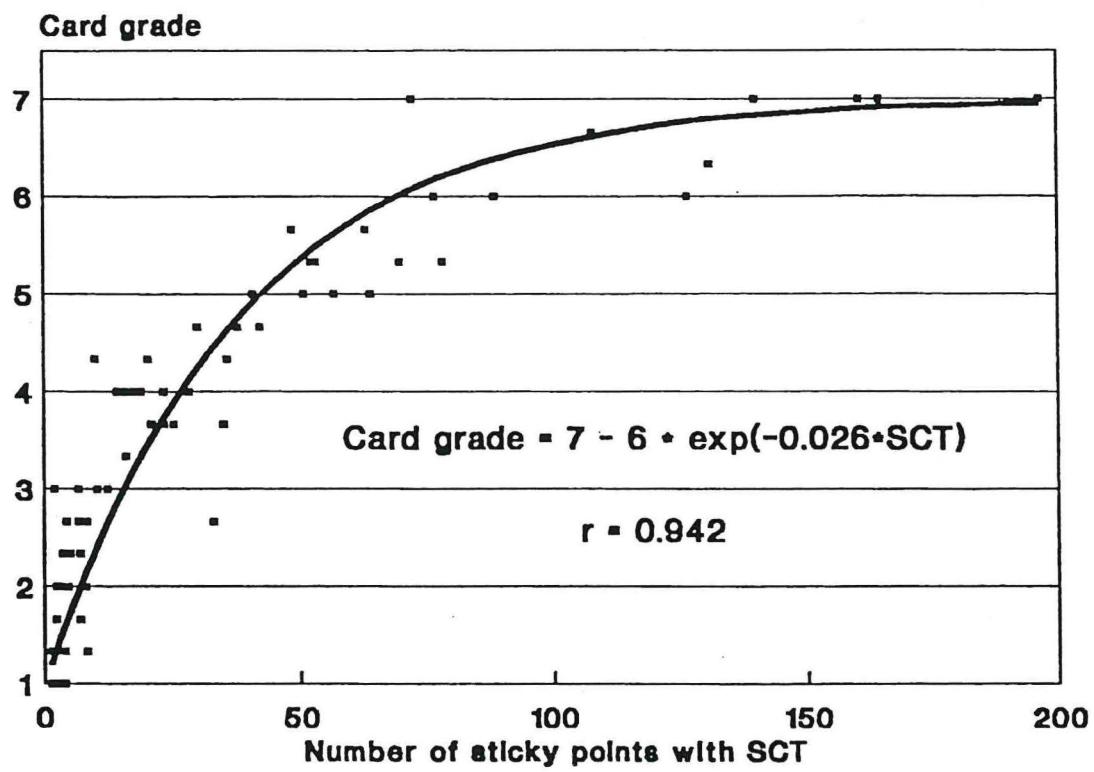


Figure 1. Card vs thermodetector SCT

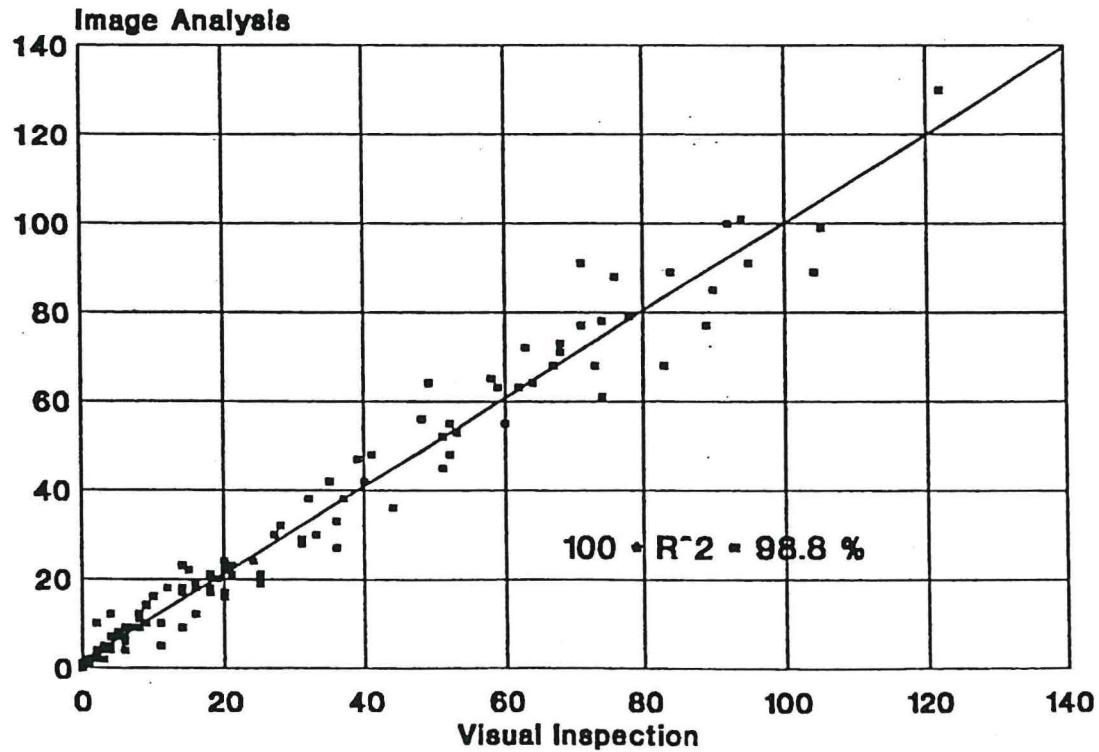


Figure 2. Image analysis vs visual inspection

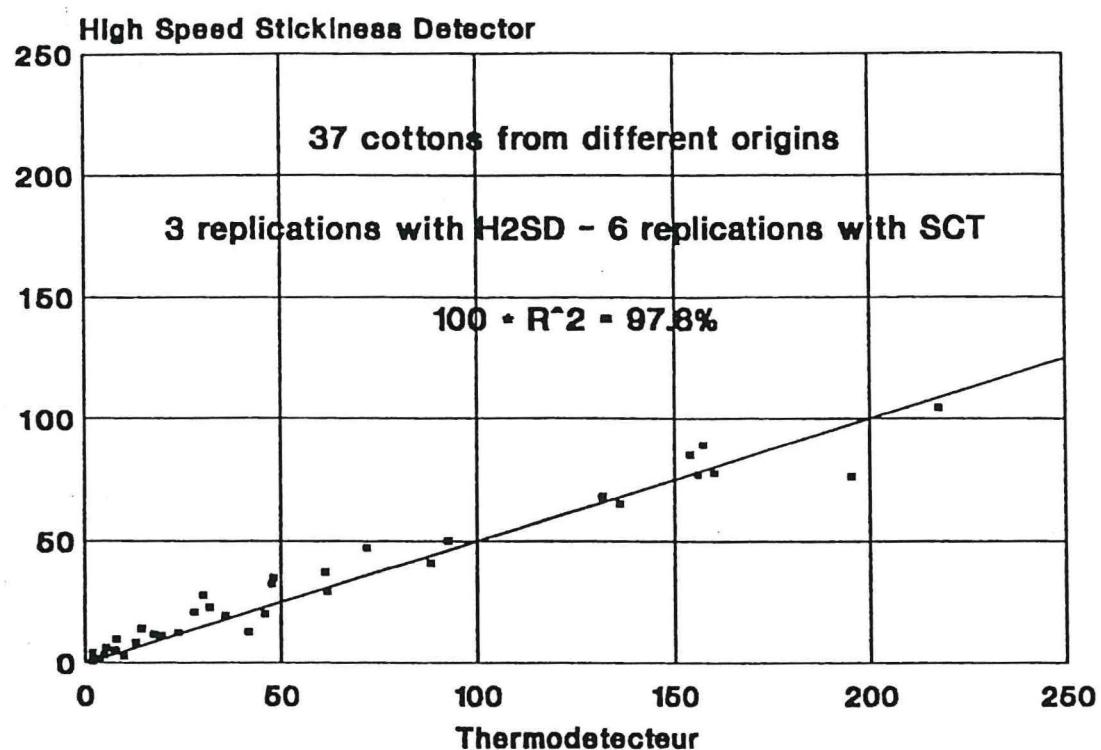


Figure 3. High Speed Stickiness Detector vs Thermodetector SCT

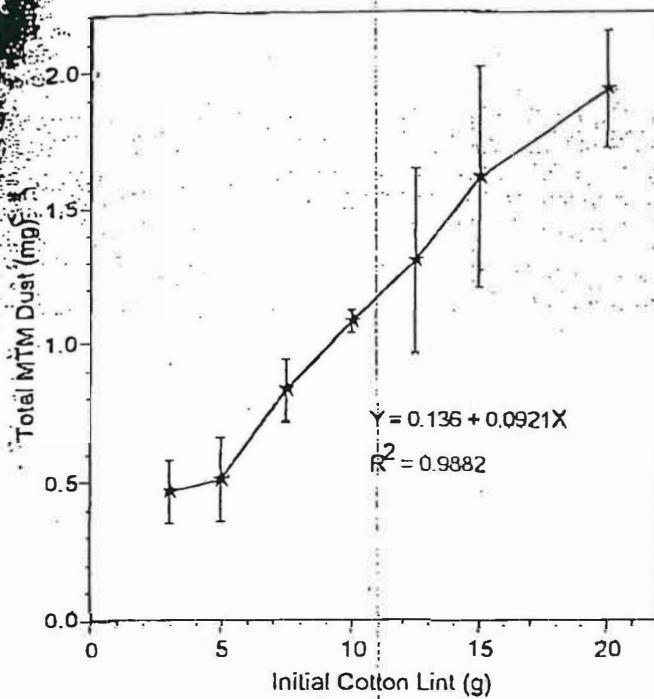


Figure 1. Relationship between cotton lint processed and cotton dust released. Each half bar represents 2 s.e.



THE HIGH SPEED STICKINESS DETECTOR: RELATION WITH THE SPINNING PROCESS

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Abstract

Our results demonstrated that High Speed Stickiness Detector (H2SD) correlates very well with the Sticky Cotton Thermodetector (SCT), ITMF recommended method, in measuring entomological stickiness potential of cotton fibers.

Twenty cottons of a wide range of stickiness were evaluated with card, SCT and H2SD, and micro-spinning tests were conducted to correlate bolt quality results on yarns and troubles encountered during the process, with stickiness evaluations.

A stickiness classification of the cotton production seems to be possible since observed results give good predictions of the observed troubles during spinning with H2SD measurements, and since H2SD give results at the same rate as HVI do.

Introduction

Two types of sugar have the potential to produce stickiness phenomena, entomological sugars and, in certain particular cases, physiological sugars. The experience gained by the CIRAD in this field shows that in nearly all cases it is entomological sugar (excretion by insects such as white fly and aphids) that is responsible. Insect excretions form tiny beads of sugar that contaminate the fiber. Physical tests such as minicard or thermodection therefore constitute good predictive tests for stickiness of entomological origin.

Preliminary studies have shown that even in countries which suffer particularly badly from stickiness, a significant proportion of the harvest is uncontaminated. However, because no control system is in place to determine production stickiness, the entire production is labelled as «sticky cotton» and, in consequence, is subjected to systematic downgrading.

It is becoming increasingly important to rapidly measure the sticky potential of cottons before they enter the spinning process as it is possible to reduce these sticky effects by appropriate means: mixing cottons that present different levels

of contamination, reducing relative humidity in the premises (Gutknecht & al., 1988) or by various treatments: lubricants, washing, etc. (Perkins, 1993 ; H. H. Jr. Perkins, D. E. Brushwood, 1994).

CIRAD-CA is developing a new measuring system where the human element in sample preparation, in the test itself and in counting the sticky points, has been reduced to a minimum. The duration of the test has also been reduced to render the determination of cotton stickiness compatible with the speed of HVI lines.

The new high speed sticky cotton detector is made up of 5 work stations (R. Frydrych, E. Hequet, G. Cornucjols, 1994):

- sample preparation;
- application of heat and pressure;
- application of pressure at ambient temperature;
- cleaning the aluminium surface;
- counting of the sticky points.

Now, the question is: is it possible, through measurement of the stickiness of raw cotton, to predict the troubles that may occur during spinning?

Materials and method

Twenty one cottons were selected depending on their origin and their potential to produce stickiness.

The following tests were performed: minicard tests, SCT tests, H2SD tests.

Tests using the laboratory card were performed at 55 % relative humidity and at 22°C. All tests were carried out in a random manner. Relative humidity was checked hourly and was seen to be very stable (RH = 55 ± 2 %). The card flats, lower waste-collection tray and the grids were cleaned after three cottons i.e. every 30 g, or systematically after very sticky cotton (grade 6-7). Flats were cleaned by metallic wire and the grids using a brush; the pressure rollers (covered with honeydew) were cleaned with water then dried with a cloth and a hair-dryer for about 10 seconds.

The cottons' stickiness potential was evaluated using the seven CIRAD grades presented in table 1.

Thermodetector tests were performed with CIRAD thermodetector in an atmosphere of RH = 60 ± 2 % and at 22 ± 1°C. Cottons were analyzed in a random design; 3 tests on 2.5 g of cotton per replication and 3 replications to obtain 9 readings per cotton. A replication was performed each day.

A 2.5 g web of cotton was sandwiched between two aluminium plates. Pressure was applied while heating to 85 ± 5°C for 12 seconds. Pressure was then applied a second time (cold) for 2 minutes. The sticky points were counted after leaving the cotton web between the aluminium sheets for 1 hour.

For H2SD tests, the fiber sample weighs between 3 and 4 grams and has a surface area of about 250 cm². The sample is opened using a mechanical rotory-type opener to obtain a very homogeneous fiber-mounting interface, and to allow all types of cotton to be processed (saw or roller ginning).

The sample is then placed on a strip of aluminium foil originating from a roll at least 300 meters long. The aluminium is rolled along a conveyor belt which transfers the sample in front of each station. The aluminium strip is rolled up at the other end of the machine.

Pressure is then applied to the sample for 25 seconds while the heating element is in contact with the cotton. The temperature differential between the heated cotton (53°C) and the mounting (21°C) creates a thin layer of steam on the aluminium foil, which causes the sugar or honeydew drops to be deposited onto the aluminium mounting. The heating element exerts a pressure of about 600 g/cm².

Pressure is then reapplied for 25 seconds at ambient temperature immediately after the hot pressure phase. This fixes the sticky points to the aluminium foil. The same amount of pressure is applied as during the hot-pressure phase.

The fiber mass is aspirated and the aluminium sheet then cleaned automatically.

The sticky points are counted by video camera as it scans the sheet. The image is then analyzed by computer. The software used calculates the number of sticky points. Tests using the high speed stickiness detector (H2SD) were performed at 60 % relative humidity and 21°C. Three tests per replication and 2 replications were made to obtain 6 readings per cotton.

Fourteen cottons were selected from the 21 cottons previously described. One

spinning test was performed for each cotton and the following analyzed: regularimetry and a detailed analysis of the yarn.

Spinning trials were performed on a SHIRLEY-PLATT nucospinning machine comprising a card; drawing frame and ring spinning using two drawing areas. The technical characteristics of the machines used are given below:

- cotton opener: each 45 g sample of cotton underwent opening and mixing on our laboratory opener (web received onto a drum 77 cm in circumference).
- card : GRAF metallic wire was employed. Eight stationary flats were cleaned manually after each trial. The cotton web produced was wound around a drum identical to that used on the opener.
- drawing frame : three drawings were performed, each with a value of 10.5. The first converted the web into a sliver, the two others homogenized and refined the sliver by doubling at 5 and 10 respectively. The length of sliver obtained was 15.60 meters and was used to feed the four spindles.
- spinning: composed of two drawings; the back draught was fixed at about 6.5, the front draught fluctuated depending on the incoming tex and, on average, was at 2100. The tex of the yarn was 20. The torsion applied was calculated taking account of the fiber length of each cotton. Each spindle furnished about 250 meters of yarn.
- regularimetry: performed on a USTER GGP-IPI regulator; the settings chosen were as follows : speed 50 m/min, thin (-50 %), thick (+50 %), neps (200 %); 125 m of yarn per cup * 4 cups were tested. Results were adjusted to 1000 m of yarn, the baseline for USTER tests. A detailed analysis of neps on the same yarn was performed using a method developed at CIRAD to identify the different neps observed (R. Frydrych and J. Gutknecht, 1989); percentages obtained for each type of imperfection were adjusted to total neps on 1000 m to obtain the number of neps per type of imperfection on 1000 m.

Neps observed:

- seed coat fragments due to broken seeds,
- fiber neps:
 - . due to immature fibers
 - . produced by honeydew on the sliver which, when passing through the spinning machine, results in the pulling up of the fibers around the rollers;
 - . also produced by beads of sugar which cause the clumping of a mass of fibers stuck together ;
- miscellaneous fragments such as leaves, stem fragments. Temperature and hygrometric conditions in the course of the study were 22°C and 55 % relative humidity during spinning, 22°C and 65 % relative humidity during testing of resistance and regularimetry.

Because the spinning of very sticky cotton is difficult, we decided to intervene as regards honeydew deposits and wrapping around the rollers by cleaning the rollers when the production process was disrupted.

Results and discussion

Comparison of stickiness detection methods

Figure 1 shows that the card-thermodetector relationship is not linear as the card demonstrates a saturation phenomenon for very sticky cottons whereas the thermodetector does not. We therefore sought an equation which would take this phenomenon into account, and developed the expression given below :

$$\text{Card} = A - B \cdot \text{Exp}(-C \cdot \text{Thermo})$$

Calculation of coefficients A, B and C (see figure 1) renders the relationship linear and thus allow the $(100 \cdot R^2)$ coefficient to be calculated. This coefficient is 90 %, i.e. an increase of 7.5 % in R^2 in relation to simple linear regression.

Figure 2 shows that the card-H2SD relationship is very similar to the card-thermodetector relationship. The coefficient of determination is 86 %.

Figure 3 shows both card-SCT and card-H2SD relationships. The H2SD gives a higher card grade than the thermodetector for a given number of sticky spots. This means that with the H2SD, it is possible to detect more sticky points per square centimeters than with the thermodetector.

Figure 4 shows that the relationship between H2SD and SCT is linear, correlation coefficient is excellent. The slope of approximatively 0.5 confi that the sticky spot density obtained with the H2SD on aluminim foil is high than with the SCT.

Effect of stickiness on the ring spinning process

It would be unrealistic to draw definitive conclusions from only 14 cottons. aim of this study was rather to investigate tendencies and to better identify parameters to measure in the study of spinning disruptions caused by stickiness as the spinning of sticky cottons is very difficult and takes a great deal of time. The observations and measurements required are lengthy and thus justified preliminary investigation.

We have already demonstrated, in previous studies, that it is possible to breakdown the number of total Uster neps into seed coat fragments, real fiber neps (long fibers), sticky fiber neps and miscellaneous fragments (leaves, stem fragments, polypropylene etc.). It would therefore be logical to correlate the number of sticky fiber neps with the method used to measure stickiness on raw fibers (figures 5 & 6). The number of sticky points obtained on the H2SD and the thermodector shows a good correlation with the number of sticky fiber neps. The same is observed with the card. It seems that with the H2SD the possibility to predict sticky neps is higher than with the card (coefficient of determination of 70 % and 47 respectively). It should therefore be possible, from measuring raw cotton, to predict the increase in the number of neps due to stickiness.

As concerns i) spinning disruptions, ii) the number of sticky points deposited on the back draught roller of the spinning machine (figures 7 and 8) causing fiber to wrap around the roller (figures 9 and 10) and iii) manual intervention prevent spinning from being interrupted (figures 11 and 12), the correlation with the number of sticky points measured on the H2SD using raw fiber is good in all cases. The correlation is in general less good with the card grade should therefore be possible to quantify ring spinning disruptions from measurements performed on raw fiber.

It is difficult to precisely determine the financial loss caused when a country is branded as a sticky cotton fiber producer. It can nevertheless be estimated if the cotton is discounted by 5 to 10 % with regard to the standard rate. Taking the mean price to be on 1,400 dollars per ton of fiber, the financial loss can be estimated at 105 dollars per ton in average.

Insofar as the discount is calculated with respect to fiber price, its impact obviously increases as prices rise.

The eradication of the sticky cotton phenomenon should therefore result in financial gain equal to the discount rate currently practiced. Without going far, a valid estimation of the commercial impact (supposing that 80 % of production does not cause any problems during spinning), would place about 80 % of the production at the standard price with the remaining 20 % discounted as described above.

In this case the overall discount rate would be no more than 1 or 2 % (1 dollar per ton on average), which is already very satisfactory.

Conclusion

In conclusion, the obtained results are encouraging as they show that it is possible to link the intensity of stickiness measured on raw fiber to problems encountered during spinning. The current tendency is to say «your cotton is sticky so I don't want it»; whereas in the situation where sticky cottons are mixed with non-sticky cottons in a given region and in the absence of a systematic measurement of stickiness intensity, this position is excessively negative. Cottons that are only slightly sticky or non-sticky seem to cause very few problems during processing. The systematic measurement of stickiness should therefore allow producers to sell their cotton with a discount adjusted to stickiness potential rather than using big discounts for all cottons irrespective of stickiness potential. Spinners would be better informed as regards the products they are buying and would have advance knowledge of processing problems and therefore be able to limit them (mixing of cottons of various origins and stickiness potentials, reduced relative humidity etc.).

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Table 1. The seven CIRAD card grades.

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4	Fairly numerous sticky points, the cotton tends to wrap around the delivery rollers after about one minute
5	Numerous sticky points, the cotton tends to wrap around the rollers quite quickly (in about 1/2 minute)
6	Numerous traces of stickiness, the cotton wraps around the rollers very quickly
7	Immediate sticking and wraps around the rollers almost instantly

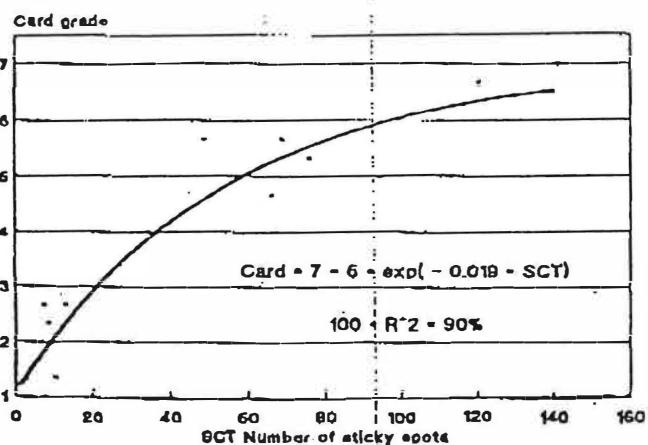


Figure 1. Card versus Sticky Cotton Thermodetector.

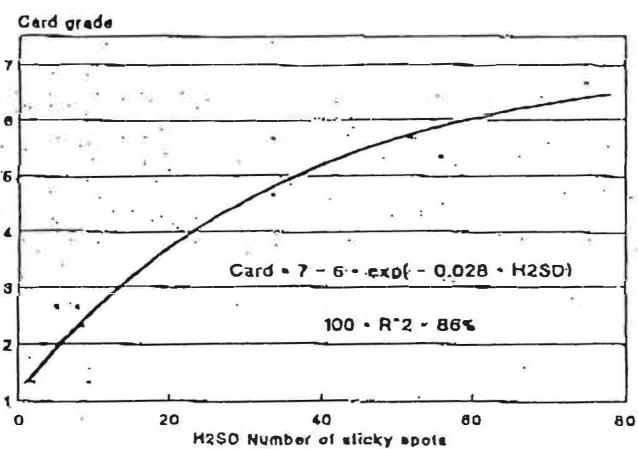


Figure 2. Card versus High Speed Stickiness Detector.

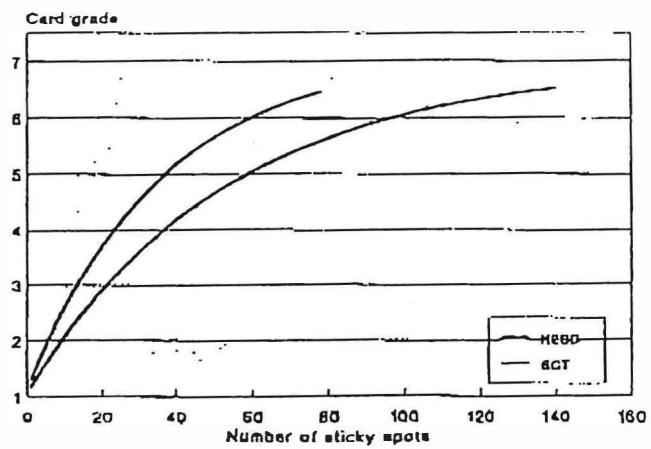


Figure 3. Card versus CIRAD Stickiness Detectors.

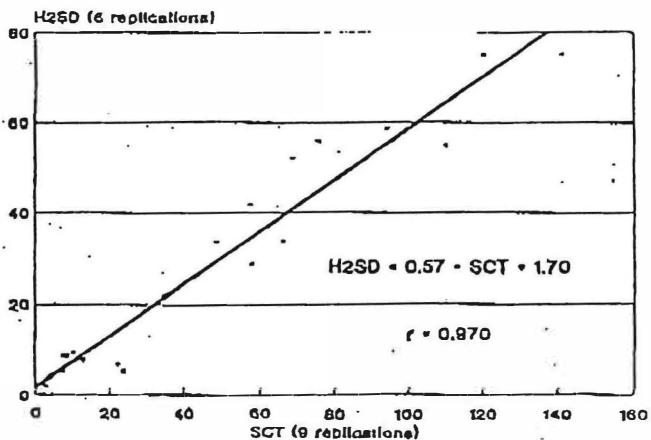


Figure 4. High Speed Stickiness Detector versus Sticky Cotton Detector.

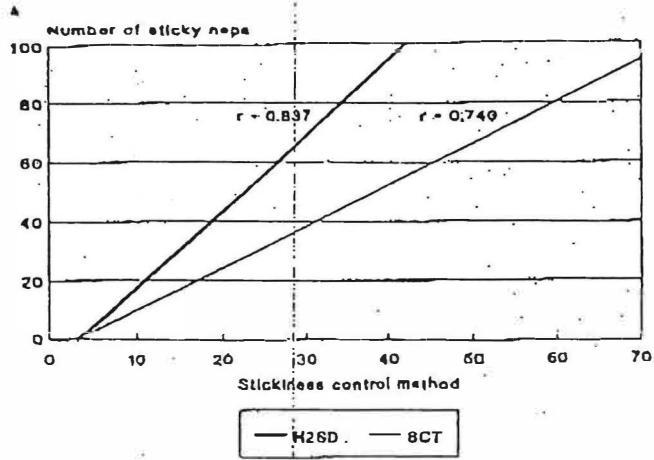


Figure 5. Number of sticky neps on 20 tex yarn versus stickiness control methods.

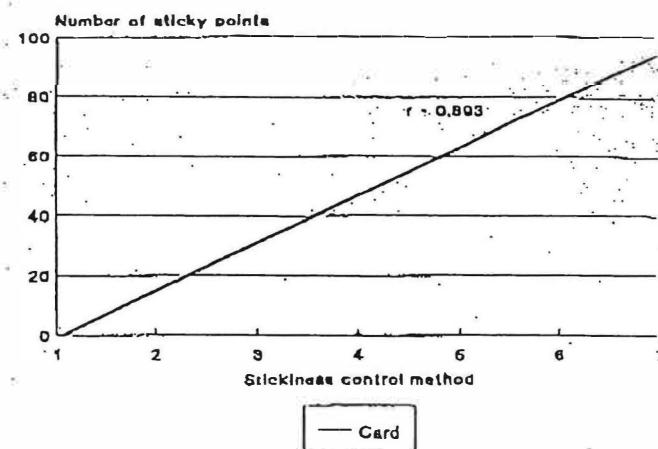


Figure 8. Sticky points on the back draught roller on the RS frame v. stickiness control method.

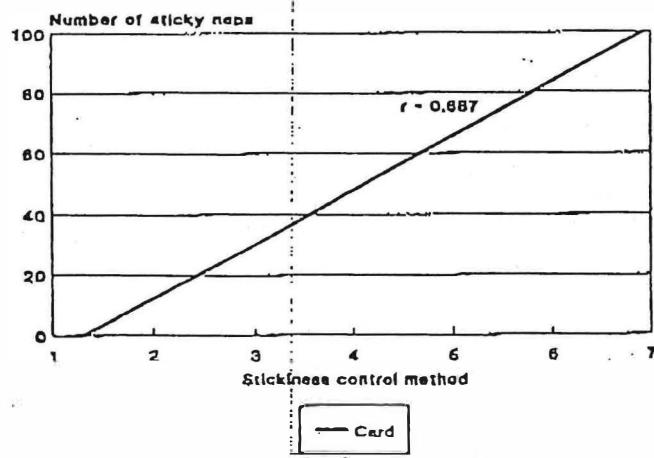


Figure 6. Number of sticky neps on 20 tex yarn versus stickiness control method.

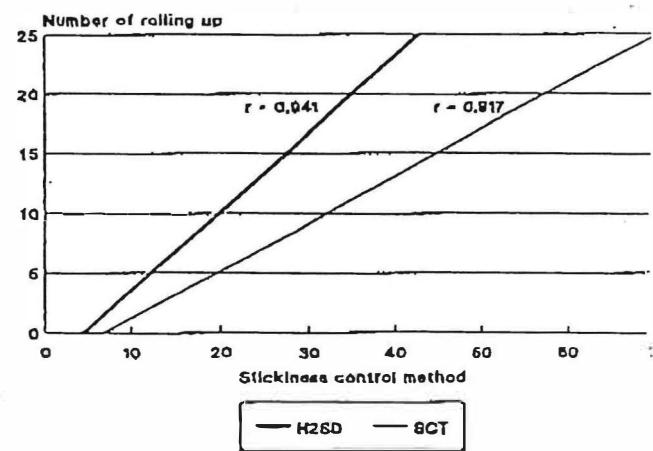


Figure 9. Rolling up on the drawing system's first roll of the RS frame v. stickiness control methods.

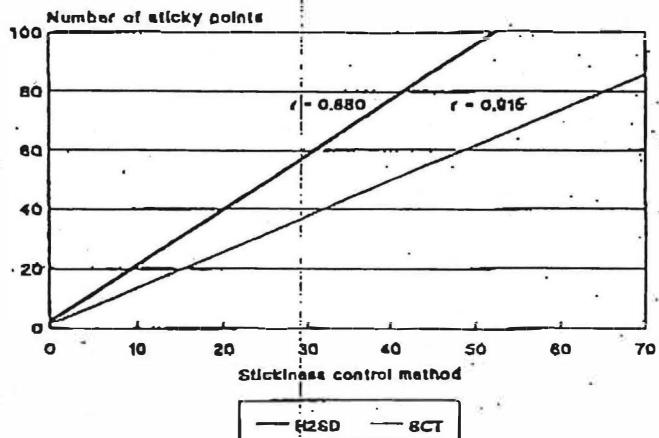


Figure 7. Sticky points on the back draught roller on the RS frame versus stickiness control methods.

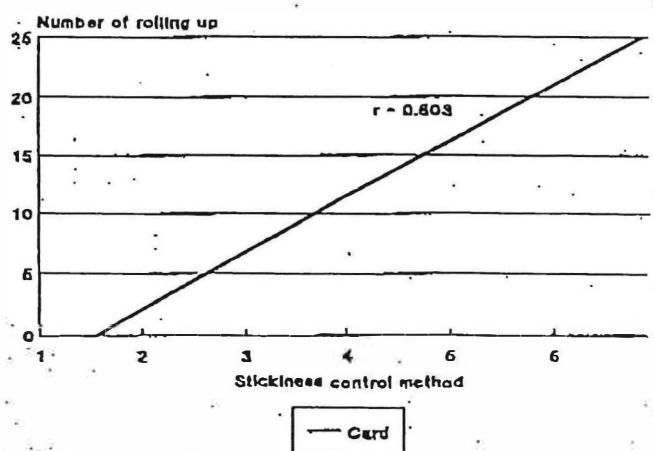


Figure 10. Rolling up on the drawing system's first roll of the RS frame v. stickiness control method.

Introduction and Background

The thermodeector (TD) method is an effective method for assessing cotton stickiness caused by honeydew contamination from aphids and whiteflies. The TD was developed and is sold by the Institute for Research in Cotton and Exotic Textiles (IRCT), Montpellier, France [2,3,4]. The method consists of preparation of a thin web of fibers, placing the web between sheets of aluminum foil, heating and cooling the web under pressure, and counting the number of sticky spots that adhere to the sheets of foil. In March, 1994, the International Committee on Cotton Testing Methods (ICCTM) of the International Textile Manufacturers Federation (ITMF) Zurich, Switzerland, adopted the TD method as the reference method for assessing honeydew stickiness of cotton replacing the minicard method [1]. We reported results at this conference last year showing the high correlation between results from the TD method and results from the established minicard method [6]. However, little was known about any between laboratory differences that might exist for the method. In 1993, the Honeydew Working Group of the ICCTM initiated the procedure to conduct an international interlaboratory test designed to determine between laboratory variation of the test method [1]. Samples were prepared at the USDA, ARS, Cotton Quality Research Station (CQRS) in Clemson, SC, and were distributed in early 1994 to laboratories that had agreed to participate. This report summarizes and examines results of this interlaboratory test. Additionally, new data from comparative tests on hand harvested cottons from plots included in whitefly control experiments are reported.

Measurements

Figure 11. Interventions to remove points and wrapped fibers versus stickiness control methods.

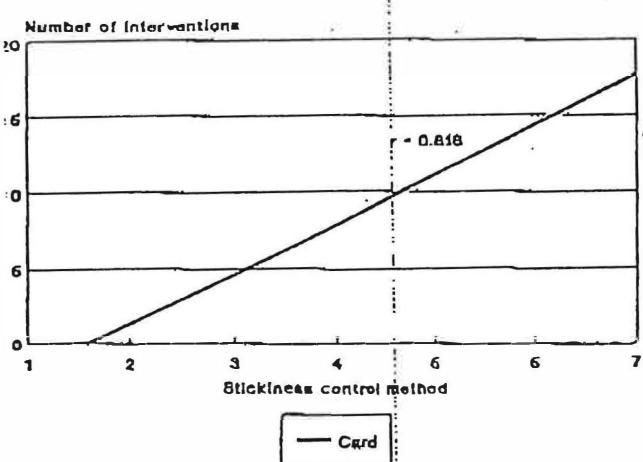


Figure 12. Interventions to remove points and wrapped fibers versus stickiness control method.



INTERLABORATORY EVALUATION OF THE THERMODEECTOR COTTON STICKINESS TEST METHOD

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Abstract

An international interlaboratory test designed to determine the effectiveness of the between laboratory variation of the thermodeector sticky cotton test method was conducted. All of the participating laboratories readily differentiated the nonsticky and the sticky samples. There were some level differences in counts between laboratories, and several laboratories tended to count too many spots on nonsticky samples. However, level differences in results were small between laboratories in which technicians had received similar training for conducting the thermodeector test. The implication is that, with standardized procedures and training, interlaboratory variations could be small. Future refinements of the method should be designed to minimize both between laboratory differences and the occurrence of false positive results.

Thermodeector Interlaboratory Test

About 20 laboratories known to have access to a thermodeector were invited to participate in the interlaboratory test. Thirteen laboratories agreed to participate, and, to date, results have been received from 10 laboratories. The CQRS laboratory participated in the test in blinded fashion.

The five cottons used in the test were selected from bale sized lots so that sugar tests and other stickiness tests could be conducted and evaluations to assess processing stickiness could be conducted on modern commercial opening, cleaning, and carding machines at CQRS. The cottons were prepared for use in the interlaboratory test by processing approximately 25 pounds of each test cotton through an opening hopper and one beater section of a standard textile opening line. This gave some degree of blending to ensure that samples sent to the different laboratories were uniform. The cotton was still in tufts that would be similar to raw stock sampled from bales.

Reducing sugar contents of the samples were determined by the USDA potassium ferricyanide method and stickiness levels were determined by the minicard method [5]. The processing stickiness was determined subjectively by observing the performance of 50-pound lots of each cotton during passage through state-of-the-art opening and cleaning machines and a chutie fed card.

The instructions to participants were kept very simple and were based on instructions from the TD manufacturer and on experience gained from experiments in the CQRS laboratory. Since the TD was introduced, IRCT has suggested some changes in the test procedure. The heating plate temperature recommended for the early models was 90°C, but now the recommendation is 80°C. Also IRCT now recommends letting the sample stand for 30 minutes after testing before separating the sheets of foil to count the sticky spots. In the instructions to participants, each participant was asked to conduct the test using the conditions they normally use and to specify those conditions on the report form. Each laboratory reported relative humidity in test area, heating plate temperature, and whether spots were counted immediately or after 30 minutes. The general instructions furnished to participants were basically those supplied by the TD manufacturer. The samples were tested in triplicate by each laboratory.

In general, the results of the test were good. There were some level differences between laboratories. This is probably inevitable and should have been the expected result for a relatively new test method that has not had rigid standard procedures for operation and interpretation of results between laboratories. However, the degree of differentiation between the sticky and nonsticky cottons was excellent for essentially every laboratory. This is strong evidence that the method is very sensitive to variations in stickiness and that standardization of all aspects of conducting the test should lead to minimization of between laboratory differences.

About half of the laboratories used a heating plate temperature of 80°C and half used 90°C. Also about half counted spots immediately and half counted after 30 minutes. No obvious differences were noted in results that could be attributed to heating plate temperature. There appeared to be a slight trend toward higher numbers of spots when counting after a 30-minute delay, but this is far from conclusive. The test was not designed to isolate these 2 variables. However, one laboratory tested samples using both heating plate

Standardization Proposals: The Thermodetector and its Methodology

Richard Frydrych and Eric Hequet, CIRAD-CA, Montpellier, France

1. Cotton Stickiness Problem

The cotton stickiness problem in spinning is highly complex as stickiness may be caused by various types of contamination:

- kernel, traces of oil, etc.
- physiological sugars due to the plant
- honeydew, sugars produced by homoptera, the aphid *Aphis gossypii* and the whitefly, *Bemisia tabaci*

The most serious type of stickiness that causes the worst problems in spinning is cotton contamination by honeydew. It is found on the plant and at various stages of fiber processing into yarn.

On the cotton plant, aphids and whiteflies are mainly found on the underside of leaves and on the leaf stalks. They produce honeydew, which is found on the leaves and on the fiber as soon as the bolls open. If climatic conditions are propitious, fungi develop on the honeydew to form fumagin. This can also be found on non-sticky fibers, i.e. in the absence of honeydew. The ginning process scatters honeydew droplets into the mass of fibers and these droplets are then very difficult to be detected to the naked eye (Fig. 1).

In the spinning industry, honeydew settles on various machine parts, such as the carding feed rollers, the draw-bench rollers, the feeder tables and the open-end turbines. Apart from the frequent machinery downtime due to dirt build-up, honeydew causes yarn irregularities.

The thermodetector SCT measures the stickiness of cottons polluted by insect honeydew. Figures 2, 3, 4 show the different types of honeydew recovered from a sheet of aluminium foil after testing on the thermodetector.

In March 1994, the International Committee on Cotton Testing Methods (ICCTM) of the International textile Manufacturers federation (ITMF), adopted the SCT thermodetector method as the reference method for assessing honeydew stickiness of cotton. The SCT thermodetector and its methodology have been standardized at CIRAD in order to reduce the variation sources which can have an effect on the number of sticky points.

2. Possible Variation Sources

It has been shown that the number of sticky points can vary according to the following parameters

2.1 Opening Phase

- Opener type: manual or mechanical
- Card wire cloth: effect of needles density and shape
- The cotton must be opened by hand before being opened by the card wire cloth

2.2 Thermodetector Phase

- The level of the pressure on the lower wooden board applied by the hot plate and the upper wooden board
- The temperature level of the hot plate

2.3 Counting Phase

- Aluminium foil cleaning
- Light efficiency
- Wait a few minutes before reading off the sticky points.

Appendix S-7

3. SCT Thermodection Standardization at CIRAD

3.1 SCT Thermodection (Fig. 5)

The SCT thermodection (2) is composed of:

- A lower wooden board placed on 10 springs, and covered with a copper-plated aluminium platen (7) : surface : 0.1408 m²
- An aluminium hot plate :
 - surface : 0.1792 m² which is under the cover (10)
 - temperature : obtained by an electronic regulator (11) adjusted to 82.5°C and placed in an electronic box (9)
 - force applied on the lower board : 780 N ± 50
- An upper wooden board :
 - surface : 0.1408 m²
 - force applied on the lower board : 589 N ± 50

3.2 Accessories Necessary for Using the Equipment

- **Figure 5**
 - stand (1)
 - box containing a lamp "PAR 100 to 120 W, FLOOD 12° or 30°", a fan (3) and its strut (5) ; the aluminium foil must be lit up by a low-angle light and the fan makes the fibers vibrate for a better reading off
 - aluminium foil holder (4) and its strut (5')
 - rolls of aluminium foil (12), thickness 10 to 20 microns
- **Figure 6**
 - mechanical opener :
 - 1 opener (18) covered with Graf card wire (13) :
 - main cylinder : diameter 156 mm ; width 220 mm
 - feeder : diameter 35 mm ;
 - gear ratio 1/40 to 1/41
 - card wire : needle = density 50 /inch² ; height = 11 mm ; angle = 12°/30°
 - cleaning brush (15)
 - 1 needle (16) for removing web from opener
- **Figure 8 :**
 - cleaner (26) covered with non-woven fabric from Chicopee (rayonne + binder + impregnation of 10% mineral oil), weight 400g ± 50

4. Methodology Standardization

4.1 Testing

- **Setting Up the Equipment (Fig. 5)**
 - pull forward the slide (10) carrying the hot plate as far as it will go, so as to slightly pre-heat the lower platen (7),
 - to start the test, push back the hot plate and draw a length of aluminium foil (12), matt side upwards, from the dispenser (4),
 - the samples should be conditioned and tested at a relative humidity of 65%.
- **Sample Preparation with the Mechanical Opener (Fig. 6)**

The accessories are as follows:

- opener (18),
- brush (15),
- needle (16).

Appendix S-7

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- pull forward the slide (10) carrying the hot plate as far as it will go, so as to slightly pre-heat the lower platen (7),
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- the samples should be conditioned and tested at a relative humidity of 65%.

● Sample Preparation with the Mechanical Opener (Fig. 6)

The accessories are as follows:

- opener (18),
- brush (15),
- needle (16).

The sample is obtained as follows:

- before each trial, clean the opener card wire (13) with the brush, rotating the drum by hand. Every 15 tests or so, clean (14) under the equipment to prevent impurities from being picked up,
- take a sample from the mass of cotton and weigh 2.5 ± 0.05 g,
- pull the sample apart by hand and place it on the feed table, spreading it out over a length of around 11 cm. Start the mechanical opener to obtain a uniform web,
- detach the cotton web with the needle. Take hold of the end of the layer of cotton web (17), turn the drum using the handle and press down the web towards the feed table to help separate it from the pins.

• Cotton Testing

The Thermometer is used as follows to test for stickiness (Fig. 7):

- place the cotton web (17) on the sheet of aluminium foil (12) on the thermometer,
- place a second sheet of aluminium foil (19), matt side down, over the cotton web. Flatten with the palm of the hand,
- draw forward the trolley (10) with the hot plate. Press it down immediately on the sample using the 2 levers (20); press down hard to lock the plate in position in the catches (21). This pressure lasts 12 seconds,
- when the alarm sounds, unblock the 2 levers by releasing the catches (22) and push the trolley and hot plate right back,
- quickly apply the upper wooden pressure board (23) to the prepared sample and lock into the catch (24) until the second alarm sounds (2 minutes); mark the sample reference on the top sheet,
- unblock the upper wooden pressure board by releasing the catch (25); swing up the pressure plate,
- remove the prepared sample and leave it to stand on a table about 60 minutes before reading off the sticky points,
- the waiting time can be used to prepare the next samples.

4.2 Counting the Sticky Points

Sticky points are read off with the following accessories (Fig. 8).

- The box containing the spot lamp and the fan can be:
 - either fixed to the thermometer when the sample to be examined is on the lower plate of the equipment,
 - or sat on a table when the sample has been placed on it,
 - in both cases, the light should be just level with the aluminium foil, and the fan causes the fibers to vibrate for a better read-off.
- A cleaner (26) covered with several layers of non-woven fabric removes non-sticky fibers. After a few hundred tests, it is necessary to remove the top layer of non-woven fabric.

The sticky points are read off as follows:

- remove the top sheet of aluminium foil (19) and place it on a table matt side up,
- place the cleaner at one end of the sheet; merely draw it across the surface once without pressing to remove the cotton web; then in the other direction, to remove the fibers that are not stuck. This leaves the sheet with large, medium and small sticky points. Count only the sticky points with fibers (28) using for example the very practical counter pen (27), marking each point with the felt tip. The Figures 2, 3, 4, show different types of sticky points,
- sometimes, fibers remain stuck to the aluminium foil; they can be removed by brushing lightly with the edge of the hand. If they do not come off, they are sticky points,

Appendix S-7

- for the top sheet of aluminium foil, draw the cleaner across the surface in the same way as for the bottom sheet and count the sticky points,
- add together the sticky points on the top and bottom sheets.

In order to acquire a reliable estimate of the stickiness of the cotton, we recommend carrying out 3 tests per cotton. The mean of the 3 tests corresponds to the degree of stickiness.

4.3 Statistical Analysis

Such statistical analysis are generally necessary in research to show the difference between two treatments. Statistical analysis of the number of sticky points shows that the distribution is not normal ; the distribution is close to a Poisson distribution. The variance of the results is an increasing function of stickiness. Transformation of variables is thus required before statistical analysis of stickiness in order to stabilize variances and normalize distribution. Square root transformation should be used.

5. Equipment Maintenance

The thermodetector does not require any particular maintenance; nevertheless it is necessary

- to keep the hot plate trolley rails clean,
- check equipment operation using 2 reference samples of cotton. If no sticky points settle during tests, check the temperature of the place with a thermometer placed beneath it. The temperature should be between 80 °C and 88 °C and should be tested with the digital thermometer (sensor needle). This temperature is obtained by the electronic regulator adjusted to 82.5 °C.
- check the fuse if the plate does not heat up,
- after, several thousand tests, if the cooper-plated aluminium platen is deformed by hard foreign bodies inside the samples, then replace it.
- after several thousand tests, verify the forces applied on the lower board by hot and ambient temperature plates.

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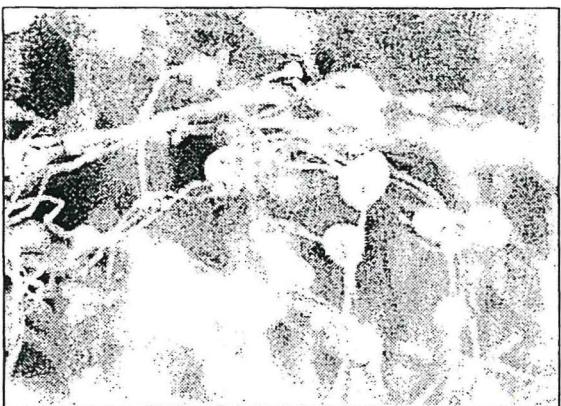


Figure 1. Honeydew droplets in the mass of fiber

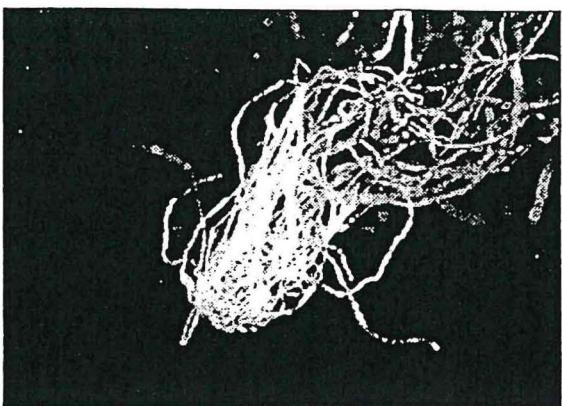


Figure 2. Small sticky point with attached fibers, on aluminium foil

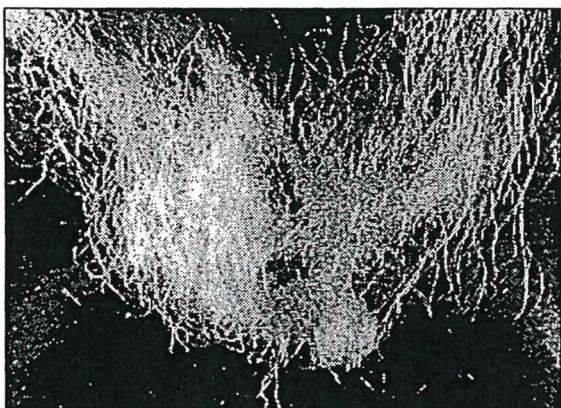


Figure 3. Pair of sticky points with attached fibers, on aluminium foil



Figure 4. Small sticky point contaminated by fumagin, with attached fibers, on aluminium foil

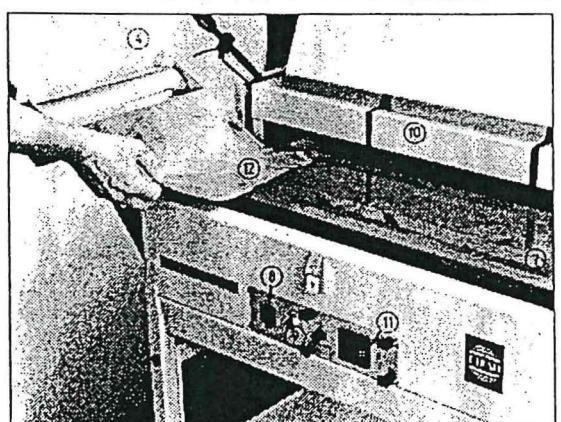
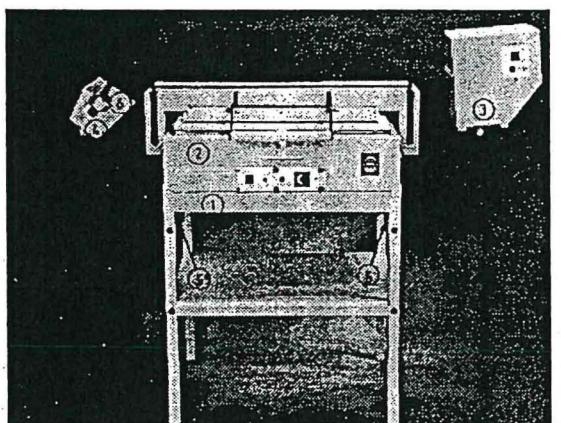


Figure 5. ThermoDetector SCT and accessories

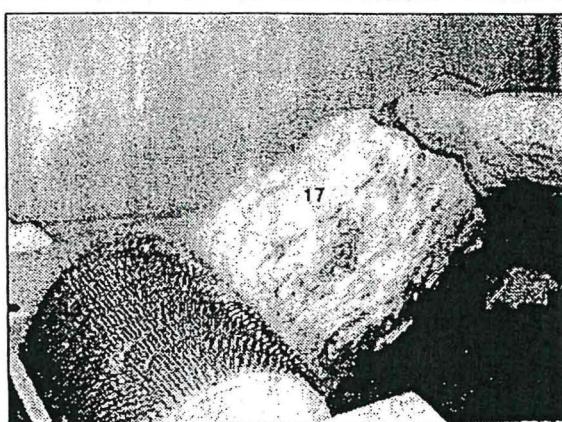
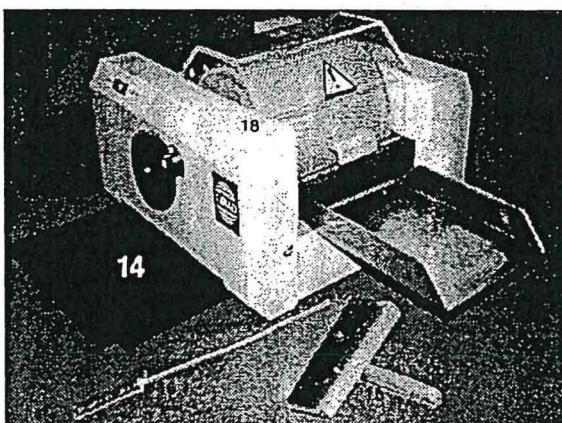


Figure 6. Mechanical opener

Stickiness

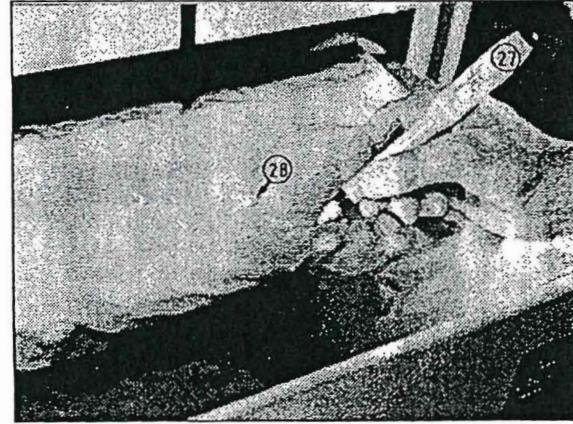
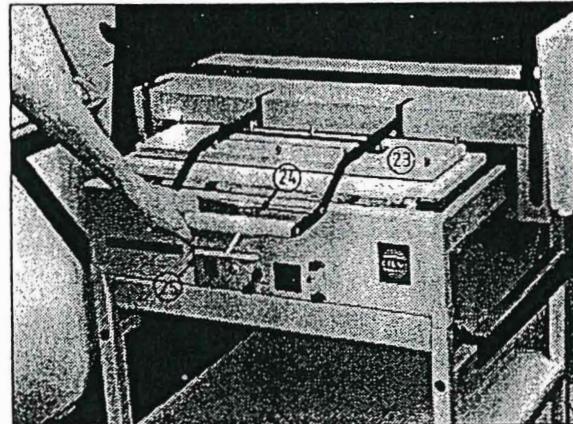
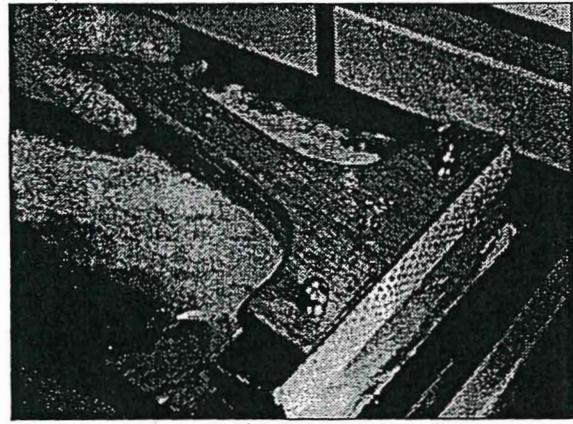
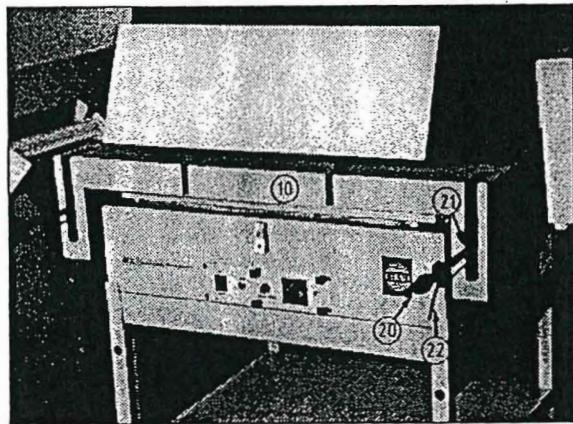
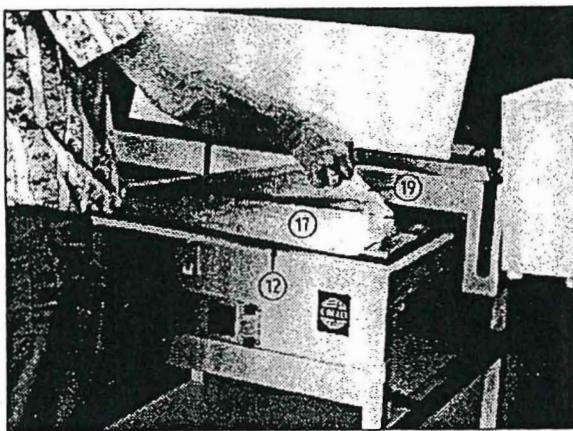


Figure 7. Cotton testing

Figure 8. Counting the sticky points

THE USE OF THE HIGH SPEED STICKINESS DETECTOR ON A LARGE RANGE OF COTTON COMING FROM DIFFERENT COUNTRIES

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Abstract

For some years now, all those involved in the cotton industry, from grower to spinner, have become increasingly concerned by the stickiness encountered during cotton-to-yarn processing, and have attempted to find a remedy. Unfortunately, even today it is very difficult to precisely identify producer countries affected by this problem as stickiness is governed by several factors which induce annual and spatial variations that modify its intensity. Also, no official system is yet available to classify this criterion. Furthermore, as this phenomenon has already produced marked economic effects, information concerning the origins of contaminated cottons is not always made available.

Introduction

It was at the beginning of the 1980's that certain spinners noted that the spinning process was substantially disrupted by sticky cottons. This stickiness can be caused by physiological sugars produced by the plant or by entomological sugars produced by insects.

Several authors have noted that physiological sugars cause stickiness during spinning:

Perkins (1971) reported that small groups of immature fibers were causing problems on the card web feeding rollers and that these cottons contained very high concentrations of physiological sugars. He noted that it is advisable not to use this type of cotton in spinning. This lack of maturity is also the origin of fiber neps formed by fibers tangling during machine processing. These tangles result in the production of poor quality yarn that shows a low dye affinity (Perkins and Bargeron, 1980).

Wyatt (1976) reported that sugar levels of 0.3 % or less did not cause any problems. He noted that when dealing with a low micronaire index, sugar levels may reach 0.8 %.

Entomological sugars are produced by insects excreting sugary substances, generally known as honeydew. This honeydew contaminates the fiber and can be found at each step of fiber processing, i.e. from the plant to the yarn (Héquier and Frydrych, 1992). The main producing insects are the aphid *Aphis gossypii*, the white fly *Bemisia tabaci*, and to a lesser extent the mealybugs *Pectinophora gossypiella*, *Nycteolus vestator* and *Phaenacoccus* (Couvillod, 1986). The report presented here only concerns the two main pests.

When on the plant, aphids and white flies live mainly on the inner surface of the leaves. They puncture the sap's descending circulation system, sucking out the sap as food. They excrete honeydew onto the leaves and onto the fiber of open bolls either in the form of a very fine spray of droplets (white flies) or in the form of large drops (aphids). Under certain conditions fungi are found growing on the honeydew (Hilliges and Bräcil, 1993), forming fumagine. If large amounts of sugar are deposited onto the leaves, these form droplets that fall onto the fiber, causing substantial contamination. The ginning process disperses the honeydew thus rendering it difficult to detect by eye.

Cottons contaminated by insect-derived honeydew cause process disruptions from the ginning phase to spinning operations:

- When processed by saw ginning, the contaminated fiber deposits honeydew onto the teeth of the saw and sticks there (Declercq, 1973). Fibers

clogged in the extractors prevent the air from being extracted. Both these effects require machine stoppage and cleaning. When studying roller ginning, Khalifa and Gameel (1982) reported output of 5 to 7 kg per gin and per hour, whereas output for clean cotton is 25 to 30 kg.

During spinning, the honeydew attached to the fiber generally sticks to all items that exert pressure, i.e. the card rollers, those on the drawing frame, the brushes and the spinning assembly (Perkins, 1983-a; Gudmoch et al., 1988; Perkins, 1991; Shigeak Ikuwa, 1992). This honeydew also contaminates the tables that feed rotor-spinning openers and can be found deposited within the rotors (Marquie et al., 1983). These deposits cause the fibers to rise upwards, leading to irregularities in the card web and in slivers. This predisposes to breakages in the yarn and alters its quality. Machines must be stopped and cleaned at a frequency that depends on the extent of this contamination.

Numerous detection methods have been developed to measure stickiness and reduce its effects. The CIRAD technology laboratory has developed two thermomechanical methods for this detection: the SCT thermodetector and the high-speed H2SD. Both systems are presented here and have been used to measure cottons from various origins.

Methods and materials

Thermodetection method

Principle. This thermomechanical method (Frydrych, 1986) combines the effect of heat and pressure applied to a sample of cotton placed between two aluminium plates. The aluminium plates are inert to the test sample and provide rapid transfer of the heat. When the temperature increases, the cotton releases its water which is absorbed by the honeydew. This therefore becomes sticky. The honeydew contained within the cotton sample then sticks onto the plates. Pressure is then applied immediately at ambient temperature to fix the honeydew to the plates, and these spots can then be counted.

The cotton sample is processed at 65 % RH and at a temperature of 21°C. The following methodology is applied: a 2.5 g sample of cotton is opened on a manual opener to form a web with a density of 30 g/m². This is then placed between two sheets of aluminium and the entire assembly is placed on the lower plate of the thermodetector and hot pressure is applied for 12 seconds. This is followed by pressure applied for 2 minutes at ambient temperature. The assembly is then left for one hour before the sticky points on the upper and lower sheets of aluminium are counted. The count is established as follows: the cotton web on the lower sheet of aluminium is removed. The plate is cleaned using a special non-woven cleaning pad impregnated with mineral oil. The sticky points on the two sheets of aluminium are then counted. The test is repeated three times per sample to determine the extent of the stickiness.

High-speed H2SD

The main advantage of the high-speed stickiness detector is that it can monitor and evaluate the stickiness of production batches. If no methods are available to monitor cotton, the entire production may be considered as sticky and its price will fall. The ultimate aim therefore is to pick out non-sticky cotton and also provide the user with a system to manage purchases and stocks.

The H2SD high-speed stickiness detector (Frydrych et al., 1994) presents the following advantages:

- human intervention in sample preparation and during stickiness evaluation is reduced to a minimum,
- the measurement is quantitative, giving a honeydew count,
- it is possible to determine the size of the sticky points,
- a result is obtained every 30 seconds.

Principle. The analysis is performed at 65.2 % RH and 21 °C. A sample of cotton (about 3 grams) is opened using a rotor to form a mass with a

density of about 160 g/m². This is placed on an aluminium plate which passes successively in front of 4 stations. Hot pressure is applied to the sample. The combination of the water in the ejection and the temperature differential between the heat applied and the aluminium produces a thin layer of weevils on the sheet of aluminium. The sticky points in contact with the plate are fixed in place by pressure exerted at ambient temperature. The cotton is then removed and the sticky points are evaluated by an image analyzer which counts the points and determines their size. Like for the thermodeector, three counts are made for each sample.

Results and Discussion

1. Testing of 96 cottons on the CIRAD laboratory SCT thermodeector: relationship between mean and variance

Ninety-six cotton samples, with three replications, originating in different countries and saw-ginned were tested on the thermodeector. The intra-sample distribution of the number of sticky points was not normal. The data were therefore transformed before statistical analysis in order to stabilize the variances and normalize distribution (Dagnécic, 1975).

This choice was made after a diagram was constructed showing the dispersion of the means and variances on a logarithmic scale. Figure 1 shows the linear relationship between the mean and the variance, given by the equation:

$$\text{Log}(\text{variance}+1) = 1.046 \times \text{Log}(\text{mean}+1) \text{ with } r = 0.78$$

As the relationship between the mean and the variance was close to equality, the initial data were converted into square root values.

2. Validation at the Cotton Incorporated laboratory: mean-variance relationship

This mean-variance relationship was validated on the thermodeector at the Cotton Incorporated laboratory in Raleigh, testing 829 samples with 2 repetitions. Figure 2 shows a relationship close to equality, where:

$$\text{Log}(\text{variance}+1) = 0.97 \times \text{Log}(\text{mean}+1) - 0.004 \text{ with } r = 0.84$$

3. 96 cottons tested on the CIRAD H2SD high-speed detector

The 96 cottons already tested on the SCT were also analyzed on the H2SD with three replications. The relationship between the mean and the variance is illustrated in figure 3. This was:

$$\text{Log}(\text{variance}+1) = 0.986 \times \text{Log}(\text{mean}+1) + 0.1 \text{ } r = 0.77$$

Thus, the H2SD also gave a relationship between the mean and the variance close to equality.

4. Thermodeector and H2SD: Precision of the results as a function of the number of tests

In the studies described above, the parameters used to plot the curves were little different in practice from those valid for the Poisson law. The intra-sample distribution of the number of sticky points is very close to a Poisson-type distribution.

The precision of any measurement run is given by the confidence interval around the mean. If it is accepted that the number of sticky points follows Poisson's law, the confidence interval will be asymmetric. In cases of Poisson's law for parameter λ , the confidence interval around λ is determined by using the expression given below (Gozé, 1993, citing Saporta, 1990):

$$\frac{1}{2r} \chi^2_{(1-\alpha/2)} \leq \lambda \leq \frac{1}{2r} \chi^2_{(2(1-\alpha/2))}$$

Where: r = number of measurements per sample

M = mean observed

λ = true mean

α = confidence level

Generally, we use the confidence limits for the expectation of a Poisson variable (Pearson and Hartley, 1976). For practical reasons we use a scale (figure 4, drawn up by Chaumie and Chanselme, 1996) to give this interval as a function of the number of repetitions (1, 2, 3). Each mean observed on the x axis has a corresponding confidence interval of the "true" mean as a function of the number of repetitions per sample.

5. Relationship between SCT thermodeector and CIRAD laboratory H2SD

A very good relationship was obtained between the results for the 96 cottons on the thermodeector and on the H2SD as a correlation coefficient of 0.95 was observed (figure 5). The data were converted into square root values in order to meet the conditions required for linear regression. The regression coefficients were such that, by returning to the original scale, the number of sticky points detected by the H2SD were half the count obtained on the thermodeector, whereas the surface area counted was 8-fold less. This is due to the rotor opener which produces excellent quality contact between the aluminium plate and the sample.

6. Relationship between the SCT thermodeector and the CIRAD H2SD and the Cotton Incorporated H2SD

An H2SD has been installed at Cotton Incorporated in Raleigh. The first validation tests were conducted on a range of 42 sticky cottons of various origins (Africa, central Asia, USA, etc.). These cottons were tested on SCT and H2SD machines at CIRAD, then on the H2SD at Cotton Incorporated. The relationships (figure 6) between the results given by these three devices were very good as shown by the correlation coefficients below:

SCT and CIRAD H2SD $r = 0.95$

SCT and Cot. Inc. H2SD $r = 0.97$

Results obtained on the CIRAD H2SD and the Cotton Incorporated H2SD (figure 7) also showed a good relationship as the coefficient of correlation between these was 0.92. However, a slight difference was observed between the two machines, indicating that a procedure should be designed for their calibration.

7. Advantages of the high-speed H2SD detector

Like the thermodeector, the high-speed H2SD gives quantitative results. As the H2SD is entirely automated, it presents several advantages: it is fast as it gives a result every 30 seconds and its speed is similar to that shown by commercial HVI machines used for the bale-to-bale determination of cotton fiber characteristics. No operator effect is involved as the operator's role is reduced to feeding the machine. The sticky points are counted and sized by an image analyzer.

Tests conducted on the thermodeector give honeydew-fiber points of varying sizes, ranging from small honeydew deposits with a few fibers to very large deposits with a veritable tuft of fibers. It is obvious that, during spinning, these will have different effects as regards contamination of pressure cylinders and the lifting up and rolling round of fibers. Sizing the sticky points is therefore essential in order to correctly evaluate the impact they have.

We therefore analyzed the results given by the testing of the 42 cottons. Honeydew deposits were divided into three surface area categories, corresponding to small, medium and large. We set the limits for these categories from our experience gained with sticky cottons:

small:	from 0.9 to 5 mm ²
medium:	from 5 to 10 mm ²
large:	greater than 10 mm ²

For each repetition, table 1 shows the mean percentage by size of the 42 cottons. This percentage appears to be relatively stable. The small sticky points corresponded to 65 to 67 % of the total, the medium 14 to 15 % and the large 19 to 20 %.

Table 2 gives the size distribution of the sticky points for 4 cottons, and shows that each cotton is very different from the next: Cotton no. 4 is the least contaminated, with a mean of 10 sticky points. However, 2 of the sticky points were larger than 10 mm². Cottons 1 and 23 are very sticky and the percentage of small sticky points in cotton 23 is very high (79.6 %), as opposed to only 63.5 % in cotton 1. Considerable size variability is therefore observed and it seems likely that these cottons will behave differently during spinning.

Conclusion

The thermodector is used to detect cottons contaminated by insect honeydew (Brushwood and Perkins, 1993). In 1994, the machine was validated by the ITMF (International Textile Manufacturer Federation) which now recommends this technique for the measurement of stickiness caused by insects (reference 420/92).

Although the thermodector resolved the problem caused by stickiness, it is not sufficiently rapid to give a reliable classification. We therefore designed another more rapid stickiness detection system (30 seconds) that is also fully automated, to give a quantitative determination of the number of sticky points and measure their size.

An excellent correlation is obtained between the results provided by the SCT thermodector and the H2SD. A calibration method should nevertheless be developed so that all H2SD machines give consistent results.

Using these new detection methods, researchers can now obtain a continuous supply of reliable information about the stickiness problem in producer countries. They should even be able to propose solutions to decrease or even eliminate stickiness. By carefully mixing cottons, spinners will be able to reduce the incidence of stickiness, improve equipment function and enhance the quality of the yarn produced.

Acknowledgment

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Table 1: Distribution of sticky points by size category (small, medium, large) for 42 cottons x 3 repetitions.

Repetitions	Mean percentage of sticky points by size category		
	Small > 0.880 to 5 mm ²	Medium > 5 to 10 mm ²	Large > 10 mm ²
Repetition 1	65.4	13.9	20.7
Repetition 2	65.6	14.4	19.8
Repetition 3	66.8	13.9	19.3

Table 2: Size distribution by category for 4 cottons

Cotton	Total number of sticky points for all 3 categories	Number of sticky points by size category		
		Small > 0.88 to 5 mmS	Medium > 5 to 10 mmS	Large > 10 mmS
Cotton 1				
rep 1	43	28	6	9
rep 2	53	37	6	10
rep 3	41	22	7	12
Mean	46	29	6	10
Percentage	100	63.5	13.9	22.6
Cotton 4				
rep 1	5	3	0	2
rep 2	11	3	4	4
rep 3	13	9	4	0
Mean	10	5	3	2
Percentage	100	51.7	27.6	20.7
Cotton 11				
rep 1	19	11	2	6
rep 2	17	11	3	3
rep 3	23	17	2	4
Mean	20	13	2	4
Percentage	100	66.1	11.9	22
Cotton 23				
rep 1	31	24	3	4
rep 2	24	19	3	2
rep 3	31	25	1	5
Mean	29	23	2	4
Percentage	100	79.6	8.1	12.3

Log (variance+1)

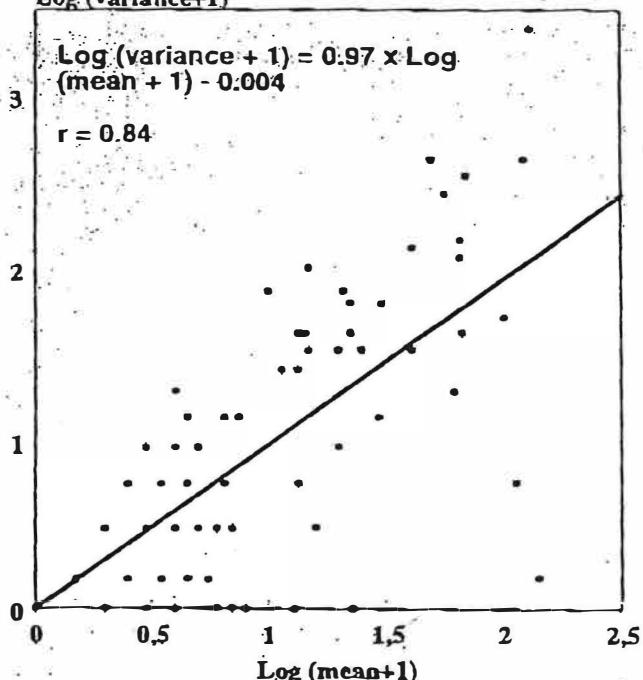


Figure 2 : Mean - variance relationship for the thermodeector SCT Cotton Incorporated laboratory (829 samples)

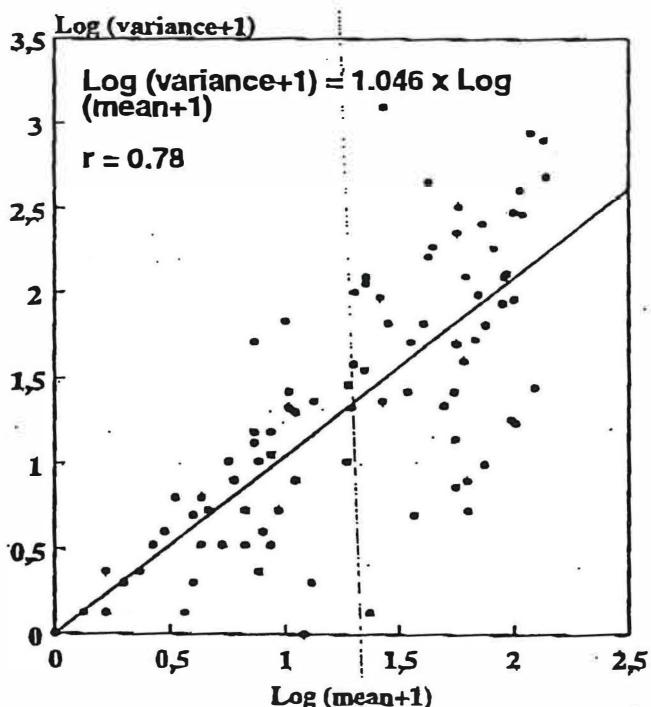


Figure 1: Mean - variance relationship for the thermodeector SCT CIRAD laboratory (96 samples).

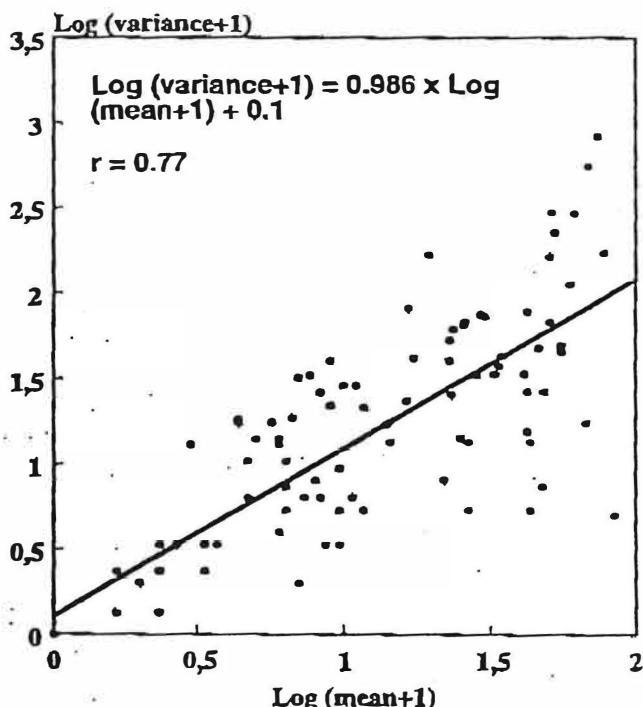


Figure 3 : Mean - variance relationship for the High Speed Stickiness Detector (H2SD). CIRAD laboratory (96 samples).

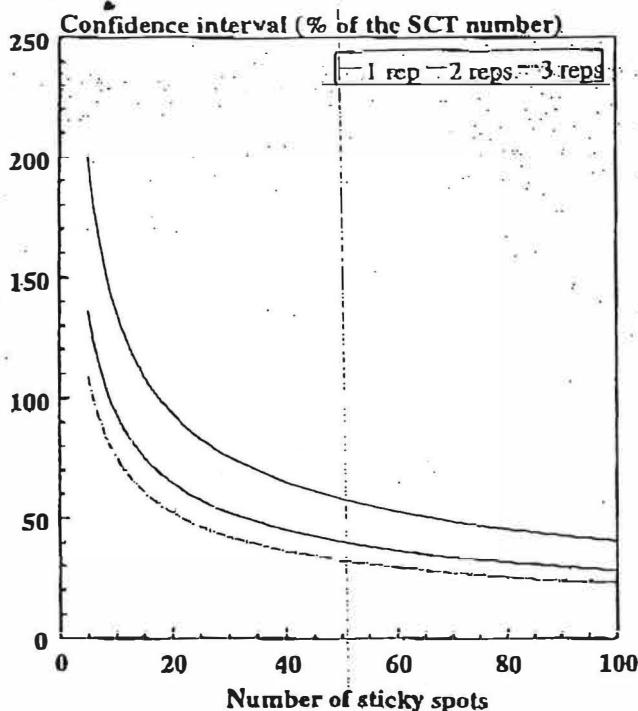


Figure 4 : Confidence intervals (%) for the number of sticky spots with SCT or H2SD

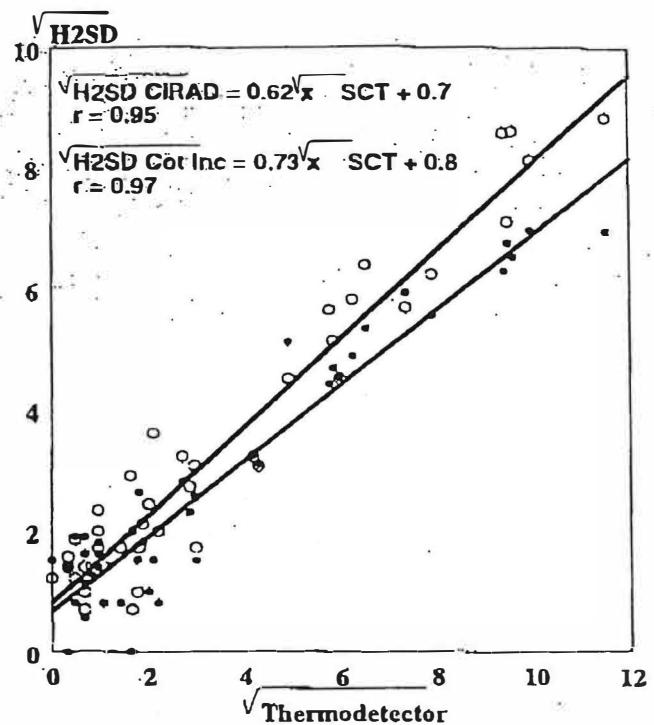


Figure 6 : SCT vs H2SD on 42 cottons from different countries. CIRAD and Cotton Incorporated laboratories

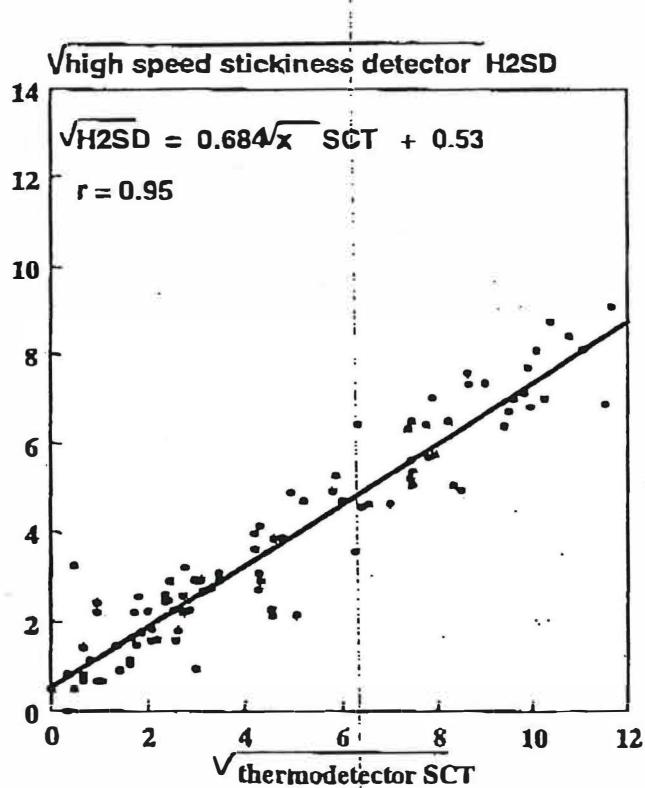


Figure 5 : Thermodectioner SCT vs H2SD on 96 cottons from different countries. CIRAD laboratory

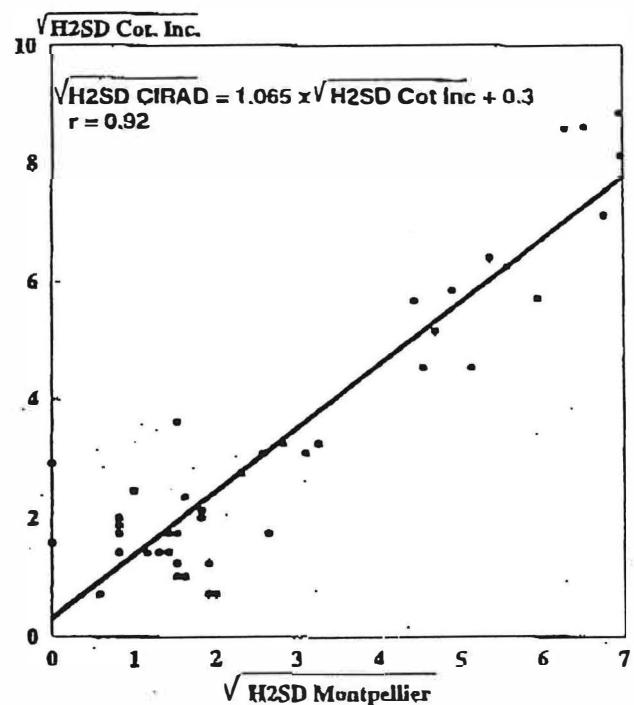


Figure 7 : H2SD CIRAD vs H2SD Cotton Incorporated on 42 cottons from different countries



The SDL-CIRAD High Speed Stickiness Detector (H2SD): Improvements Incorporated in the Production Version

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Abstract

The stickiness of cottons during the spinning process has now become a selection criterion in the spinning industry. It would therefore be advantageous at the production stage to evaluate the stickiness of each bale. The analytical rate of the H2SD detector is compatible with that of HVI measurement lines and the results it gives correlate well with those obtained on the SCT Thromodetector. The H2SD is therefore a suitable instrument for a bale-by-bale evaluation. In comparison with the prototype, the production machine has been improved for intensive use in an industrial environment and modified to provide easy maintenance.

Introduction

An analysis of the 1996-1997 season shows that cotton is grown in more than 70 countries, with world-wide production estimated at approximately 20 million tonnes. Certain cottons disrupt the spinning process by depositing sticky substances onto machine parts that exert pressure and generate heat, for example the card, drawing frame and open-end rotor turbines. These cottons are primarily contaminated with honeydew produced by aphids and whitefly. The resulting increase in nepiness and irregularities decreases the quality of the yarn produced as well as adversely affecting efficiency.

For spinners, the stickiness of a given cotton has therefore become a major selection criterion. Thus, cotton producers are sometimes obliged to sell their cotton at a discount. Under these conditions, a country or a region that has acquired a reputation for supplying sticky cottons may see its entire production down-graded, for quality and price, whereas in fact, a study may show that the major proportion of the cotton produced in that country is uncontaminated. The ability and capacity to characterise each individual bale for its degree of stickiness at the production stage can therefore be a considerable advantage, separating the uncontaminated cotton so that it can be more profitably utilised. Spinners could thus reduce the effects caused by contaminated cotton by using appropriate means, such as mixing cottons for which the degree of stickiness has previously been determined, decreasing relative humidity (Gutknecht et al., 1988; Frydrych, 1996), or using various treatments, such as additives (Perkins, 1992) or washing (ICAC, 1994) etc. Cotton producers could also categorise cotton before sale, to obtain a better price.

Testing the stickiness of each bale requires quality control equipment that is able to detect stickiness as rapidly as the analyses performed by HVI lines for other characteristics. To meet this challenge, CIRAD has developed a high speed detection system that functions

more rapidly than the traditional SCT Thermodetector (Perkins, 1993). The equipment is the H2SD (High Speed Stickiness Detector). Here, we present the improvements made to the detection system and describe the performance of this machine which is manufactured in partnership with the SDL International Group in the UK.

H2SD Detection and Measurement of Stickiness

Improvements Made

The H2SD (Frydrych et al., 1994) is made up of five work stations (**Figure 1**). A sample of cotton is opened, using an opening roller to form a pad and placed on a conveyor covered with a disposable layer of aluminium foil (1). The sample is carried successively and automatically from one station to the next. Heat and pressure are applied to the sample (2); in order to transfer the stickiness to the foil. The sticky points in contact with the aluminium foil are fixed by another application of pressure at ambient temperature (3). The cotton sample is then wiped from the aluminium foil (4) and the sticky points are evaluated by an image analysis system under specific lighting conditions (5). As these stations are independent, several samples can be processed simultaneously. Thus, the machine is able to produce a sample result every 30 seconds. This 30-second window corresponds, in fact, to the time required for the technician to feed samples into the machine and note the reference name by typing on the keyboard. It will therefore be reduced still further when automatic feeding is operational and when sample references are entered using bar codes. Both of these options are under development.

As the H2SD can analyse approximately 120 samples/hour, work was conducted to optimise the functioning of each station in order to render the machine compatible with intensive use in an industrial environment. In addition, access to the various parts of the machine has been improved for easy and rapid maintenance. This applies to both the mechanical and the electronic sections of the machine.

The opening roller (1) opens a cotton sample weighing approximately 3.5grams in 15 seconds. This opening system has been designed to provide maximum opening of the cotton while producing as little dust and as few loose fibres as possible; the system generates very little noise as it relies on direct drive motors for the feeding and opening rollers. The opening roller is housed beneath a rigid cover that is compatible with the processing of all types of cotton (saw-ginned or roller-ginned) and provides an excellent interface between the sample and the aluminium foil on the conveyor.

A single housing contains the hot-pressure plate (2) and the ambient-temperature pressure plate (3). The plates are automatically cleaned after each test to remove any sticky residues.

The cleaning system (4) for the aluminium foil consists of pneumatically removing the mass of unstuck fibres and discarding them into a container outside the machine. A rotating cylinder covered with a special non-woven material then removes any further fibres not adhering to the honeydew deposits. Before counting the sticky points, any

residual dust is removed from the image analysis station by suction, where the image of the sticky points is taken.

The sticky-point counting system consists of a camera, standardised lighting and our own image-processing software (5). Information displayed on the screen (**Figure 2**) includes a digital image of the sticky points (1), a histogram of sticky-point size (2), the results including the sample reference name (3), the total number of sticky points and distribution in three size classes (small, medium and large). It has been shown (Hequet et al., 1997) that this size distribution is very variable from one cotton to the next. Disruption caused in the spinning process probably depends on the size of the sticky points, as well as the actual number. Weighting of the total sticky-point count with respect to size should also be considered.

The rotor, pressure unit, cleaning system and image analyser are independent modules that can be replaced with ease. The assembly made up of the conveyor mechanism and the modules is mounted on a slide system that can be withdrawn from the machine, for ease of maintenance.

The machine's control system has been concentrated in a rack configuration containing the various electronic cards and components. General system functions are checked on powering-up the machine and the automatic processes are controlled by a microcomputer.

Results Obtained with the H2SD

Fifty cottons by 3 repetitions (**Figure 3**) have been tested with the SCT Thermodetector and H2SD. A very good relationship was obtained between the results on the Thermodetector and on the H2SD; a correlation coefficient of 0.92 was observed. The data were converted into square root values in order to meet the conditions required for linear regression.

Conclusion

As many cottons now show stickiness caused by insect honeydew, the development of a rapid method for the detection of stickiness is more important than ever. This will allow countries with a reputation for producing sticky cottons to make better use of their non-sticky cotton, and provide the spinning industry with a tool for managing cotton purchasing and storage. The H2SD high-speed sticky cotton detector provides the ideal solution at a reasonable cost.

The improvements made to the production version optimise the machine's operations for intensive use in an industrial environment and provide easy access to the different stations for rapid maintenance. These changes increase the machine's reliability while conserving an analysis rate compatible with HVI measuring lines i.e. (20 to 30 seconds). The results obtained with the H2SD correlate well with those given by the apparatus currently recommended by the ITMF Committee on Cotton Testing Methods, the SCT Thermodetector. A bale-by-bale classification of stickiness for entire production batches can therefore be envisaged.

Under an agreement finalised last year between CIRAD and SDL International of the UK, SDL are currently manufacturing the SCT Mechanical Thermodetector, of which more than 100 are in use world-wide. The H2SD new concept unit is presently undergoing production evaluation at SDL, and will be available for delivery mid 1998.

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Figure 1: H2SD principle: five work stations

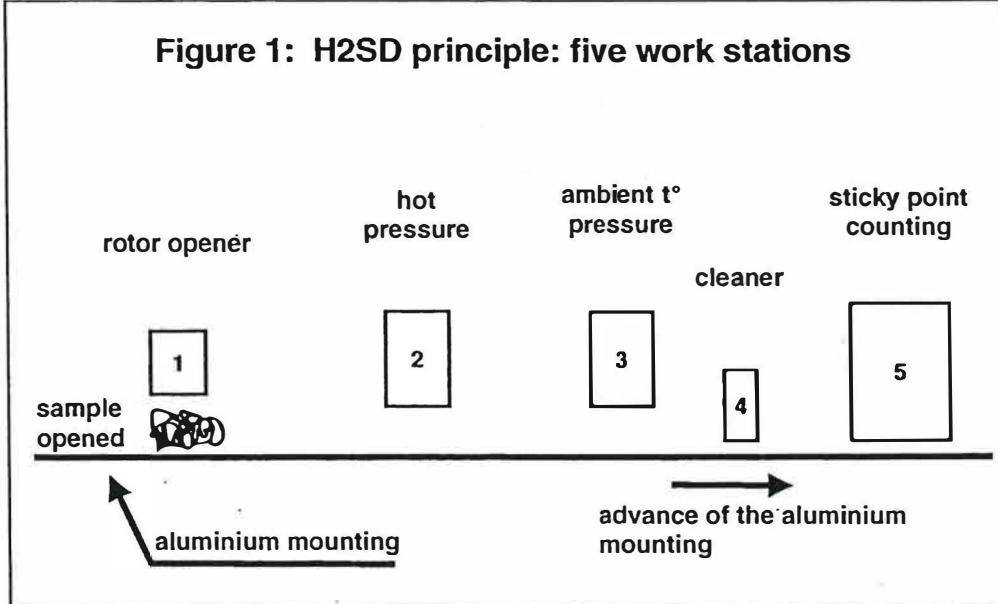


Figure 2: Results on the screen

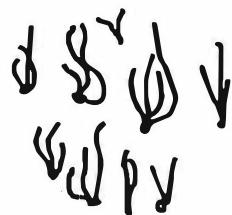
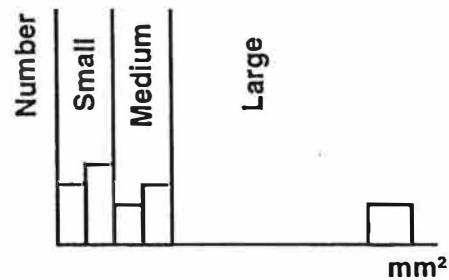


image (1)



histogram (2)

(3)

reference	total	small	medium	large	level
stand 1	10	5	3	2	

Figure 3: Thermodetector SCT vs H2SD on 50 samples from different countries (mean of 3 replications)

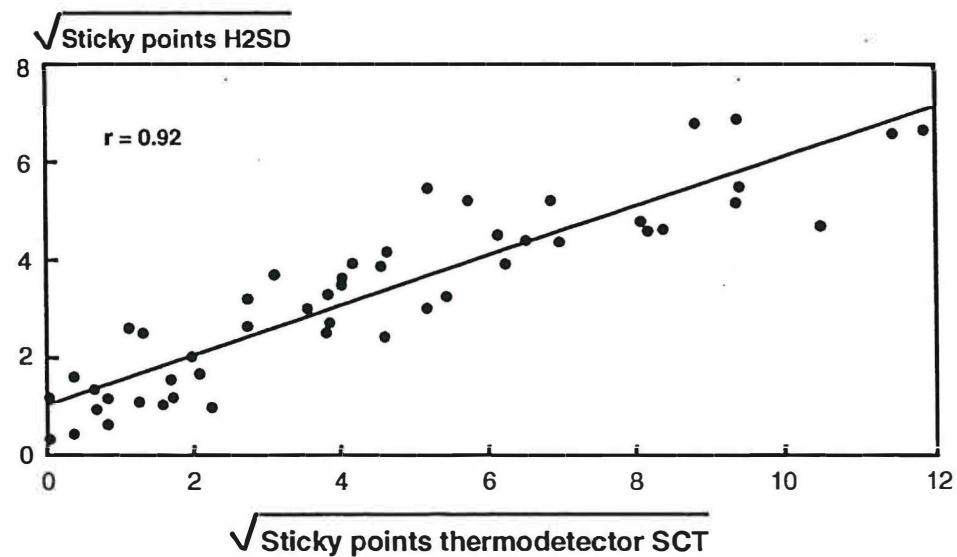


Table 7. Number of samples and percent classified into Thermodeector stickiness for seed cotton and lint in Test 2.

From TD rating	0	1	2	3	Total	Missed*
0	29	3	1	5	38	
	76.32	7.89	2.63	13.16	100.00	9
1	11	13	8	13	45	11
	24.44	28.89	17.78	28.89	100.00	
2	4	4	28	4	40	4
	10.00	10.00	70.00	10.00	100.00	
3	2	1	3	1	7	2
	28.57	14.29	42.86	14.29	100.00	
Total	46	21	40	23	130	26
Percent	35.38	16.15	30.77	17.69	100.00	

*Indicates classified as sticky when not sticky or as not-sticky when sticky, regardless of level.

Table 8. Summary data for Test 3.

Observations	Resistance	Infrared	Cotton	Sample #	TD*	Clemson
24	6.5	6.8	L	1	3	
24	6.2	6.9	L	2	1	
24	6.5	6.5	L	3	1	
24	6.8	6.2	L	4	0	
24	6.4	6.9	L	5	1	
24	6.4	6.7	L	6	0	
24	6.3	6.8	L	7	0	
24	6.5	6.1	L	8	1	
24	6.3	6.9	L	9	0	
24	6.7	7.3	L	10	0	
24	6.2	6.3	L	11	3	
24	6.4	6.9	L	12	1	
24	6.3	6.9	L	13	0	
24	6.6	6.6	L	14	3	
24	6.3	6.8	L	15	1	
24	6.4	6.4	L	16	2	
24	6.7	6.6	L	17	1	
24	6.5	6.1	L	18	2	
24	6.3	6.4	L	19	2	
24	6.6	6.5	L	20	0	
24	6.8	6.5	L	21	0	
24	6.4	6.2	L	22	2	
24	6.3	6.2	L	23	3	

* Thermodeector stickiness

Table 9. Prediction of stickiness based on Clemson Thermodeector evaluation of Test 3.

From TD rating	0	1	2	3	Total	Missed*
0	4	4	0	0	8	4
	50.00	50.00	0.00	0.00	100.00	
1	2	5	1	1	7	2
	28.57	42.86	14.29	14.29	100.00	
2	0	0	3	1	4	0
	0.00	0.00	75.00	25.00	100.00	
3	2	0	2	0	4	2
	50.00	10.00	50.00	0.00	100.00	
Total	8	7	6	2	23	8
Percent	34.78	30.43	26.09	8.70	100.00	

*Indicates classified as sticky when not sticky or as not-sticky when sticky, regardless of level.



DETECTION AND COUNTING OF TWO COTTON CONTAMINANTS: SEED COAT FRAGMENTS AND HONEYDEW DEPOSITS

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Abstract

At present, many cottons are contaminated to varying degrees by Seed Coat Fragments (SCF) and insect honeydew. It is essential to obtain more information on the quality of the raw material and a more precise description of the yarn quality. This paper deals with two instruments developed by Cirad's Cotton Technology Laboratory for detecting and counting these two contaminants. The relationship of Trashcam (an image analysis method for counting SCF), and H2SD (High Speed Stickiness Detector) with reference methods is discussed.

Introduction

Today, in order to meet market requirements - that are in part related to progress made in spinning techniques - it is essential to obtain more information on the quality of the raw material and a more precise description of the yarn quality. Rapid measurement techniques, called HVI, are currently employed to measure the technological characteristics of cotton fiber. These techniques are used for commercial classification purposes and in varietal improvement programs, on condition in this case that certain precautions are taken (Gourdot et Hequet, 1994). However, these fiber classification criteria such as length, strength, micronaire, trash are insufficient to predict the quality of the finished product and are unable to guarantee that the spinning process will function correctly since fiber contamination by foreign matters, such as insect honeydew and seed coat fragments SCF, may disrupt the process.

These contaminants may push down prices for producers and have negative effects on yarn production and quality. Cirad has therefore developed equipment and techniques for use in its research programs that are intended to reduce these effects, i.e. Trashcam used to evaluate SCF, the SCT thermodeector and rapid H2SD detector to measure cotton stickiness.

Effects of Contaminants on Yarn Quality

At present, seed coat fragment nepiness is a major factor taken into account by Cirad as these fragments reduce the efficiency of fiber cleaning, increase breakage incidence during spinning (Price, 1987) and affect the appearance of the yarn. It has been shown that this character is heritable (Bachelier, 1998).

Insect honeydew disrupts the spinning process by clogging equipment and results in poorer quality yarn. This yarn shows fiber neps without honeydew B and caused by the fiber rising upwards B and neps that contain honeydew (Prydrych, 1996). These imperfections increase the total count determined by capacitive-sensor regularimeter.

Figure 1 illustrates three cases of nepiness encountered in Ring Spinning (RS) detected on a capacitive-sensor regularimeter and where only a detailed analysis of the yarn is able to determine the different types:

in case (A), the majority of the neps are seed coat neps with a few fiber neps (mature cotton) and virtually no plant debris neps. Total neps number therefore corresponds to the number of seed coat fragment neps.

in case (B), the percentage of fiber neps is higher as the cotton is insufficiently mature.
in case (C), these cottons have been contaminated by honeydew which corresponds to a considerable proportion of the neps. The high fiber neps count is largely due to stickiness, not to immaturity. The relationship between total neps and Seed Coat Fragment neps is less pronounced than in case (A).

In all cases, these foreign matters increase the number of yarn defects. They also decrease productivity and require special processing by spinners. It is therefore essential to be able to identify and quantify this matter as early as possible, either during selection or processing.

Counting Seed Coat Fragments in Fiber and Yarn

Trashcam was developed by CIRAD to estimate the potential nepiness caused by SCF at the earliest stages of varietal breeding programs (Gourlot *et al.*, 1995). This method is based on image analysis captured by a camera or a scanning device, and provides SCF count and size in card web.

Preliminary studies have demonstrated the efficiency of Trashcam count on card web to estimate SCF neps count provided by UT3 (Zellweger-Uster) on yarn (Drean *et al.*, 1998). These results allowed the use of Trashcam on card web as an early selection method in breeding programs to determine cultivar's SCF content without need of spinning (Bachelier, 1998).

In addition to providing a SCP count and size in card webs, methodology has also been developed to allow Trashcam to count seed coat neps in yarn. The yarn is wound around a white plate for an image acquisition. SCF are counted and sized by image analysis. Trashcam counts were very similar to those obtained visually on the same yarns. Figure 2 shows a very highly significant correlation between Trashcam counts on yarn plate (IA Yarn) and that provided by visual counting (Visual Yarn). The slope is not different from 1 and the y-intercept at the origin not different from 0 at a 5% significance level.

Counting SCF on yarn by Trashcam is a method developed to replace detailed analysis on capacitive-sensor evenness tester which requires visual examination of each neps on yarn and is therefore long and not economically acceptable. Today, the CIRAD cotton technology laboratory uses Trashcam for routine analysis and research works concerning SCF.

The following paragraph shows the results obtained by Trashcam on 94 cottons that were ring-spun to 20 tex yarn. The 94 cottons were tested for SCF in fiber and in yarn using Trashcam and for evenness and nepiness using UT3 in usual global analysis.

Trashcam Validation in Routine Analysis

Figure 3 shows the relationship between SCP counts on yarn (IA Yarn) and in fiber (IA Fiber) provided by Trashcam. The correlation is very highly significant ($r = 0.91^{***}$). These results confirm and validate those obtained on a limited number of cottons for the development of the method (Krisfa *et al.*, 1998).

The relationship between Trashcam count on yarn plate (IA Yarn) and total neps (200%) counted by UT3 (figure 4) is also very highly significant ($r = 0.86^{***}$). However, the differences between the two counts show that Trashcam, only by considering SCF, counts far more imperfections than the UT3 which is widely used in the industry and counts all nep classes (SCF, fiber neps ...). A slope of 1.5 is observed between the two counts (with a square root transformation of the data).

Trashcam measurements were taken with settings suitable for the detection of all SCP present in the yarn. The difference noted between Trashcam and

UT3 counts can be explained by the fact that smaller SCF may not be detected by UT3 due to the thresholds applied in this method (200% neps). This information provided by Trashcam may well be of interest for cotton researchers and spinners.

Stickiness Measured by the Rapid H2SD Detector

Cotton stickiness level has become a major selective criterion for spinners. Producers are sometimes therefore obliged to sell their cotton at a discount, and under these conditions, the entire production of a country with a reputation for supplying sticky cottons may be reduced in price, even though a large part of the fiber crop is uncontaminated. Obviously therefore, the ability to characterize each bale for its degree of stickiness at the production stage is a considerable advantage as the uncontaminated cotton can be sold at a higher price.

It has been demonstrated (Hequet and Frydrych, 1992; Frydrych *et al.*, 1995) by micro spinning sticky cottons and non-sticky cottons, that the number of sticky points determined on the SCT thermodetector and on the rapid H2SD detector correlates with the number of wraps during spinning and with the number of yarn defects. A study, financed by the Common Fund, is ongoing in industry to establish the critical threshold for cotton contamination, beyond which problems appear, resulting in malfunctions and poorer quality yarn. Spinners could thus reduce the negative effects of stickiness on machines and on yarn quality, using appropriate means such as mixing cottons or decreasing the relative humidity of the mill (Yao, 1990; Frydrych, 1996).

Establishing the stickiness of each bale required a machine capable of rapidly measuring stickiness. SCT thermodetector, ITMF reference method, is not rapid enough to work at the same speed the HVI lines measure other fiber characteristics. High speed stickiness detector (H2SD) has been developed to measure stickiness far more rapidly than the SCT thermodetector. This machine provides a result every 30 s and minimize operator effect.

Relationship Between H2SD and SCT

587 raw cottons from various geographical origins were tested on the thermodetector and the H2SD with 3 repetitions per sample. A large range of sticky cottons have been chosen, 0 to 150 sticky points determined with SCT, and in addition we have included some rarely encountered very sticky cottons, more than 150 sticky points.

The results show (figure 5) that the H2SD-thermodetector relationship is excellent. For a large range of sticky cotton (0 to 200 SCT sticky points) the relation is not linear, the expression is given below:

$$SQR(H2SD) = -0.027(SCT) + 0.952 SQR(SCT) + 0.442 \quad r = 0.96$$

However, for a range of 0 to 150 SCT sticky points (also very sticky), figure 6 shows that the relationship is linear and may be expressed as:

$$SQR(H2SD) = 0.675 \times SQR(SCT) + 0.9 \quad r = 0.92$$

Of these 587 cottons, 95 cottons were tested a second time on the H2SD with the same number of repetitions. An excellent correlation was noted between the two tests with $r = 0.94$ (figure 7). The results of the two tests were close to being equal. A statistical analysis showed that the 0.936 slope of the regression line was not different from 1 and that the y-intercept at the origin (0.17) was not different from 0. This clearly demonstrates that the H2SD method gives reproducible results.

Alternation of Very Sticky / Non Sticky Cotton Samples on H2SD

138 samples from a very sticky cotton (cotton A) and the same number of samples from a non-sticky cotton (B) were tested alternatively on H2SD.

The results of this test (figure 8) show that the automatic cleaning operation of H2SD after every test is sufficiently efficient to guarantee non-contamination of the machine from one sample to the next.

Conclusion

Today, many cottons are contaminated to varying degrees by Seed Coat fragment and insect honeydew. Cirad's cotton technology laboratory has developed techniques for use in its research programs that are intended to reduce these effects.

The Trashcam can be used to count SCF on yarn in practical applications. The results obtained in routine analysis demonstrate the efficiency of this method.

The H2SD is now used in the commercial version, the correlation with thermodector is highly significant. The automatic cleaning operation after every test is sufficiently efficient to guarantee non-contamination of the machine from one sample to the next and consequently gives reproducible results. A bale-by-bale classification of fiber on the basis of its stickiness is now therefore possible.

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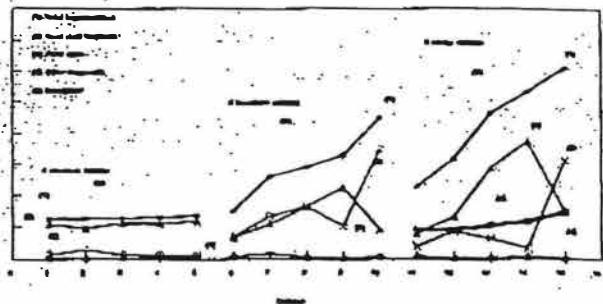


Figure 1. Various imperfections counted with the Usler regulator equipped with the visualizing device

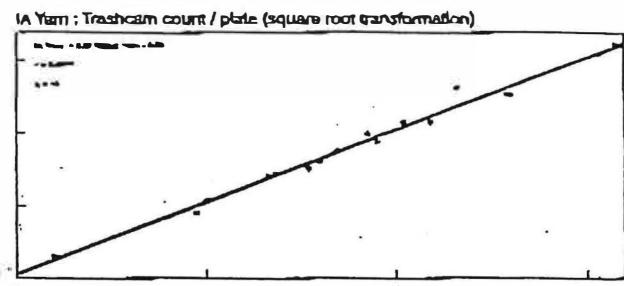


Figure 2. Trashcam count vs visual count on yarn plate Ring Spun 20 tex yarn

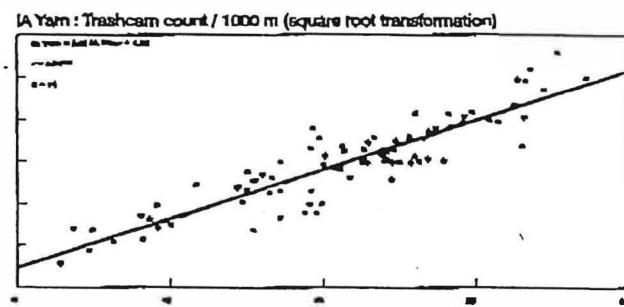


Figure 3. Trashcam on RS 20 tex yarn vs Trashcam on fiber

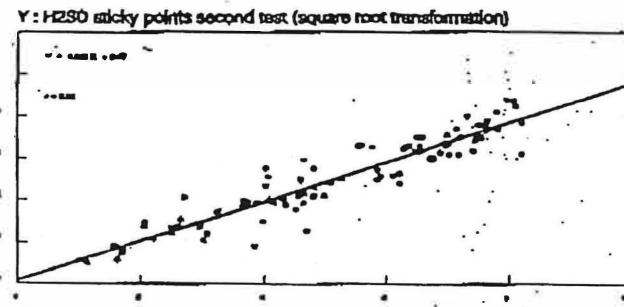
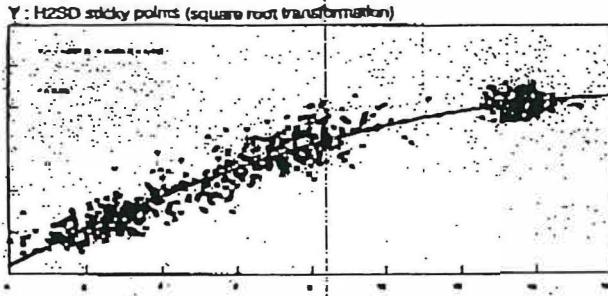
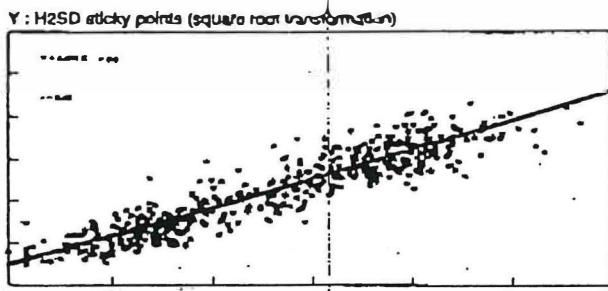


Figure 4. Trashcam count on yarn plate vs UT3 neps (200%) count Ring Spun 20 tex yarn



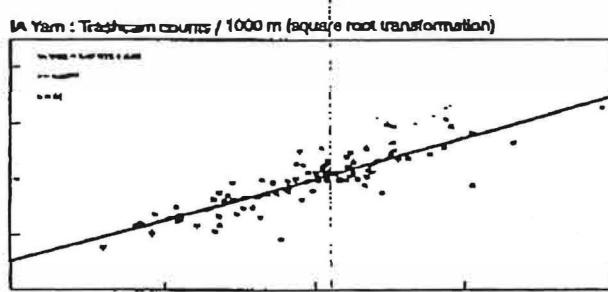
X : Thermodetector SCT sticky points (square root transformation)

Figure 5. H2SD vs Thermodetector SCT on 587 samples from different countries. (mean of 3 replications)



X : Thermodetector SCT sticky points (square root transformation)

Figure 6. H2SD vs Thermodetector SCT on 455 samples from 0 to 150 sticky points (mean on 3 replications)



Neps 200 % UTS counts / 1000 m (square root transformation)

Figure 7.

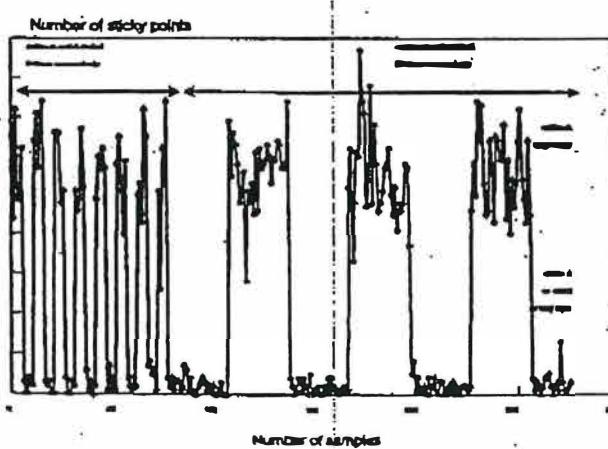


Figure 8. Alternation of very sticky / non sticky cotton samples on H2SD

EVIDENCE ON THE ORIGINS OF SUGARS

CAUSING STICKINESS IN COTTON

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Abstract

Since the mid-1990s, the International Textile Center (ITC) has been engaged in a collaborative research effort aimed at developing reliable measurements for stickiness of cotton fibers, in order to enable efficient management of this contamination problem.

The HPLC is indispensable for identifying the sources of stickiness contamination (plant sugars vs. insect honeydew and the types of insects involved). Nevertheless, the HPLC cannot be a good predictor of stickiness. Apparently the stickiness potential of cotton is not only linked to the percentage of a specific sugar, but to the balance between the various sugars as well. Another likely factor is that moderate amounts of rainfall renders the cotton fiber less sticky by diluting the honeydew deposits on the lint, spreading the sugars over a larger fiber surface without significantly lowering the sugar content.

Introduction

Since the mid-1990s, the International Textile Center (ITC) has been engaged in a collaborative research effort aimed at developing reliable measurements for stickiness of cotton fibers, in order to enable efficient management of this contamination problem.

In 1996, fifty bales were selected by PCCA (Plains Cotton Cooperative Association, Lubbock - USA) to get a wide range of stickiness due to aphid (*Aphis gossypii*) infestation. Eleven of these bales were from one module.

In 1998, fifty bales from Arizona and fifty bales from California were selected by Calcot (Bakersfield, California) to get a wide range of stickiness due to white fly (*Bemisia tabaci*) infestation. Within the California bales, 23 were bales coming from one module.

Material

The bales were broken and layered. Ten samples were taken from each bale. Stickiness data were collected on these cottons using the ITC's HPLC (High Performance Liquid Chromatography) instrument and card machine.

Results and Discussion

The sugars present on the lint were extracted, then the 1500 samples obtained were analyzed with the HPLC to identify entomological and physiological sugars. By a careful use of columns and eluants, the sugars present in the extract can be separated and characterized. The following sugars were detected: inositol, trehalose, glucose, fructose, trehalulose, sucrose and melezitose. In general these sugars account for at least 85% of the known carbohydrates present on honeydew contaminated cotton lint. A high percentage of melezitose reveals the presence of aphid honeydew, whereas with both melezitose and trehalulose present and trehalulose being dominant indicates white flies. The other sugars are generally found on both non-contaminated and honeydew-contaminated cottons. Tarczynski using the aphid-stylet technique to obtain pure phloem sap from cocoa plants showed that the major sugar translocated is sucrose (>90%). Hendrix (1995) reported that "only a few of the sugars in white fly or aphids honeydew are found in the insect's diet; most sugars in these secretions are produced by the insects from phloem sap". The glucose and fructose contained in the honeydew are created from sucrose by the insect.

same conditions. The same wild strain growing on crude whitefly honeydew in the nutrient base had a rate of 0.013 ppm/s which was comparable to growth on sucrose. These results indicate that CO₂ flux will be a good method of monitoring microbial respiration during the screening and development of bioremediation agents. A reliable reading could be obtained within one to three minutes after placing the sample in the test chamber. The comparable result with filter paper or lint indicates that filter paper can be substituted as needed in later tests which will simplify screening of various strains and growth conditions. Seed respiration did not influence the results in these test which indicated that this technique will be applicable to later bioremediation trials. Several different chamber sizes are adaptable to this system and a probe configuration for monitoring modules in the field is possible.

Conclusions

Based on a sample of 250 yeast strains collected from the phyllosphere of cotton and other plants in the San Joaquin Valley, the ability to utilize the sugars in honeydew seems to be a rather common and variable trait in this yeast population. These results indicate that further selection might yield good bioremediation strains. The ability of the CO₂ measurement system to rapidly detect yeast metabolism on the lint substrate means that this system will be useful in monitoring microbial activity during bioremediation.

Acknowledgments

The author would like to acknowledge the various contributions of S. Delgado, P. Kaufmann, K. King, C. Lau, and Dr. A. Maltby to this study. A portion of this work was funded by a grant from the USDA ARS Postdoctoral Research Associate Program.

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STICKY COTTON EFFECTS

ON THE CARDED SPINNING PROCESS

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Abstract

Numerous papers have been published describing the disruptions of the spinning process caused by cotton rendered sticky through contamination with insect honeydew. By contrast, few quantitative results are available concerning the actual damage caused by this stickiness.

A project, labeled "The improvement of the marketability of cotton produced in zones affected by stickiness" is sponsored by the Common Fund for Commodities, and International Cotton Advisory Committee (ICAC) as supervisory body. The following bodies participate to this research: Sudan Cotton Company (SCC) as project executing agency, Agriculture Research Center (ARC), Institut Textile de France (ITF), and Cirad. One of the goals of this project is to evaluate the effects of stickiness on the spinning process.

A study was conducted under hygrometric conditions usually recommended from preparation up to spinning. 26 bales of cotton of different grades were tested. The study provided several important results concerning carded spinning.

Firstly, a comparison of the results obtained using measuring instruments such as SCT, H2SD and HPLC (results from ITC) showed that H2SD seems to be the most adapted method to predict stickiness during spinning.

Stickiness monitoring through the different processing steps shows that the different cleaning and opening operations do not affect the stickiness level of the cottons. No notable disruptions during the different preparation operations prior to carding were detected due to stickiness, in 3 to 4 hours test conditions.

By contrast, all the machines from the card through the rest of the production line are affected by stickiness to varying degrees. The increase

in breakage and the reduced yields seems to be linked with the number of sticky points, with some imprecision due to stickiness distribution. The roving frame seems to be highly stickiness sensitive.

A correlation exists between the number of sticky points and the degradation observed in the quality of the slivers, the strands and the yarns for several parameters. The evenness of the card sliver and the drawing frame did not appear to be stickiness-related; the effect on product quality is only statistically significant from the roving frame.

Sensitivity to stickiness, from a quality standpoint, was entirely different from one spinning process to the other: while ring spun yarn showed a significant degradation in nearly all its characteristics (notably the mass CV%, fineness, thickness, neppiness, strength and hairiness), open-end yarn was only affected for its strength and hairiness. This difference is assumed to be due to yarn structures, and measuring device sensitivity.

Although the correlation noted between stickiness and disruptions are statistically significant, some show relatively broad confidence intervals. The precision of the predictions for these parameters is therefore very low when establishing a critical threshold, i.e. the number of sticky points on the H2SD above which the stickiness will become economically damaging.

In the conditions of these researches, any threshold could be given as a rough guideline and actual values are left to the discretion of the different users.



RELATIONSHIP OF INDIVIDUAL HONEYDEW SUGAR CONCENTRATIONS ON COTTON LINT STICKINESS POTENTIAL AND MEASURED SUGAR CONTENT

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Abstract

Cotton fiber stickiness caused by the presence of sugars can not only depend upon the total amount sugars, but which specific ones are present. Studies were conducted to measure the stickiness potential of seven sugars commonly found in honeydew cottons. A single upland cotton was treated with pre-determined amounts of these sugars by misting with an air brush applicator. Resultant treatments were analyzed for sugar content to determine actual sugar retention. Stickiness measurements were conducted on rotary blended and hand blended treatment samples to determine degrees of stickiness at five different sugar concentrations. The characteristic honeydew sugars trehalulose and melezitose as well as the disaccharides turanose and sucrose were found to exhibit higher stickiness potentials than the other tested sugars on the thermodetector, especially at concentrations above 0.5%. Sucrose treated cottons did not get high ratings on the minicard test as observed for the same sugar on the thermodetector.

Introduction

Plant sugars on the surface of cottons are part of the natural growing process. Lint stickiness often experienced during textile processing usually occurs when concentrations of these sugars exceed normal levels. Plant sugars, although evenly distributed on the lint, can accumulate on card crush rolls, spindles, and other machinery that comes in direct contact with the cotton (Perkins, 1991; Perkins, 1993). Sugar extracts from non-insect contaminated cottons usually contain (except in the case of severe weathering and/or microbial damage) at least 10 identifiable different carbohydrates. The four most prevalent individual carbohydrates in plant

sugars are the monosaccharides glucose and fructose and two disaccharides sucrose and trehalose. Usual orders of concentration are glucose, fructose, sucrose, and trehalose (Brushwood and Perkins, 1996; Brushwood, 1997). Ratios depend upon a number of factors such as cotton boll maturity, growing and harvesting conditions, area of growth, and variety.

Another source of sugars on harvested cottons is from insect contamination such as the sweet potato whitefly (*Bemisia tabaci*) and cotton aphid (*Aphis Gossyii*). Contamination is commonly found on cottons grown in areas where factors such as weather and other conditions conducive to these insects exist. Each insect processes large quantities of plant phloem sap during feeding activities. The excess phloem is excreted in the form of highly concentrated honeydew droplets that fall on the open bolls of cotton (Talpaz, 1983). Without vigilant monitoring and control of whitefly and aphid population during cotton growing seasons, the potential for honeydew contamination is high. Honeydew consists of highly concentrated extremely sticky carbohydrates randomly deposited on the surface of cotton lint.

Heavy honeydew contamination on cottons can have very devastating effects in all phases of textile processing. Deposits on rolls, blades and other equipment sometimes make processing virtually impossible. Shutdown and clean-up is costly. In addition to the normal plant sugars, honeydew has been found to contain the unique carbohydrates trehalulose and melezitose (Bates et al., 1990; Byrne et al., 1990; Brushwood and Perkins, 1994; Brushwood, 1998; Hendrix et al., 1994; Tarczynski et al. 1992; Wei et al., 1996) along with a number of more complex oligosaccharides that may also contribute to stickiness. The major sugars that have been identified and routinely quantitated by high performance liquid chromatography (HPLC) in whitefly contaminated cottons, in order of prominence, are trehalulose, fructose, glucose, melezitose, sucrose, trehalose, and smaller amounts of turanose (Brushwood and Perkins, 1994). These seven sugars generally account for 80 to 85% of total known carbohydrates (Brushwood, 1997). Aphid honeydew, which contains little or no trehalulose, is dominated by melezitose, glucose, fructose, sucrose and smaller amounts of trehalose and turanose totaling about 80% of the known sugars identifiable by routine HPLC analysis. Compositions of insect honeydew can vary depending upon a number of factors including other host vegetation (Hendrix et al., 1992).

This work was conducted to determine if the above sugars commonly found on insect and non-insect contaminated cottons were different in the individual stickiness potential when applied to cotton lint. Stickiness was measured by the standard GRAF/IRCT thermodetector (TD) and minicard tests at different concentrations. Stickiness ratings were correlated with numerical modified Perkins sugar test (Brushwood, 1998) results. Identification of the sticky sugars could aid in research currently underway to focus on eliminating or minimizing the effect specific sugars have on processing stickiness.

Materials and Methods

Five different concentrations of the sugars glucose, fructose, sucrose, turanose, trehalose, trehalulose, and melezitose sugars were applied to non-sticky, non-insect contaminated 1997 Upland cotton. Each individual sugar or mixture was sprayed on the surface of a blended (5 passes through a Syncromatic Blending hopper blender, Fiber Controls, Gastonia, NC) cotton in 10 gram lots spread over a surface area of 500 cm² on a 1/2 loading balance. Applications were made using a Model 1500 Craft brush (20 pounds regulated pressure). The sprayer provides a very fine mist which aided in successfully distributing the sugars evenly on the exposed cotton surfaces.

Preliminary high performance liquid chromatography analysis (Dionex anionic DX-300 Spectrophotometer using a PA-1 column and isocratic mode) of sugar extracts from the untreated cotton revealed concentrations of the sugars glucose (0.05%), fructose (0.05%), trehalose (0.03%), a

A new methodology usable by researchers and spinners for short staple fibre microspinning

From this specific methodology developed by Cirad, the scientist is able to widen his investigation to variable quantities of cotton ranging from 50 to 500 g. The choice of the amount of cotton will be induced by the cost of the study, the kind of information and the accuracy of the results to be obtained.

Experimental procedure

For industrial carded varieties of cotton, the procedure is as follows: first opening and blending of cotton, then carding, condensation of the web in a sliver, drawing steps and spinning. As far as the microspinning is concerned, the previous procedure is used by adapting it as a function of the quantity of cotton to be spun.

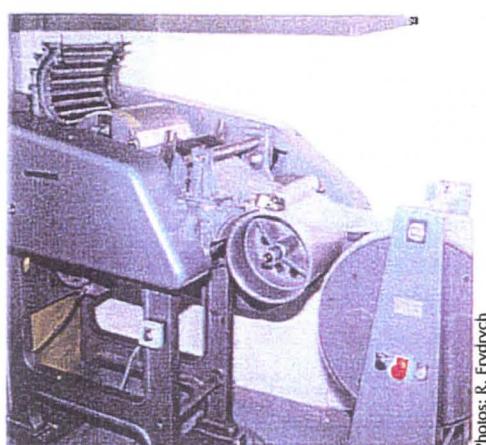
The microspinning stages for an amount of cotton ranging from 50 to 500g are showed in box 1 and figure 1.

The Cirad uses a Platt microspinning equipment which consists of a minicard, a drawing frame, and an eight spindles spinning frame with double drawing, as well as a six Suessen open-end rotors.

Practical results

According to the sample weight (figure 2), the sliver length is comprising between 15.6 and 175 m and the sliver counts range between 2 300 to 3 500 tex.

From these slivers, it is possible to spin in ring spinning or /and rotor to obtain a yarn length between 1 000 to 20 000 m, depending of the count.



Opening and blending: 100 g of cotton

Box 1. Microspinning steps.

The full set of spinning tests must be carried out in standard room conditions.

First step: opening and carding

The fibre preparation consists in blending, cleaning, disentangling fibres. It can be split into the two following stages:

- cotton opening and blending for samples of 50 g and over; for samples of 250 to 500 g, the sample is split into 5 parts of 50 or 100g. The subsamples form into 5 fleeces that will then be carded;
- carding operation provides the cleaning, disentangling and parallelizing of fibres while eliminating a part of the neps and short fibres. Depending on the starting weight of the sample, i.e. 50 or 100 g, the outgoing web of a weight of 5g/m² is taken either by the cylinder, respectively l = 0.77 m or 1.57 m.

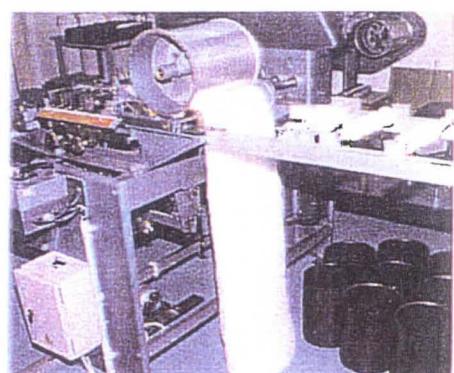
Second step: drawing

The drawing consists in passing the fibrous flow (fleece or sliver) between four pairs of pressing cylinders, driven at different tangential speeds. In all cases, it is necessary to perform three drawing operations. The first passage changes the card outgoing fleece into a sliver. The two other operations correspond to those performed in an industrial plant. Two ways:

- sliver from the sample of 50 g is collected on a taken drum;
- sliver from the sample of 250 g and over is collected in cans.

Third step: ring spinning and rotor spinning

Spinning consists in winding the yarn on a support. The two main types are being used: ring and rotor spinning.



Conclusion

It is a specific and original microspinning methodology which consists in processing both very small quantities of cotton fibres:

- 50 g necessary to evaluate the varietal improvement
- quantities ranging from 250 to 500 g necessary for researchers and spinners to evaluate the behaviour of cotton fibres in the spinning processes
- the yarn length produced may be used to weave fabrics and to carry out different kinds of tests such as that of dyeing affinity.

Figure 1. Microspinning process.

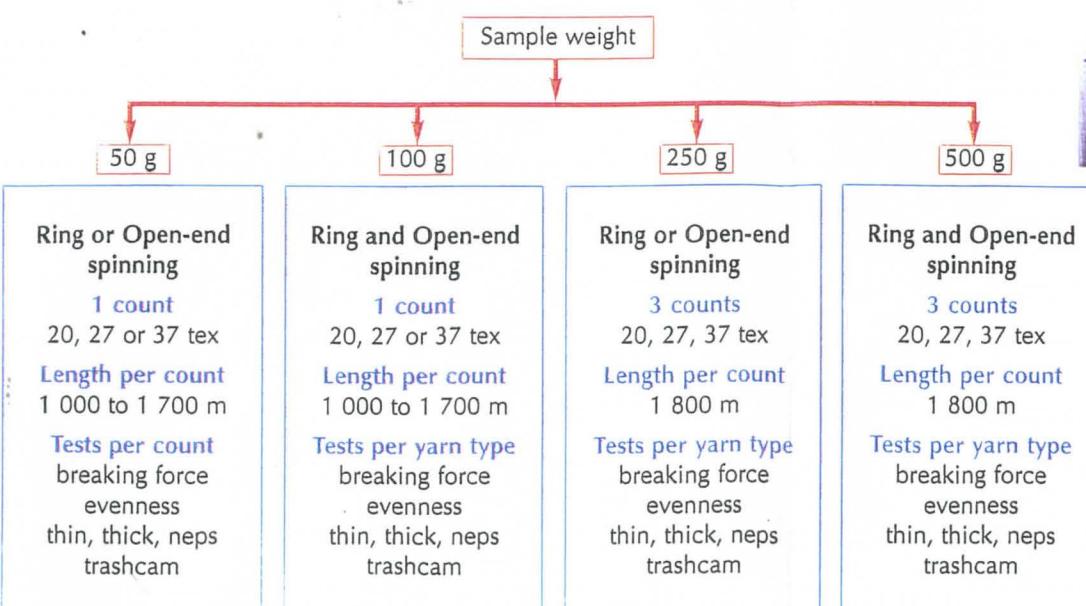
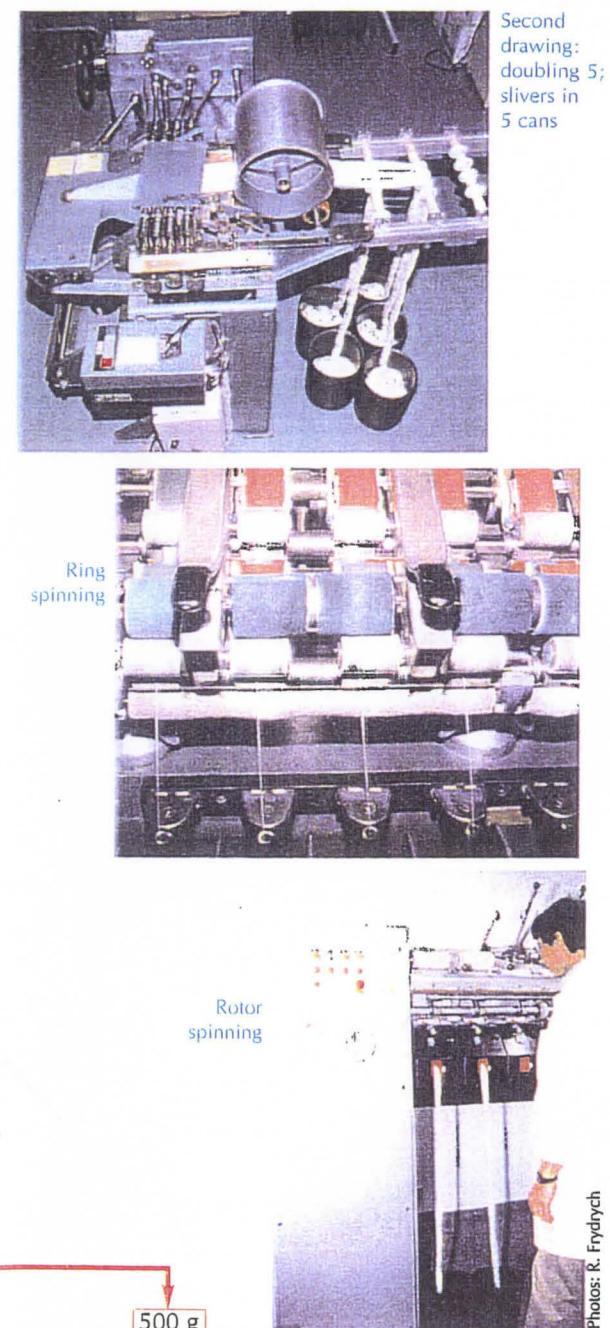
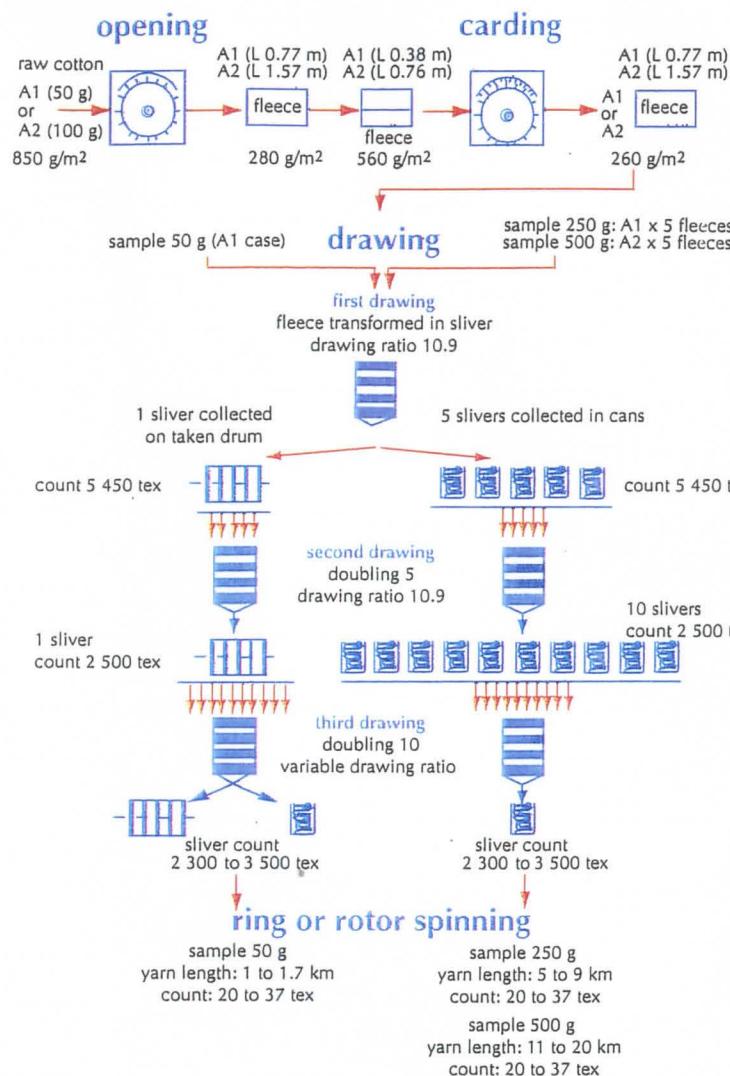


Figure 2. Microspinning trial for different cotton sample weights (50 to 500 g).

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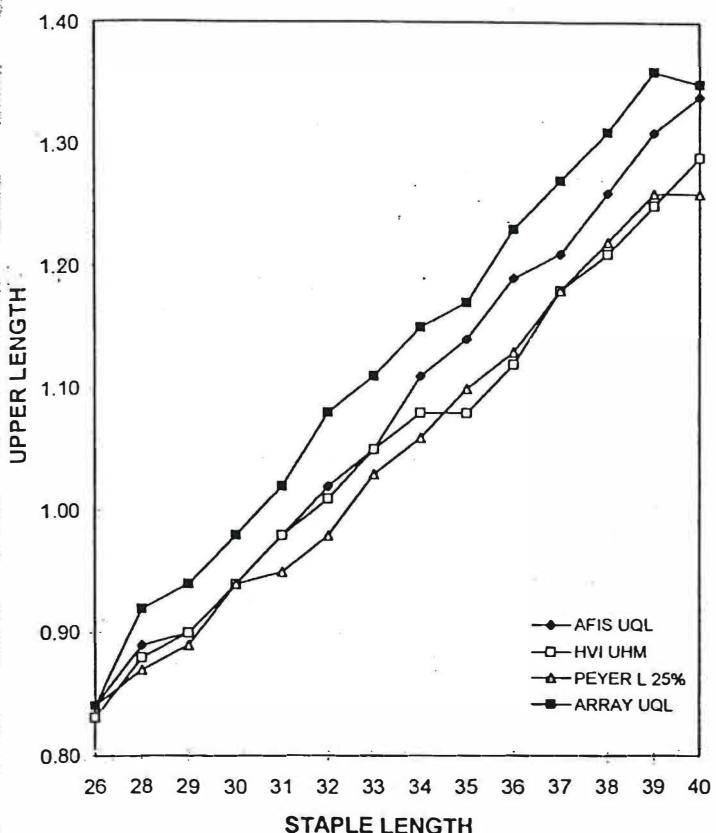


Figure 1. Staple Length versus Upper Length.

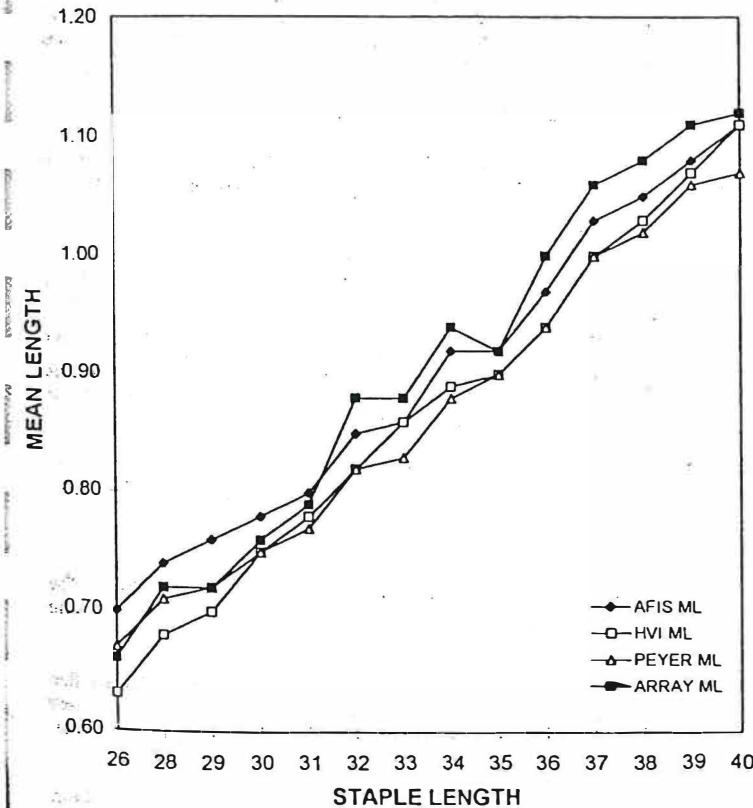


Figure 2. Staple Length versus Mean Length.

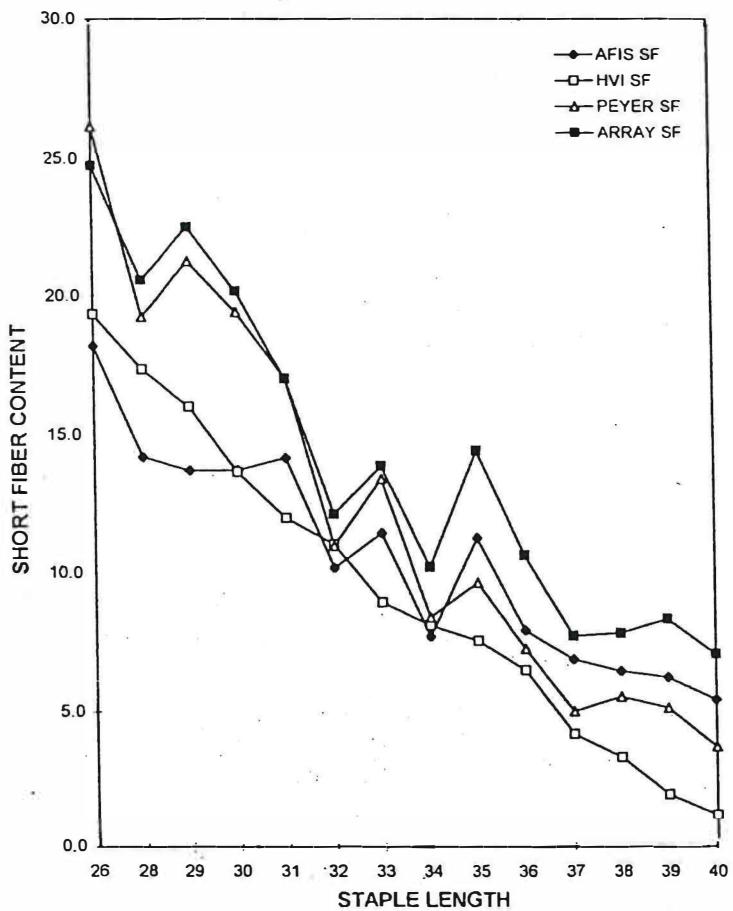


Figure 3. Staple Length versus Short Fiber Content.



SEED COAT FRAGMENT COUNTING AND SIZING IN CARD WEB

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Abstract

A method to differentiate cultivars depending on their SCF contents on yarn was developed in CIRAD CA using a GGP Uster Evenness Tester. Results indicate a high SCF heritability, but fabrication of yarn is too costly to be used for breeding programs. So, a new method, using image analysis, has been developed for counting and sizing up SCF on card web. SCF counts were made on card web and compared to those obtained by Uster Tester III on 20 tex, 27 tex, 37 tex yarns for 30 cottons. Number of SCF on yarn can be predicted with R^2 as great as 80%.

Introduction

A recent report by the ITMF (International Textile Manufacturers Federation) entitled "Cotton Contamination Survey - 1993" studies "spinners' observations concerning the problem of contamination and foreign matter in cotton". The results of the survey indicate that contamination by "seed coat fragments" is significant. It must be stressed, however, that degrees of contamination are not dealt with in this survey, and that the survey was carried out on samples from origins which are not necessarily representative of production. Moreover, no subsequent validation control was carried out. Its results, therefore, serve merely as a general pointer.

These results can be found in the table 1 according to main geographic areas.

The "seed coat fragment" problem is on the increase because of changes that have occurred over the past few years:

* changes in ginning techniques: the number of devices for cleaning cotton seed and fiber has increased, as has their speed, making the process more aggressive,

* changes in spinning techniques: requiring batches of fiber that are ever more homogeneous and free of foreign matter.

These seed coat fragments make up a large part of yarn neppiness. Neppiness can be broken down into five categories and regrouped into fiber neps, seed coat fragments and miscellaneous fragments:

* three types of fiber neps can be identified:

- "shiny neps" are lumps of unripe fiber; they cause uneven dying of the cloth

- "process neps" are created during the various processing steps from seed cotton to yarn (ginning, cleaning, carding, etc..)

- "sticky neps" are due to sugar on the fiber, the origin of which is either physiological or, more often, entomological (honeydew); this sugar is excreted by the aphid, *Aphis gossypii* and the white fly, *Bemisia tabaci*. Contamination from insect honeydew can result in severe production losses.

* "seed coat fragments" arise from cleaning and ginning the seed cotton as these processes tear off part of the seed coat, to which the fibers remain attached. During spinning these seed coat fragments in the yarn cause breakages and deteriorate the yarn's appearance and increase production costs related to their elimination.

* "other types of neps" group plant debris such as leaves, stems, etc. and various impurities; their presence is most often linked to the quality of the harvest and the cleaning processes employed (seed cotton and fiber).

Incidence of SCF in total yarn neppiness and heritability

The presence of SCF in the fiber causes numerous problems during spinning (J. D. Bargeron and T. H. Garner, 1988; G. J. Mangialardi Jr, 1988; L. Verschraege, 1989). Consequently, cottons known to contain large quantities of SCF are liable to heavy downgrading on the market.

To try to contend with the problem, teams of breeders and CIRAD cotton technicians began studying the phenomenon in the late 1980's (B. Bachelier, 1992).

First, it was necessary to find a way to measure the number of SCF in the yarn. Second, the heritability of the character then remained to be determined.

Measuring the number of SCF in the yarn

At present, all quality control devices measure all neps in the yarn (fiber neps + shiny neps + sticky neps + SCF + plant debris); but although certain neps seem to result solely from the environment (plant debris and sticky neps), others are probably controlled genetically to a great extent (e.g. SCF). Yarn neppiness-measuring instruments available today do not evaluate this possible heredity factor. For this reason, CIRAD-CA in Montpellier created a method whereby it was possible to measure neps in yarn according to their type (R. Frydrych and J; Gutknecht, 1989; R. Frydrych, 1992).

As a first step, a USTER GGP-IP1 regularimeter was used fitted with an "imperfector selector" (USTER News 1965). Each yarn underwent the routine global testing (total neps) then a detailed analysis of neps to identify the different types of imperfection: SCF, miscellaneous neps such as honeydew, and fiber neps.

The method is broken down into two operations:

The yarn unrolls for a limited time at a speed of 25 m/min, with the normal sensitivity settings chosen, e.g. -50%, 50%, 200% for ring spinning. The yarn is retrieved on a separate drum. Total neps are counted.

Secondly, the yarn wound round the drum mounted on the upper part of the regularimeter is introduced into the "imperfector selector", which stops it each time it encounters an imperfection. Each is then examined carefully through a magnifying glass under intense light placed in front of the yarn analyzer. The imperfections are counted by category: SCF, fiber neps, others.

The results obtained by regularimeter on 94 non-sticky cottons, spun in 20 tex, and originating in several African and South American countries, confirmed the correlation between SCF and total USTER neps.

A statistical analysis revealed that the number of SCF in non-sticky cottons can be estimated fairly precisely by an equation which includes thick places and total neps, counted by the USTER (fig. 1) ($r = 0.984$):

$$SCF = -0.14 * THICK + 0.96 * NEPS + 14$$

In the case of sticky cottons, the stickiness potential measured by the thermodetector must be added to the equation. The equation developed after analysis of 70 cottons is (fig. 2) ($r = 0.956$)

$$SCF = -0.17 * THICK + 0.92 * NEPS - 1.98 * SCT + 62$$

The technique has now been adapted and can be used on UT3.

Evaluation of yarn SCF heritability

A preliminary trial using 5 varieties was performed at 6 different locations. The seed cotton produced was ginned and the fiber spun by ring spinning 20 tex.

Total variance was broken down into varietal, location and residual variances. Heritability was estimated using the ratio:

$$\text{Varietal variance} / (\text{varietal variance} + \text{location variance} + \text{residual variance})$$

Heritability thus estimated was 73.2%.

At the same time, another trial in another country was performed using 6 varieties at 6 different locations. Estimated heritability was 76.1%.

It can be reasonably asserted, therefore, that the heritability of SCF in 20 tex ring spinning yarn is about 70%. This high level of heritability is compatible with CIRAD's aim of setting up a genetic improvement program dealing with neppiness.

However, although the present technique for counting SCF in yarn is automated it is unable to meet the requirements of a strategy of varietal improvement designed to reduce neppiness, since thousands of yarn analyses would be necessary. As the cost of a microspinning trial followed by quality control of the yarn is very high, this method would be incompatible with the usual budget at a breeder's disposal.

Setting up a quick method to count SCF on yarn

To solve this problem, CIRAD decided to evaluate the number of SCF in a card web and to study the relation between this parameter and yarn neppiness due to SCF.

Materials and methods

Two samples (500 g and 40 g) were taken from thirty cottons of various origins

Each cotton underwent the following processing and analyses:

* Spinning trials were performed on a Shirley-Platt microspinning machine comprising a cotton opener, a card, a drawing frame and a ring spinning frame using two drawing areas.

- 500 g of fibers were used in these tests to obtain about 13 km of yarn of 20 tex, 27 tex or 37 tex.

- 500 g of fiber were divided into 5 parts, each weighing 100 g.

- Each 100 g sample was opened and mixed on our laboratory opener. The web was wound onto a drum 1.55 cm in circumference. Five webs were obtained for each cotton.

- Each web was folded in the middle and inserted into the card feed roll. The stationary flats were cleaned twice during each test. The cotton web produced was wound around a drum identical to that used on the open frame. Five webs were obtained for each cotton.

- The first drawing, with a value of 10.5, converted the web into a sliver. The sliver, which was 15.60 m. long, was collected in a can. In all, 5 slivers were obtained to be used for the second drawing.

- The second drawing was used to homogenize and refine the sliver, doubling at 5. The 5 cans were placed at the back of the drawing frame.

The second drawing, with a value of 10.5, resulted in a sliver 170 m. long which was collected in a can, then divided into 10 cans. Each can contained 15.60 m. of sliver. The 10 cans were placed at the back of the drawing frame for the third drawing.

- The third drawing homogenized and refined the sliver by doubling at 10. To make 20 tex and 27 tex yarn, the drawing used is 10.5; then the sliver used to feed the 4 spindles of the ring spinning is about 2200 tex. To make 37 tex yarn, the drawing used is about 8.5; then the sliver used to feed the 4 spindles is 3000 tex.

- For each spindle, a length of sliver was collected in a can and placed at the back of the ring spinning frame.

- Ring spinning was composed of two drawings; the back draught was fixed at about 6.5, the front draught fluctuated depending on the incoming tex. Four spindles were used. For each tex, the length of sliver used was divided to obtain:

- 1500 m. of yarn for the regularimetry test (first replication). The length was wound onto four cops;

- 1500 m. of yarn to identify and count the various imperfections found on cotton yarn. The length was wound onto four cops;

- 1500 m. of yarn for the regularimetry test (second replication).

perature and hygrometric conditions in the course of the study were 22°C 50% relative humidity during spinning.

h yarn was analyzed on USTER devices as follows:

- Regularimetry: performed on a USTER UT3 regularimeter. The settings chosen were as follows: speed 50m/min., thin (-50%), thick (+50%), neps (200%).

- These settings were used for both regularimeter tests, i.e. normal test and detailed analysis.

- Normal test: two replications were made, each replication using 250 m. of yarn per cop x 4 cops to obtain 1000 m. The mean was calculated.

- Detailed analysis: performed using a method developed at CIRAD to identify the different neps observed. Each imperfection was examined in detail using a magnifying glass and intense lighting. The yarn was stopped for a given period of time (20 seconds), then loosened to obtain stabilization for 5 seconds before reading. Imperfections were classified as seed coat fragments, fiber neps (entangled fibers and sticky neps), fragments such as leaves. Percentages obtained for each type of imperfection were adjusted to total neps on 1000 m to obtain the number of neps per type of imperfection on 1000 m.

Counting of impurities on card web.

A rapid counting method for estimating cotton SCF comprises:

minicard

Equipment for image acquisition:

- a support for the card web
- a light source
- a video camera
- a PC 486 computer with video card
- software created especially for the purpose.

The 40 g fiber sample is put through the following steps:

- The sample is opened by hand to obtain a web of about 26 cm x 21 cm.
- The web is folded in four, and is carded with a smooth aluminium plaque in place of flat.
- The fiber web thus obtained is wound round a drum.
- The web is then divided into three equal parts that are placed one on top of the other and are carded a second time, this time with a normal card flat.
- Once a regular web has been obtained, 4 layers of the web are wound around a drum.

- A second drum is then introduced in order to wind another four layers of web. The operation is carried out twice to obtain 4 webs of fiber, each made up of 4 layers of card web.

- The first web is placed on the examination plate (30 cm x 22 cm) and 3 video images are taken. Each image is processed by the software and the result (number of objects and size distribution) is stored in an ASCII file.

To obtain high quality images, the fiber web is pressed against the examination plate. The side of the pressing instrument in contact with the fiber web is covered with a uniform white background.

The software reads the image line by line and impurities are revealed by localized contrasts. Contiguous lines are then analyzed to describe the contours of the objects. The area of an object is overestimated because of the slight magnifying effect produced by the anti-reflection plate onto which the fiber web is pressed. For this reason, surface areas will be described in pixels rather than in mm².

The size distribution of the impurities is established according to 30 surface area classifications, from 1 to 30 pixels.

Temperature and hygrometric conditions in the course of the study were 22°C and 65% relative humidity during resistance and regularimetry testing.

Results and discussion

Number of impurities

A statistical analysis of the number of impurities was carried out according to Fisher with 30 varieties and 4 repetitions. We corrected the number of SCF observed by Trashcam in relation to the weight of the web analyzed (0.5 g). Intra-cotton variance distribution is not normal. A square root transformation of the number of impurities observed per 500 g of fiber stabilized the variances. The coefficient of variation for the transformed trial data was 8.3%, and the F test was significant at 1 in 1000.

Figure 3 shows that the range of cottons chosen was very wide.

Surface area of impurities

Impurities were distributed into 6 classes for each cotton. The 30 classes of imperfections observed were reclassified into 6 classes of surface area.

Distribution homogeneity of the surface areas for the 30 cottons was tested using Pearson's Chi² test. The Chi² of 238.2 for 145 degrees of freedom was highly significant. This revealed that the mean distribution observed for the 30 cottons (fig. 4) was not representative of all cases observed. Figures 5, 6 and 7 show the different possible types of distribution. These variations in distribution forms depending on the cotton may be related to several causes (non-exhaustive list):

- type of harvest (manual or mechanical) leading to variations in the amount of plant fragments in the fiber.
- type and number of seed cotton cleaners in the ginning mill
- type and number of lint cleaners in the ginning mill
- variety

A precise study would be necessary to determine the impact of these different factors on the number and size of the objects revealed by image analysis.

Subsequently, research was conducted on the type of object which could represent SCF on 20, 27 and 37 tex yarn in ring spinning:

- objects smaller than 15 pixels are too small to be of significance on the yarn.
- Objects larger than or equal to 20 pixels are not generally SCF; they are often plant debris or are not categorized as neps by the UT3.

It was therefore decided to study the relation between objects between 15 and 19 pixels and the number of SCF on the yarn.

Relation between SCF on the fiber web and SCF on the yarn

Figures 8, 9 and 10 show the relationship between the number of SCF on the card web and the number of SCF on the yarn.

The correlation coefficient between the card web and 20 tex yarn is 0.916.

The correlation coefficient between the card web and 27 tex yarn is 0.912.

The correlation coefficient between the card web and 37 tex yarn is 0.888.

Conclusion

The correlation between the number of SCF on the card web and the number of SCF on ring spinning yarn is satisfactory throughout. The process is currently being computerized to obtain direct reading of the card web as it unravels. This method can be used in varietal improvement. However, investigations must continue to establish the impact of types of ginning processes on the number of SCF and their size distribution.

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Table 1. Seed Coat Fragment contamination (from Cotton Contamination Survey - 1993 - ITMF).

Geographic area	Positives answers	Number of answers
South America	32.0	129
North America	34.0	446
Africa	38.5	385
Europa	39.7	225
Asia	49.0	390
World	36.2	1575

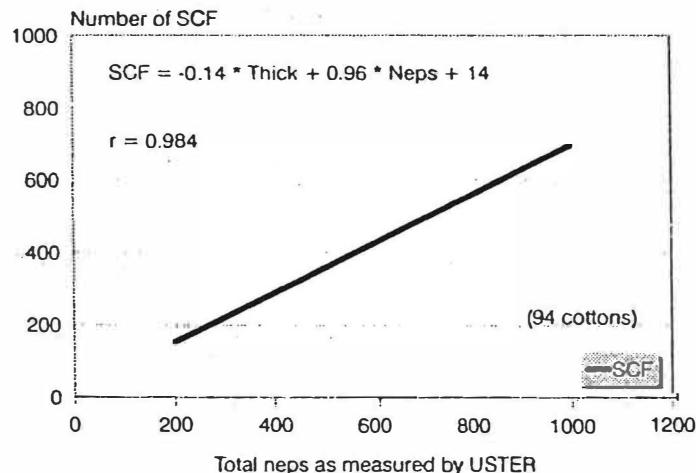


Figure 1. Relation between SCF and total USTER neps on a range of non-sticky cottons.

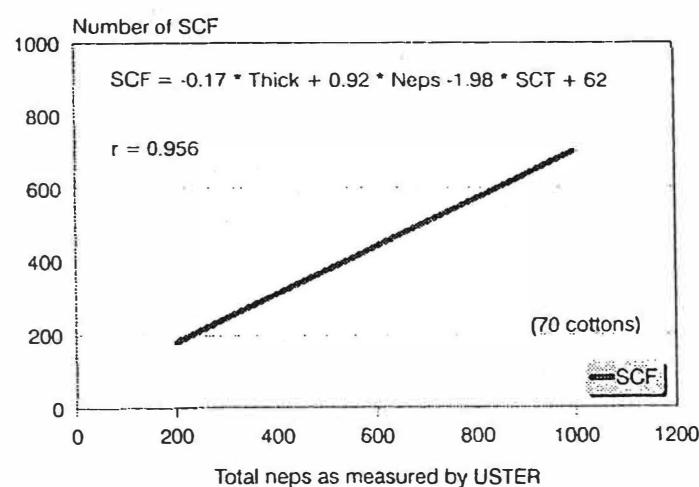


Figure 2. Relation between SCF and total USTER neps on a range of sticky cottons.

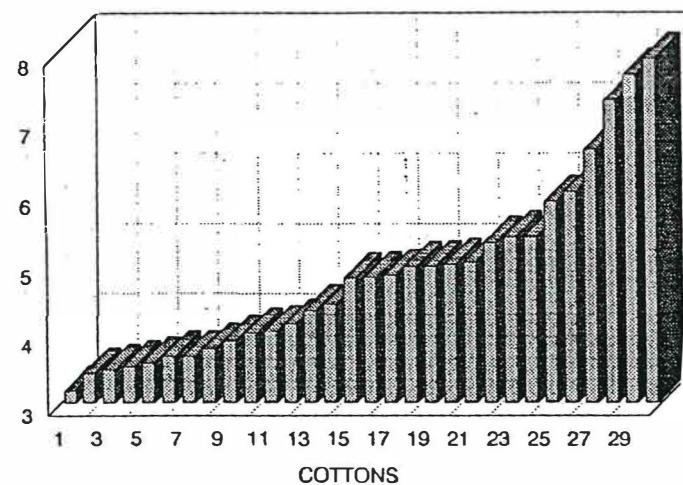


Figure 3. Trashcam count for 30 cottons: square root of the means for grams of fibres.

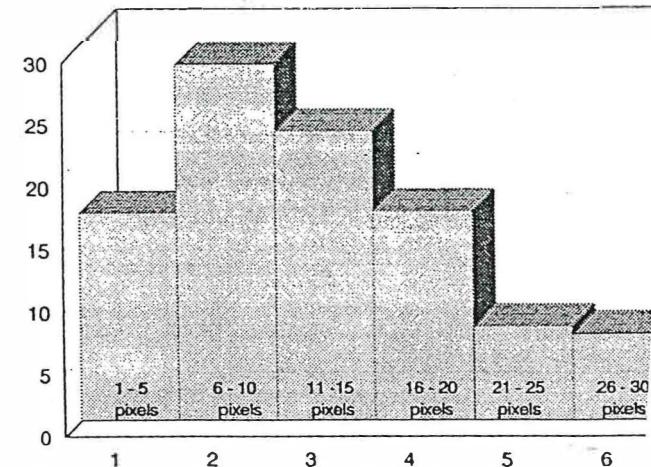


Figure 4. Averaged Trashcam count distribution for 30 cottons.

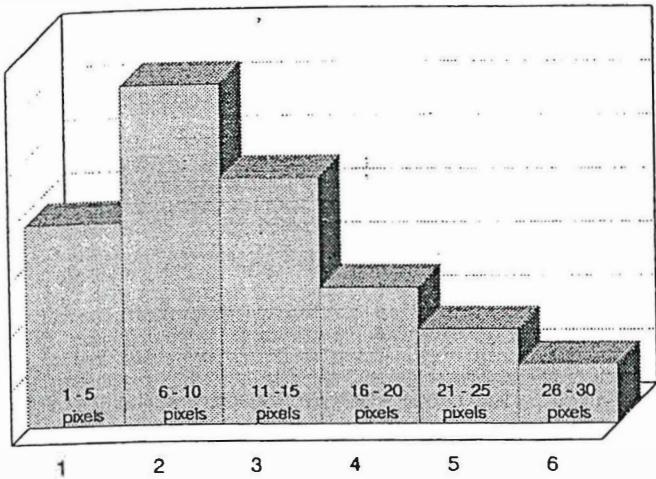


Figure 5. An example of trashcam count distribution.

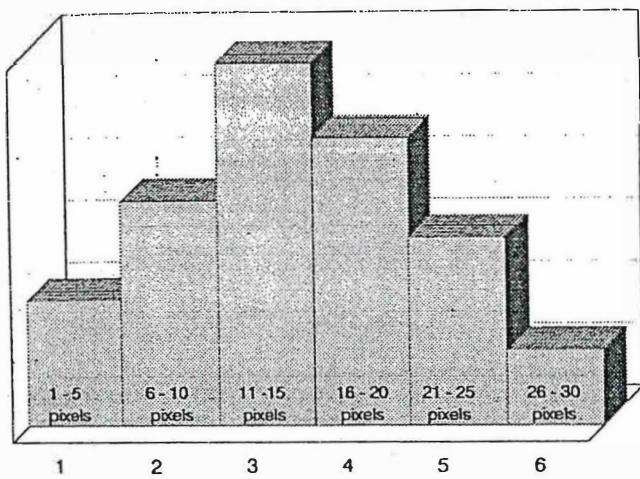


Figure 6. An example of trashcam count distribution.

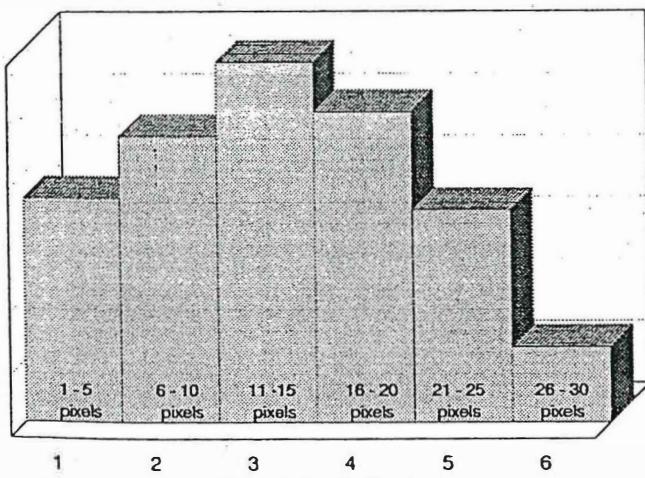


Figure 7. An example of trashcam count distribution.

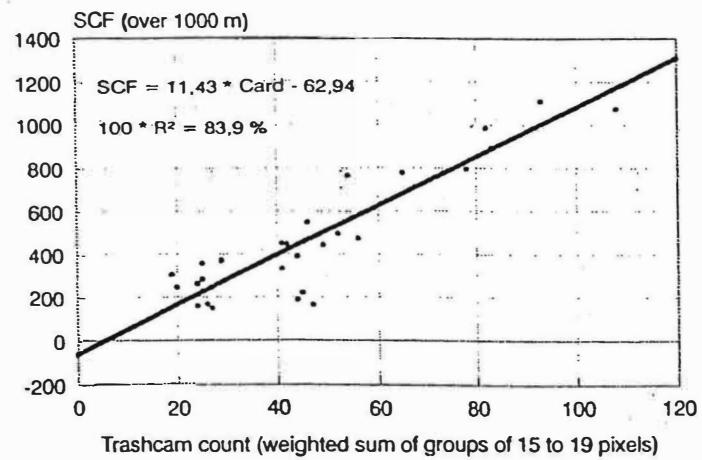


Figure 8. Seed Coat Fragments on 20 tex yarn vs Trashcam count on the web (5 grams web).

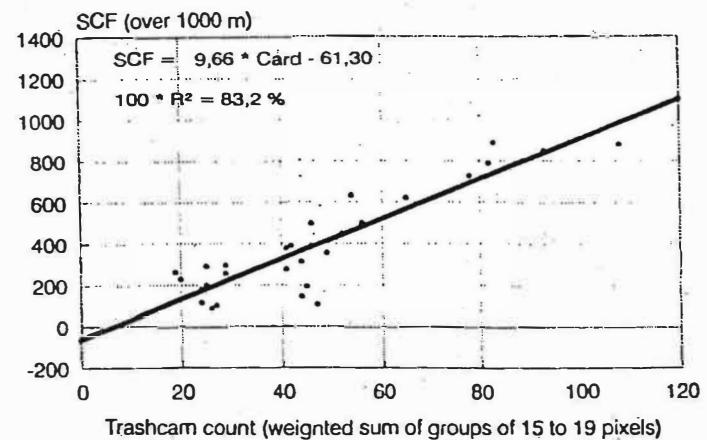


Figure 9. Seed Coat Fragments on 27 tex yarn vs Trashcam count on the web (5 grams web).

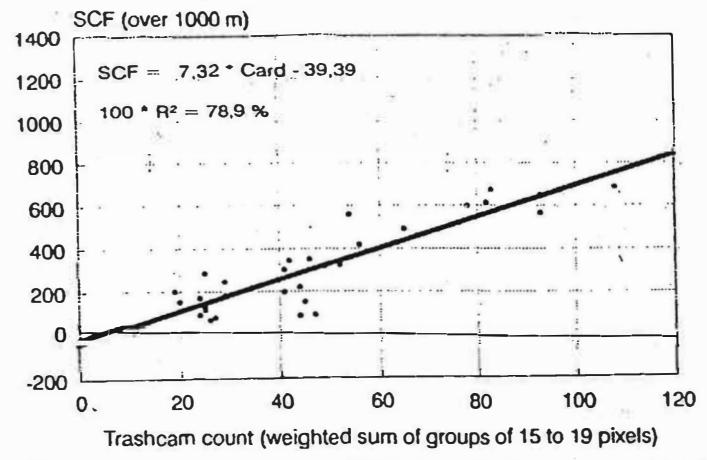
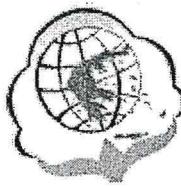


Figure 10. Seed Coat Fragments on 37 tex yarn vs Trashcam count on the web (5 grams web).





Honeydew and Seed Coat Fragments: Identifying and Counting Two Major Cotton Fiber Contaminants

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ABSTRACT

Spinning techniques are constantly progressing. Equipment is getting faster and more automated. Spinners are less and less tolerant of fiber contaminants. Honeydew and seedcoat fragments (SCF) are a major problem that cannot be detected by HVI systems. CIRAD developed techniques for honeydew and SCF detection and quantified them for use by researchers, producers and spinners. Thermodetection detects cotton entomological stickiness, results being expressed as the number of sticky spots in the specimen, providing a sample of stickiness potential. High Speed Stickiness Detector (H2SD) is fully automated and allows a bale by bale classification for stickiness at speeds comparable to HVI speed (30 seconds per sample). Results correlate well with the reference Stickiness Cotton Detector. Sticky spot size distribution is available. TRASHCAM image analysis on a card web detects seedcoat fragments. Results are expressed as an SCF total count in the specimen. Very small SCF are detected so the results can be considered as samples of SCF potential. TRASHCAM uses a scanning device and a specific algorithm. SCF size distribution is available. Yarn SCF assessment is possible without spinning any yarn. TRASHCAM can count SCF in yarn.

Introduction

In order to meet market requirements that are in part related to progress made in spinning techniques, it is essential to obtain more information on the quality of the raw material and a more precise description of the yarn quality. Rapid measurement techniques, (HVI), are employed to measure the technological characteristics of cotton fiber. These techniques are used for commercial classification purposes and in varietal improvement programmes, conditional, in this case, on certain precautions (Gourlot *et al.*, 1994). However, fiber classification criteria such as length, strength, micronaire and trash are insufficient to predict the quality of the finished product and are unable to guarantee the correct functioning of the spinning process since fiber contamination by foreign matters such as insect honeydew and seed coat fragments (SCF), may disrupt the process. These contaminants may reduce producer prices and have negative effects on yarn production and quality. CIRAD developed equipment and techniques for use in its research programs that are intended to reduce these effects, i.e. Trashcam used to evaluate SCFs and the SCT thermodetector and rapid H2SD detector to measure cotton stickiness.

Effects of contaminants on yarn quality

Currently, seed coat fragment neppiness is a major factor taken into account by CIRAD as they reduce the efficiency of fiber cleaning, increase fiber breakage during spinning (Price, 1987) and affect the

yarn appearance. This character is more than 70% heritable (Gourlot *et al.*, 1995). Insect honeydew disrupts the spinning process by clogging equipment and results in poorer quality yarn. This yarn shows neps that contain honeydew, and fiber neps without honeydew, caused by the fiber rising upwards (Frydrych, 1996). These imperfections increase the total count determined by capacitive-sensor regularimeter. Figure 1 illustrates three cases of neppiness encountered in ring spinning (RS) detected on a capacitive-sensor regularimeter where only detailed analysis of the yarn is able to determine the different types:

- in case (A), the majority of the neps are SCF neps with a few fiber neps (mature cotton) and virtually no plant debris neps. Regularimeter total nep counting therefore corresponds to the number of SCF neps,
- in case (B), the percentage of fiber neps is higher as the cotton is insufficiently mature,
- in case (C), cottons have been contaminated by honeydew, and therefore sticky neps corresponds to a considerable proportion of the regularimeter total nep counting.

The high fiber nep count is largely due to stickiness, not to immaturity. The relationship between total neps and SCF neps is less pronounced in (C) than in case (A). In all cases, the foreign matter increases the number of yarn defects. They also decrease productivity and require special processing by

spinners. It is therefore essential to identify and quantify this matter as early as possible, either during selection or processing.

Counting seed coat fragments in fiber and yarn

Trashcam, manufactured by CIRAD, capable of counting by image analysis (IA) captured by a scanning device, was developed to estimate potential neppiness caused by SCF at the earliest stages of varietal breeding programs (Gourlot *et al.*, 1995). Bachelier (1997) has clearly demonstrated the efficiency of Trashcam counts in card webs and to determine SCF content when used as an early selection method in breeding programs.

In addition to providing a SCF count in card webs, methodology has been developed to allow Trashcam to count seed coat neps in yarn.

Fifteen cottons representative of a broad range of SCF contents were ring spun (RS) and open-end spun (OE) to 20 tex yarn. The SCFs in the card web were counted by Trashcam (IAWeb) and in the yarn by three different methods:

- a capacitive-sensor regularimeter (UT3, Zellweger-Uster) based on a detailed analysis of neppiness (Frydrych, 1989). UT3 neps threshold was set to 200 % for RS, and 280 % for OE yarns.
- Trashcam on yarn plate (IAYarn),
- visual counting of the same yarn plate (Visual Yarn), with two repetitions.

Prediction of UT3 counts is more efficient for RS yarns ($r = 0.87$) than for OE yarns ($r = 0.72$) from Trashcam count on webs (Figures 2 and 3). This may be explained by the fact that UT3 do not detect small SCF which have been broken in smaller parts by the opening roller in the OE process. The comparison of Trashcam on yarn plate counts to the Trashcam on web counts give similar level of explanation for both RS and OE yarns.

The Trashcam SCF count in the card web gave a good prediction of the number of SCF in the yarn spun by RS and OE. This technique is therefore suitable for use in varietal improvement programs (Bachelier, 1997).

A very highly significant correlation was noted for the RS yarn between the results of the Trashcam count in the yarn plate and that provided by visual counting (Figure 4). If significance is set at 5%, the statistical analysis shows that the slope is not different from 1, the y-intercept at the origin is not different from 0 and the correlation coefficient is 0.99. Trashcam may therefore be considered as an efficient method for detecting and counting yarn SCFs by image analysis.

The correlation in OE yarn (Figure 5) was again highly significant ($r=0.98$). By contrast, the count provided by this technique was lower than the visual count (slope of 0.79). Thus, under the same imaging conditions, the Trashcam count is closer to the visual count in RS yarn than in OE yarn. This may be explained by the fact that the SCFs present in the OE yarn are smaller than those in the RS yarn and are therefore more difficult to detect.

The relationship between Trashcam and UT3 results on yarn plate were highly significant for both RS and OE yarn (Figures 6 and 7 respectively). However, the differences between the two counts showed that Trashcam counts far more imperfections than the UT3 widely used in the industry. This difference is due to the fact that the thresholds used by the UT3 prevent it from detecting the smaller SCFs.

Stickiness measured by the rapid H2SD detector

Cotton stickiness level has become a major selective criterion for spinners. Producers are sometimes therefore obliged to sell their cotton at a discount, and under these conditions, the entire production of a country with a reputation for supplying sticky cottons may be reduced in price, even though a large part of the crop is uncontaminated. Obviously the ability to characterize each bale for its degree of stickiness at the production stage is a considerable advantage as uncontaminated cotton can be sold at a higher price.

Micro-spinning sticky and non-sticky cottons has demonstrated that the number of sticky points determined on the SCT thermodetector correlates with the number of wraps during spinning and with the number of yarn defects (Hequet and Frydrych, 1992; Frydrych *et al.*, 1995). An ongoing study financed by the Common Fund for Commodities seeks to establish critical threshold for cotton contamination, beyond which problems arise that result in malfunctions and poor quality yarn. Spinners could reduce the effects of contaminated cottons by using appropriate means, such as mixing cottons with different degrees of stickiness and reducing relative humidity (Gutknecht *et al.*, 1986; Frydrych, 1996). They could also employ processing techniques, such as the use of additives (Perkins, 1992).

Establishing the stickiness of each bale requires a machine capable of rapidly measuring stickiness at speeds comparable to HVI lines measure other fiber properties. With this as its objective, CIRAD has developed a machine capable of measuring stickiness much more rapidly than the SCT thermodetector. This is the H2SD (High-speed Stickiness Detector) manufactured in partnership with Shirley-Developments Limited (SDL). The machine has the capacity to measure about 120 samples/h and has been optimized for use in industry. The different

mechanical and electronic sections of the machine are easily accessible to facilitate maintenance.

Eighty-seven raw cottons of various geographical origins, were tested on the thermodetector and the H2SD with 3 repetitions per sample. Results provided by the thermodetector correlated well (0.92) with those from the H2SD (Figure 8). A good prediction of the relation H2SD counting to SCT counting can be proposed as follows

$$\text{SQR(H2SD)} = 7.26 * \log[\text{SQR (SCT)} + 1] - 0.38 ; \\ r = 0.92$$

These cottons were tested a second time on the H2SD with the same number of repetitions. An excellent correlation was noted between the two tests with $r=0.94$ (Figure 9).

The results of these tests almost equal. A statistical analysis showed that the 0.94 slope of the regression line was not different from 1 and that the y-intercept at the origin (0.15) was not different from 0. This shows the high reproducibility of the H2SD method.

Conclusion

CIRAD Trashcam is used in varietal improvement programs to measure the number of SCFs in card webs. Recently, Trashcam has been shown to be suitable for counting the number of SCFs in yarn. The results in these tests were very similar to those provided by visual counts made on the same yarns.

As far as cotton contamination by insect honeydew is concerned, the improvements made to the commercial version of the rapid H2SD detector have optimized this machine for intensive use in an industrial environment and have enhanced its reliability. The results with the H2SD correlate well with those of the ITMF recommended SCT thermodetector. A bale-by-bale classification of fiber on the basis of its stickiness is now therefore possible.

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Figure 1. Imperfections counted with the Uster regulator equipped with the visualising device.

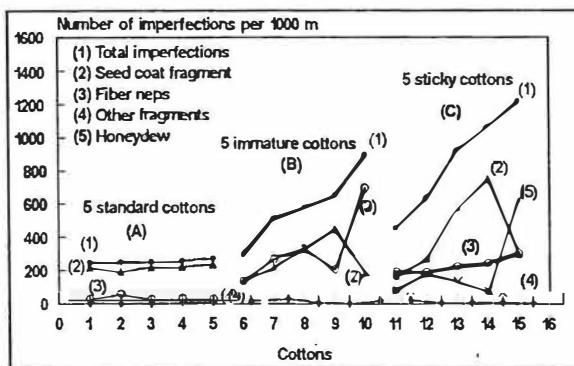


Figure 2. Yarn to web SCF count relation - Ring spun 20 tex yarn.

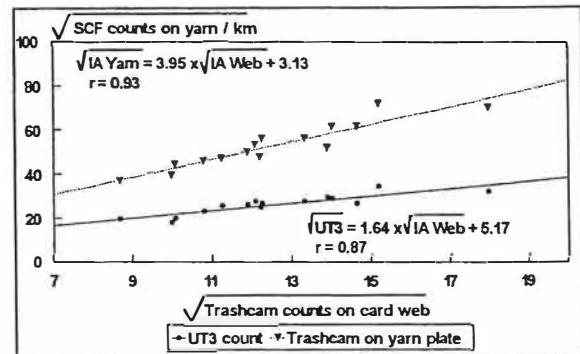


Figure 3. Yarn to web SCF count relation - Open end 20 tex yarn.

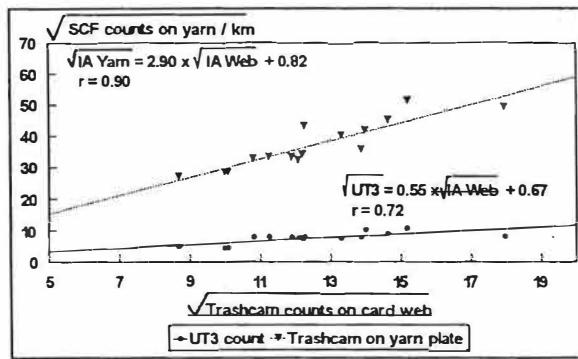


Figure 4. Trashcam on yarn plate vs visual count on yarn plate ring spun 20 tex yarn.

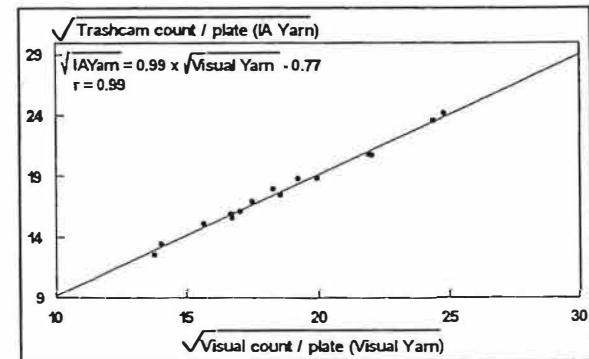


Figure 5. Trashcam on yarn plate vs visual count on yarn plate; Open end spun 20 tex yarn.

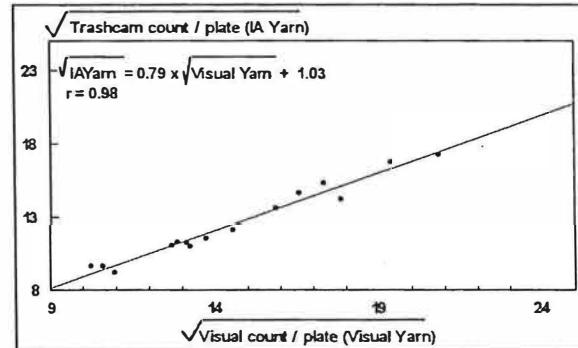


Figure 7. Trashcam on yarn plate vs UT3 count open end spun 20 tex yarn.

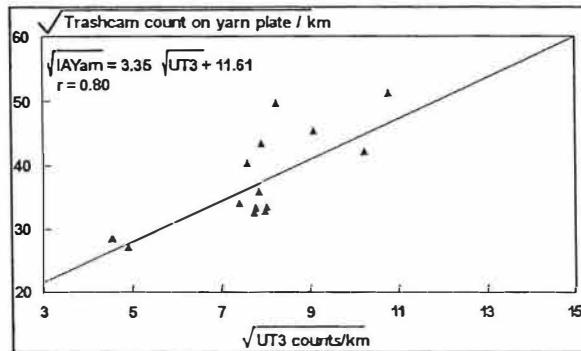


Figure 6. Trashcam on yarn plate vs UT3 count ring spun 20 tex yarn.

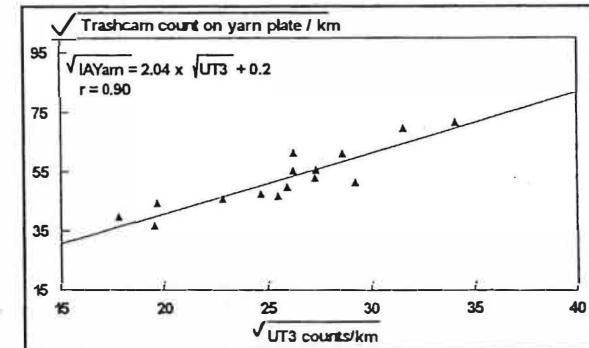
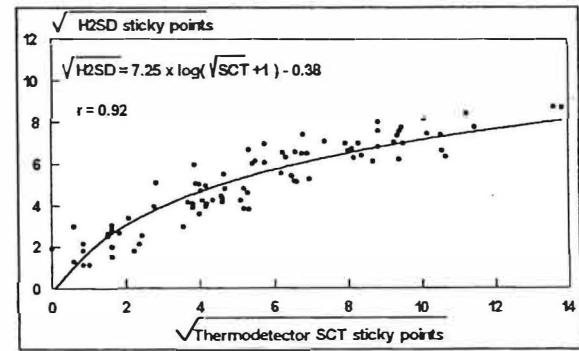


Figure 8. Thermodetector SCT vs H2SD on 87 cottons from different countries (3 repetitions).



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METHODOLOGIE FOR THE USE OF THE IRCT-RF13
THERMODETECTOR.

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The stickiness of a cotton can be determined with a thermodector. A 2.5-gram sample is prepared in layer form, placed between two sheets of aluminium foil and pressed and heated for a few seconds. Cold pressing is then applied for two minutes. The sticky points on both sheets of foil are then counted immediately or several minutes later as was done in the trials described here.

Three replications were recommended with the current thermodector method, whatever the degree of stickiness. This takes about 12 minutes, including counting. It would be advantageous to shorten this time by simplifying the procedure currently recommended according to the purpose of the results (industry or research).

Thermodector tests were carried out on eight cottons selected according to stickiness potential. Twenty replications were carried out for each sample. Figure 1 and 2 show the evolution of average stickiness. The first point on the curves in each figure shows the number of sticky points with one replication, the second is for the average number of sticky points with two replications, etc. It is seen that the average stabilizes very early on. The result for two replications is very similar to that for twenty replications.

FIG 1:STICKINESS VS NUMBER OF REPLICATIONS
Count of sticky points on lower and upper sheet

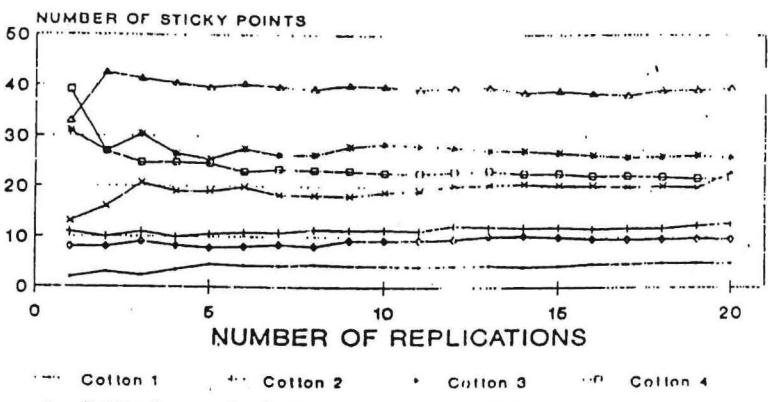
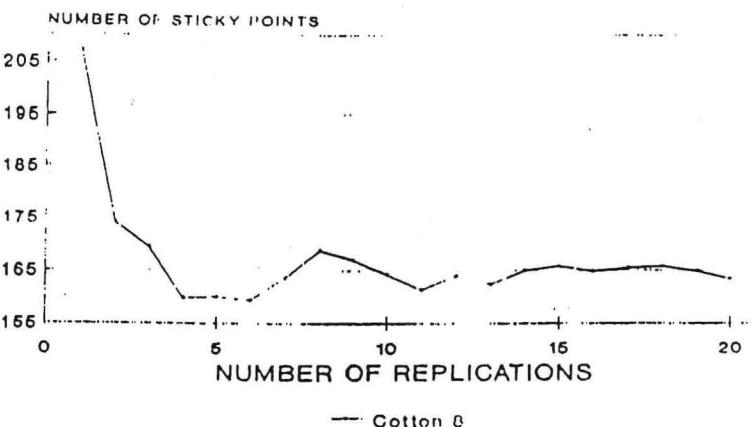


FIG 2:STICKINESS VS NUMBER OF REPLICATIONS
Count of sticky points on lower and upper sheet



To confirm the results, 75 cottons representing the entire range of stickiness (0 to 140 sticky points) were tested and classified in ascending order of stickiness. Figure 3 shows the plots for 1, 2 and 3 replications. The curves are so close that they seem to coincide for non-sticky to medium sticky cottons. Deviations only become noteworthy for very sticky cottons. Two replications are enough for commercial grading in most cases.

The following correlation matrix was obtained:

	B1	B2	B3	H1	H2	H3	BH1	BH2	BH3
B1	1.00	0.97	0.96						
B2		1.00	0.99						
B3			1.00						
H1				1.00	0.95	0.93			
H2					1.00	0.99			
H3						1.00			
BH1							1.00	0.97	0.96
BH2								1.00	0.99
BH3									1.00

Codes:

B, number of sticky points on lower sheet with 1, 2 or 3 replications.

H, " " " upper " " "

BH, total sticky points (B+H)

There is excellent correlation of the results of tests with two or three replications. It is thus not necessary to perform more than two replications.

For further simplification, it can be noted that there are always more sticky points on the lower sheet because of the temperature difference between top and bottom. Average figures were 25.09 points (73%) on the lower sheet and 9.34 on the upper sheet. Is it necessary to count the points on both sheets? Figures 4 and 5 show for the eight cottons mentioned above the evolution of the average number of sticky points on the lower sheet alone according to the number of replications. The curves are similar to those in Figures 1 and 2 showing the same evolution for top plus bottom. This would tend to show that a sticky count on the bottom sheet would be sufficient.

FIG 3: COMPARISON 1, 2 OR 3 REPLICATIONS.
Count of sticky points on
lower and upper sheet

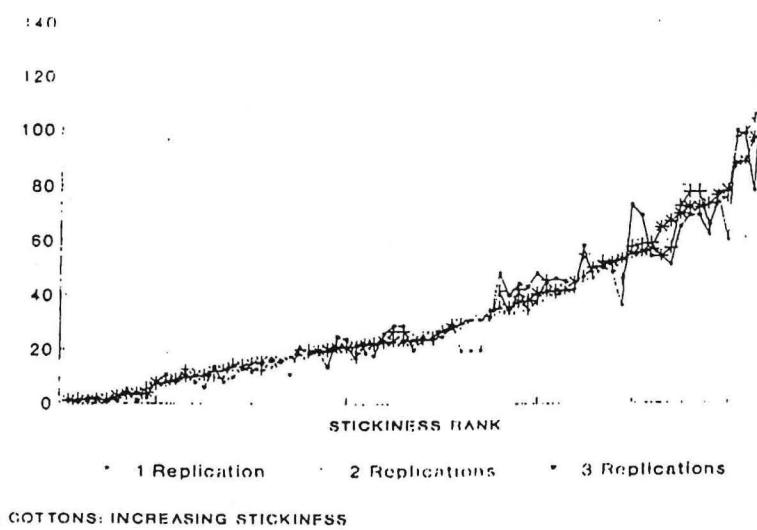
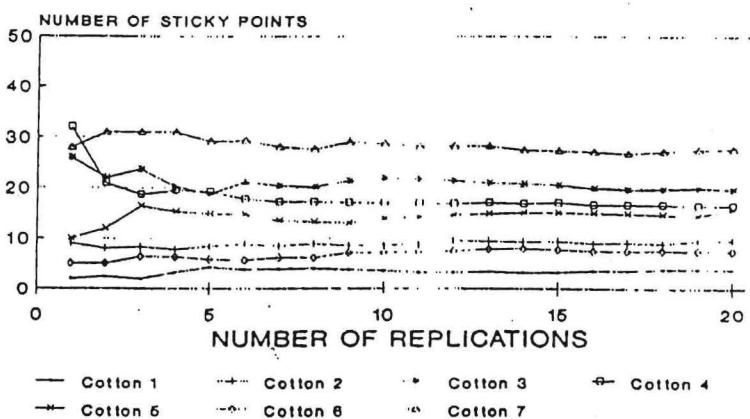


FIG 4: STICKINESS VS NUMBER OF REPLICATIONS
Count of sticky points on
lower sheet



This hypothesis was tested on 75 cottons. Correlation analysis revealed excellent correspondence between the result of a point count on the lower sheet alone and total points on top and bottom sheets.

	B+H	B	H
B+H	1.000	0.984	0.915
B		1.000	0.829
H			1.000

B+H, total sticky points on upper and lower sheets

B, number of sticky points on lower sheet

H, number of sticky points on upper sheet

The linear regression equation is:

$$B = 0.7112 * (B+H) + 0.6045 \quad R^2 = 0.9689$$

It is therefore perfectly possible to count only the points on the lower sheet and still obtain accurate information on the degree of stickiness.

The new class intervals are as follows:

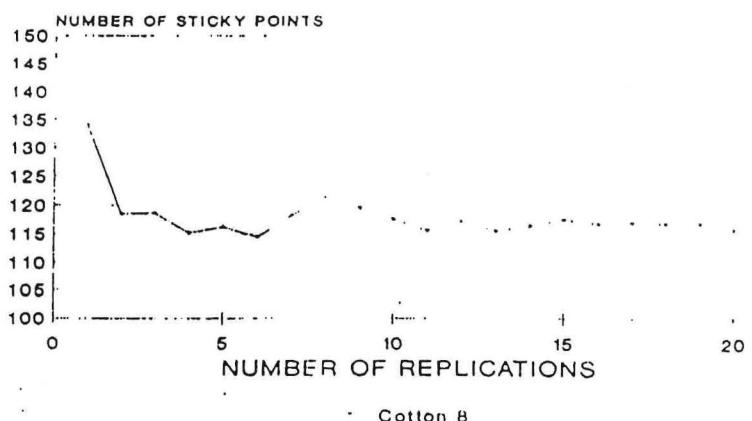
Number of sticky points

	B+H	B	
Class 1:	0 to 2	0 to 2	non sticky cotton
Class 2:	3 to 16	3 to 12	slightly sticky
Class 3:	17 to 32	13 to 23	medium sticky
Class 4:	33 to 53	24 to 38	very sticky
Class 5:	over 54	over 39	extremely sticky

In addition, as stickiness is expressed as a quantity, the results can be used in much more varied and powerful statistical analyses than that giving the grade of stickiness using the laboratory minicard.

Such statistical analysis are generally necessary in research to show a difference between two treatments, for example in the testing of the effect of a new aphicide on stickiness. Statistical analysis of the number of sticky points on the lower sheet shows that distribution is not normal. This can be seen by examining the deviations from the mean of the elementary results

FIG 5:STICKINESS VS NUMBER OF REPLICATIONS
Count of sticky points on lower sheet



of each sample. Calculation of Pearson's coefficient gives: skewness $\beta_1 = 0.20$, Kurtosis $\beta_2 = 7.14$. These values are both highly improbable with normal distribution (ideal values are: $\beta_1 = 0$, $\beta_2 = 3$).

In addition, it is easily shown that the variance of the results is an increasing function of stickiness (cf. Fig. 3). Transformation of variables is thus required before statistical analysis of stickiness. Choice of transformation can be oriented by plotting a dispersion diagram of means and variances. When the logs of the means are plotted on the x-coordinate and the logs of the variances on the y-coordinate, if the point scatter lies parallel with the bisectrix of the diagram, the relation between means and variances is of the following type:

$$\text{Log}\sigma^2 = \text{Log}a + \text{Log}m$$

$$\text{hence } \sigma^2 = a \cdot m$$

Square root transformation should be used when variance and mean are proportional. The model used for the 75 cottons studied is slightly different to that used above since some variances values are 0.

$$\text{Log}(\sigma^2+1) = \text{Log}a + B \cdot \text{Log}(m+1)$$

Applied to 75 cottons, this method gave a regression coefficient B of between 0.823 and 1.345, and hence a slope not different to 1. The intercept was between -0.279 and +0.067 and hence not different to zero. The mean was thus not different to the variance and distribution was close to a Poisson distribution. Variance was stabilized when the square root transformation was applied to the raw data.

In short, it is possible to simplify the methodology for use of the thermodection without great loss of accuracy by performing two replications instead of three and using only the sticky points on the lower sheet of foil. A test takes 8 minutes when this procedure is used.

Any use of the thermodection for statistical purposes requires prior transformation of the data to stabilize the variance. Square root transformation can be used for this purpose.

SOME EXAMPLES FOR THE USE
OF THE STICKY COTTON THERMODETECTOR
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Technologists, "Biometricien IRCT/CIRAD
International Center for Agronomic Research and
Development, Montpellier, France

Abstract

As regards the thermodetector, the relative humidity of the air has a considerable impact on the results obtained. We have demonstrated that the storage of cottons has no effect on entomological-related stickiness measured using the thermodetector. In addition, a study on the number of neps on 20 tex ring spun yarn showed that there was a strong relation between the number of sticky points on the thermodetector and the number of fiber neps.

Introduction

The problem of sticky cotton has been worsening over the last few years. Simple chemical tests are not sufficient to measure the sticky potential of a cotton. The minicard test is reliable for problems that occur in spinning, but it is both slow and costly; whereas thermodetection is just as reliable and more rapid.

Materials and methods

The stickiness potential of a cotton can be determined with a thermodetector. A 2.5 grams sample is prepared in layer form, placed between two sheets of aluminium foil and pressed and heated for 12 seconds at 80 degrees centigrade. Cold pressing is then applied for 2 minutes. The sticky points on both sheets of foil are then counted one hour later. Three replications were recommended with the current thermodetector method, whatever the degree of stickiness. This takes about 12 minutes, including counting (1). The table 1 gives the stickiness potential according to the number of sticky points.

Results and Discussion

Distribution of the number of sticky points with the thermodetector

As stickiness is expressed as a quantity, the results can be used in much more varied and powerful statistical analysis than that giving the grade of stickiness using the laboratory minicard. A study involving 75 cottons with a wide range of stickiness has shown that the distribution of the number of sticky points is not normal. It is easily shown that the variance of the results is an increasing function of stickiness (figure 1). The mean of the number of sticky points was not different to the variance, the distribution should be close to a Poisson distribution. Thus, any use of the thermodetector for statistical purposes requires prior transformation of the data to stabilize the variance. Square root transformation can be used for this purpose.

The influence of relative humidity on thermodetector results.

This study was carried out on eleven cottons of different geographical origins representing a wide range of stickiness. Each cotton was tested on the IRCT-RF13 thermodetector under 5 hygrometric conditions (35% - 45% - 55% - 65% - 75% RH) at 22°C. All measurements were carried out according to a factorial statistical design using three replications.

Figure 2 shows that the number of sticky points fluctuates according to the relative humidity of the air in the room. In the 55% to 65% zone, the results appear to be stable and this is confirmed by statistical analysis (table 2). Outside this range of relative humidity the number of sticky points decreases.

A supplementary study was performed to verify the stability of the results in the 55% - 65% range; it indicated that there were no significant differences between 55%, 60% and 65% RH (Figure 3 and table 3).

The thermodetector must therefore be used under hygrometric conditions of between 55% and 65%.

The influence of storage on sticky potential

Certain spinners store their cotton in the hope that the sticky potential will decrease. Is this worthwhile? In April 1988, tests to determine stickiness were performed on a range of cottons that were more or less sticky (from 0 to 150 sticky points). Two and a half years later, in October 1990, the same cottons were again tested under similar conditions. Two types of storage were used: stable conditions (58% RH, 21°C) or fluctuating conditions (RH = 30% to 70% - t = 18°C to 30°C).

Under stable conditions of storage (Figure 4) there was no significant difference (table 4) between the number of sticky points measured in 1988 (storage 0) and in 1990 (storage 0 + 2 and a half years), and this whatever the sticky potential of the cotton (no interaction cotton x storage). The coefficient of correlation as determined through regression analysis was 0.98.

The same results were obtained under variable conditions of storage (Figure 5 and table 5): there was no significant difference in the number of points recorded before and after storage, nor any interaction with the cotton employed. Under these conditions the coefficient of correlation was 0.95.

It would therefore seem that storage has no influence on cottons that are contaminated with insect honey dew.

Although these tests were carried out on samples of raw unpressed cotton, it would seem reasonable to assume that the time spent in storage does not have any effect on cotton stored as bales.

The influence of stickiness on the quality of yarn

Thirty cottons of 6 varieties grown in 5 regions of the same country were spun using ring spinning to produce 20 tex yarn. A detailed analysis was carried out on each cotton and the results are given in figure 6. The following points can be made:

As regards the number of neps, we noted considerable differences between the varieties for four of the regions, which correspond to varietal differences. By contrast, in the fifth region we noted a marked increase in total neps and in fiber neps, whereas seed coat fragments remained constant.

What is the cause of this increase in fiber neps, a characteristic that is relatively constant in IRCT varieties?

An analysis of the stickiness potential of cotton using a IRCT-RF13 thermodetector showed that each cotton from this region presented a high degree of stickiness. This stickiness led to disruption during carding, drawing and spinning, and resulted in the production of a more irregular yarn and thus an increase in total fiber neps.

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Table 1: Stickiness potential level

Level	Number of sticky points	Stickiness potential
A	0 - 2	no sticky
B	3 - 16	light
C	17 - 32	medium
D	33 - 53	heavy
E	> 54	very heavy

Table 2: Effect of relative humidity on the number of sticky points with thermodetector.

Relative Humidity	Number of sticky points square root transformation
35%	4.17 c
45%	5.34 b
55%	6.51 a
65%	6.63 a
75%	4.23 c

CV% = 13.6%

F = ***

Means with the same letter are not statistically different according to the Newman-Keuls test 5% level

Table 3: Effect of relative humidity on the number of sticky points with thermodetector.

Relative Humidity	Number of sticky points square root transformation
55%	3.95
60%	3.97
65%	3.96

CV% = 3.9%

F = NS

Table 4: Effect of storage on the number of sticky points with thermodetector. Constant conditions

Storage	Number of sticky points square root transformation
No	4.09
2.5 years	4.21

CV% = 13.9%

F = NS

Table 5: Effect of storage on the number of sticky points with thermodetector. Variable conditions

Storage	Number of sticky points square root transformation
No	5.39
2.5 years	5.45

CV% = 13.9%

F = NS

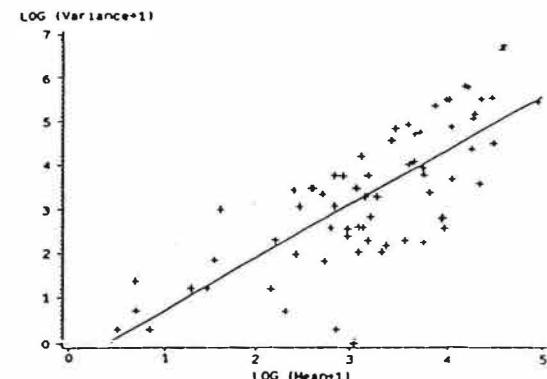


Figure 1. Number of sticky points : variance versus mean for 75 cottons, 3 replicates/cotton
 $\log(\text{Variance}+1) = 1.23 \log(\text{Mean}+1) - 0.53$
Log(Mean+1)

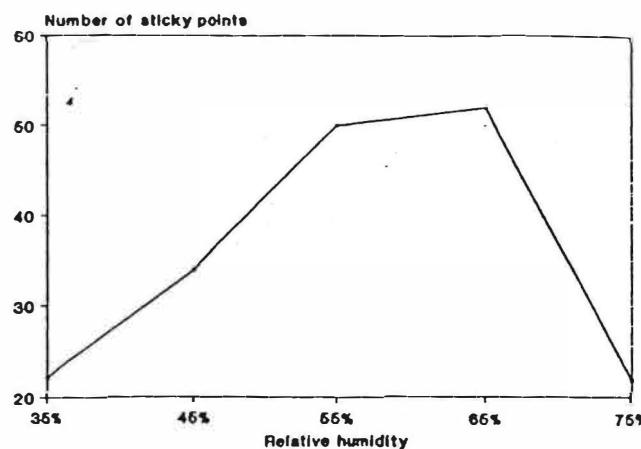


Figure 2: Influence of relative humidity on thermodetector results

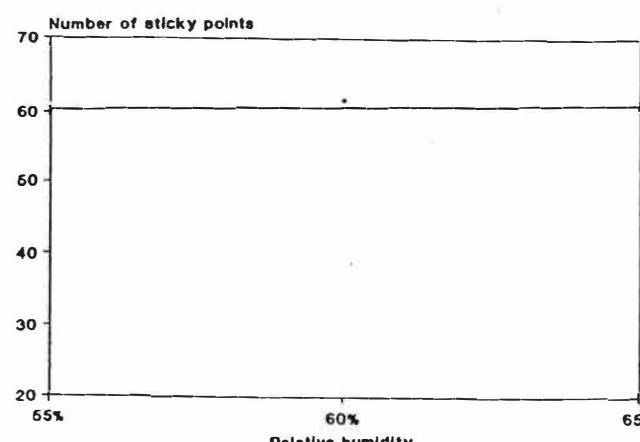


Figure 3: Influence of relative humidity on thermodetector results

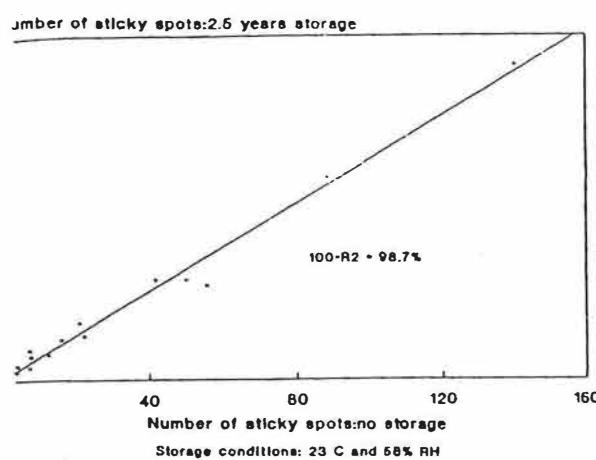


Figure 4: Storage influence on stickiness

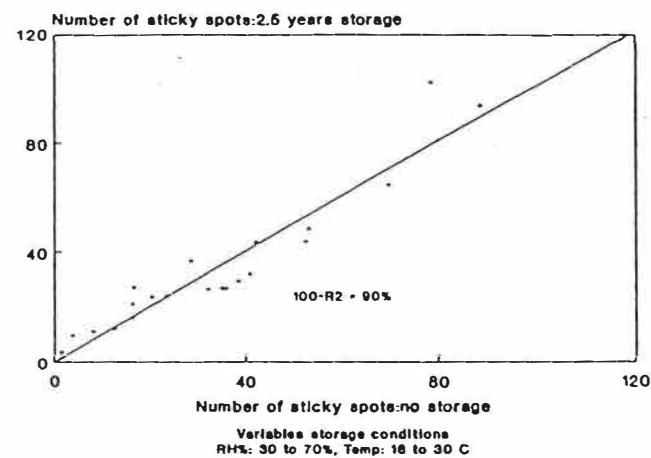


Figure 5: Storage influence on stickiness

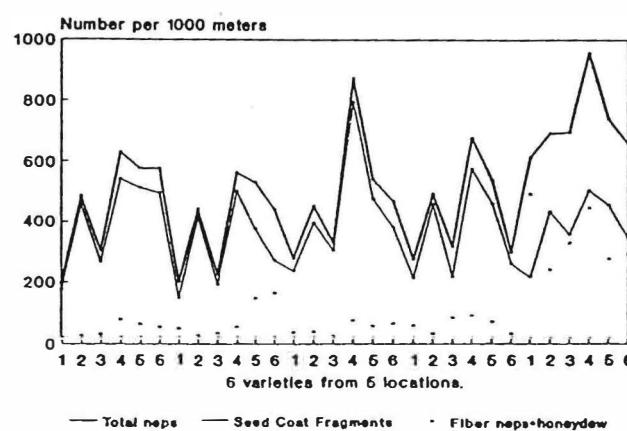


Figure 6: Effect of stickiness on yarn neps content
(Uster)

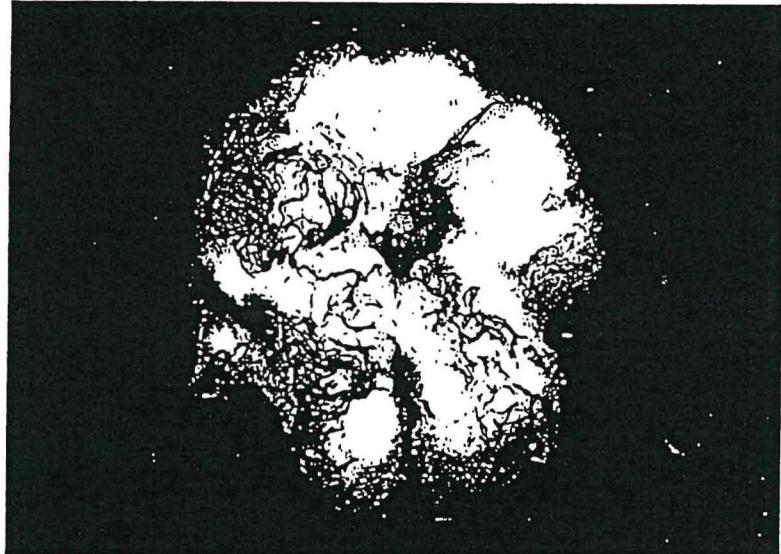




Montpellier, March 1992

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STICKY COTTON
FROM PLANT TO YARN



For presentation to:

ITMF

International Committee on Cotton Testing Methods
Working group on honeydew
21th International Cotton Conference Bremen
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Photographs taken at the technology laboratory of the I.R.C.T./CIRAD by T. ERWIN and R. FRYDRYCH.
Photographs n° 4,5,6,7 and 10 were taken by the Entomological Division at the I.R.C.T./C.I.R.A.D.

STICKY COTTON FROM PLANT TO YARN

PRESENTATION

The I.T.M.F. report "Cotton Contamination Survey 1991" involving the participation of 201 companies based in 22 different countries, alerted the industry to the fact that 27 % of cases presented problems of stickiness compared with 21 % in 1989.

These figures indicate a marked deterioration in the situation in only 2 years. There is a considerable increase in stickiness except in Europe. The Sudan remains the country most affected, but the North American zone with 31,7 % positive cases, is now at the same level as Africa (without the Sudan) i.e. 32,7 % positive cases (see figure 1). It should, however, be noted that this survey only determined the presence or absence of stickiness, rather than its intensity. Its conclusions should therefore be considered with care as cottons that are only slightly sticky do not systematically lead to problems during the spinning process.

In Europe, 17,3 % of cases were positive whereas the figure was 15,7 % in 1989, in Asia 21 % versus 13,3 %, and in South America 10,8 % versus 3,81 %. Stickiness is therefore an ever increasing, worldwide problem.

Many research projects have been initiated to examine cotton stickiness in spinning in order to better understand the phenomenon, detect stickiness and eliminate its cause.

The problem is very complex because the stickiness of cottons from different geographical origins may be due to a variety of factors, the effects of which are detailed in the specialized literature :

- various contaminants such as seed coat fragments, insecticide, oil, etc... (figures 2 and 3),
- physiological sugars,
- entomological sugars.

The latter are excreted by two homopters : the aphid *Aphis gossypii* and the aleurode *Bemisia tabaci*. These excretions (usually called honeydew) can be found throughout the different stages involved in the transformation of cotton fibers, i.e. from the plant to the yarn.

HONEYDEW ON THE PLANT

Aphids (figure 4) and aleurodes (figure 5) on the plant are essentially found underneath leaves and on leaf stalks. They excrete honeydew onto the leaves (figure 6) and onto the fibers of open bolls (figure 7). If climatic conditions are favorable, fungi start to develop on the honeydew to form fumagin (figure 8) which can also be found on non-sticky fibers, i.e. in the absence of honeydew (figure 9). If the quantity of sugary deposit on the leaves is substantial, droplets form at the leaf tips before falling onto the fibers (figure 10). These droplets, plus the honeydew directly excreted onto the fibres, combine to produce very high concentrations (figure 11 and 12). The ginning process disperses the honey dew droplets along the fiber (figure 13) and by reducing their size renders them difficult to detect with the naked eye.

HONEYDEW DETECTION ON THE FIBER

Several methods are employed to detect sticky cottons :

- simple, qualitative chemical tests (FEHLING-MASSAT, PERKINS etc.) assess reducing sugars,
- more complex chemical tests (thin layer chromatography, gas chromatography, etc.) are used to measure reducing and non-reducing sugars,
- the mechanical test involving the laboratory minicard is recognized by the I.T.M.F. as an international reference ; this test furnishes qualitative results ; the equipment is no longer in production,
- thermodetection using a thermodectioner furnishes quantitative results ; this test is increasingly used by both the industry and laboratories as shown by the numerous machines currently in use worldwide (more than 53 machines in 1992, figure 14).

At the I.R.C.T. these different tests are used specifically for different studies. Complex chemical tests are employed to identify and quantify the different sugars present in honeydew and the minicard used to analyze all types of stickiness (honeydew, crushed kernels, leaves). As the principal source of stickiness in spinning is currently due to cotton contamination by insect-derived honeydew, research workers at the I.R.C.T., technologists and entomologists have been using thermodetection for several years, even at production sites, in the application of ongoing research programs and for the large scale detection of contaminated cottons.

The study of cotton stickiness using the thermodection has revealed the presence of different types of honeydew within the fiber that can be visualized after analysis by the thermodection :

- very small size honeydew, figure 15
- honeydew group, figure 16,
- large honeydew, figure 17,
- small honeydew with sumagin, figure 18,
- large honeydew with sumagin, figure 19.

All these different forms of honeydew cause various degrees of disruption during spinning ; they induce increased irregularities in sliver and yarn, occasionally lead to yarn breakages, rotor clogging and machine shut downs.

Studies have been conducted in the technology laboratory to demonstrate the impact of cotton stickiness on yarn nepicity. Whereas USTER regularimeter determine the overall number of neps, a detailed analysis of the yarn has now been developed using the USTER GGP, IPI regulator to identify imperfections and classify them into various fragments (stem fragments), seed coat fragments, fiber neps, honeydew, figures 20, 21, 22, 23 (R. FRYDRYCH et J. GUITKNECHT, 1989, Cot. fib. trop.).

Results showed the influence of honeydew on the number of neps. Thirty cottons from 6 varieties grown in 5 regions of the same country were spun using ring spinning to produce 20 tex yarn. A detailed analysis of yarn imperfections (figure 24) showed that, for 4 of the sites, the number of seed coat fragments was very close to the total number of Uster neps. In this case, the number of fiber neps remained relatively constant. The number of total Uster neps at the fifth site was elevated and related to a very high number of fiber neps. A thermodection test showed that these cottons had a very high stickiness potential.

This example let us to perform detailed regulator and thermodection analyses on 70 cottons spun to produce 20 tex yarn. The range of cottons studied was from 140 to 1074 Uster neps and from 3 to 116 sticky points on the thermodection. Figure 25 illustrates the strong relationship between the number of sticky points and Uster neps. An examination of figure 25 shows that it is of no practical use to take account of stickiness potential in cottons that are only slightly sticky, as they do not lead to any measurable disruption of the spinning process. As regards very sticky cottons (more than 32 sticky points), the impact on the number of fiber neps is very clear.

A detailed analysis of the yarn showed that neps produced by stickiness are of different types, forms and sizes :

- neps formed by stickiness pulling up the fibers during the ring spinning process (figure 26),
- neps with a small honeydew accumulation (figure 27),
- neps with a large honeydew accumulation (figure 28 and 29).

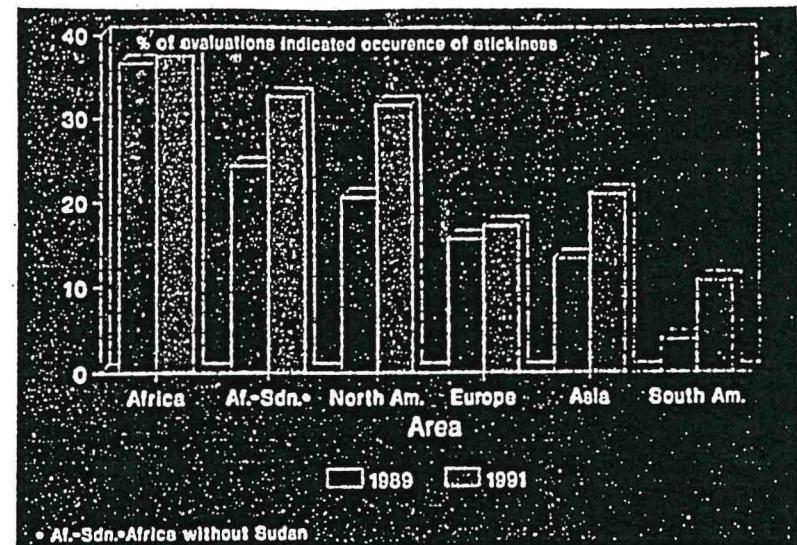


Figure 1: Developpement of stickiness from Cotton Contamination Survey ITMF

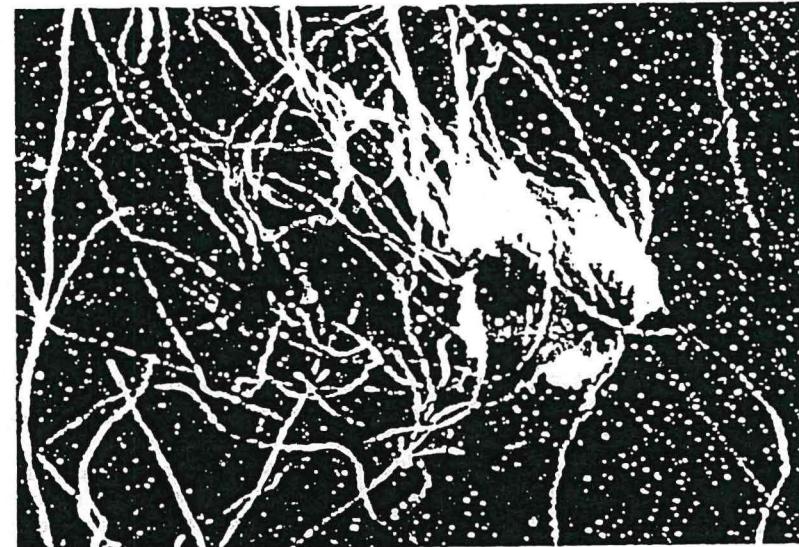


Figure 2: Crush kernel on card rolls
(glanded variety with gossypol)

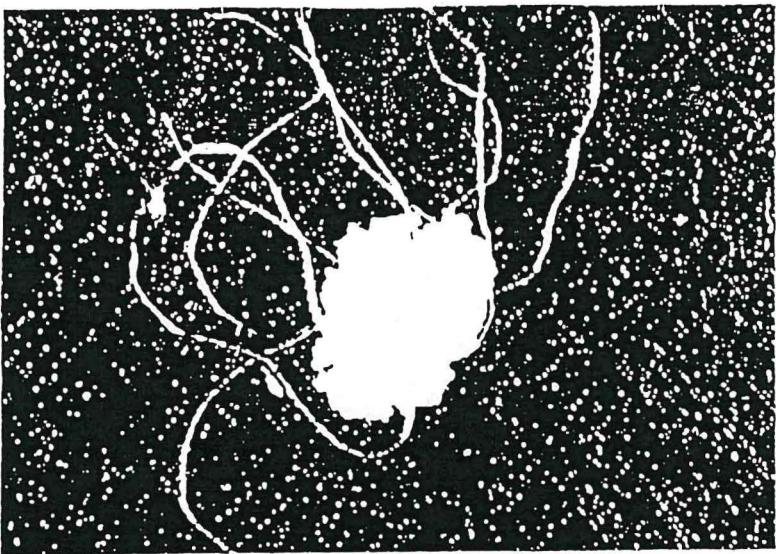


Figure 3: Crush kernel on card rolls
(glandless variety without gossypol)

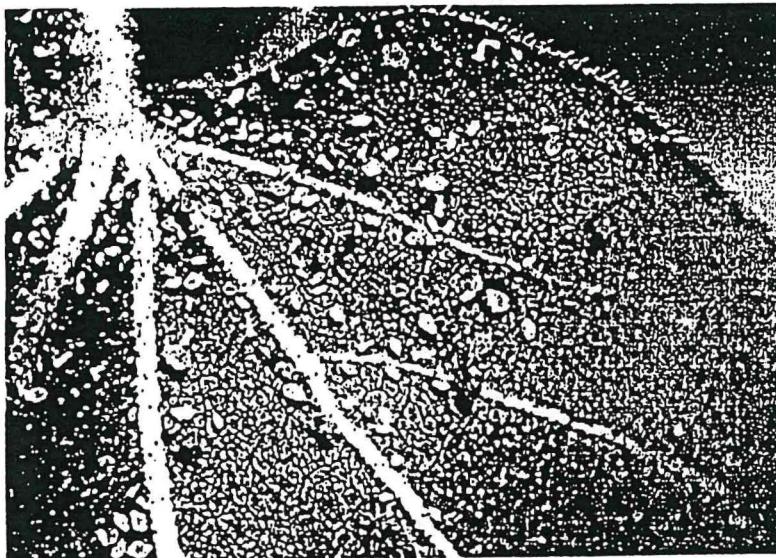


Figure 4: Aphid (*Aphis gossypii*)
on the underside of the leaves

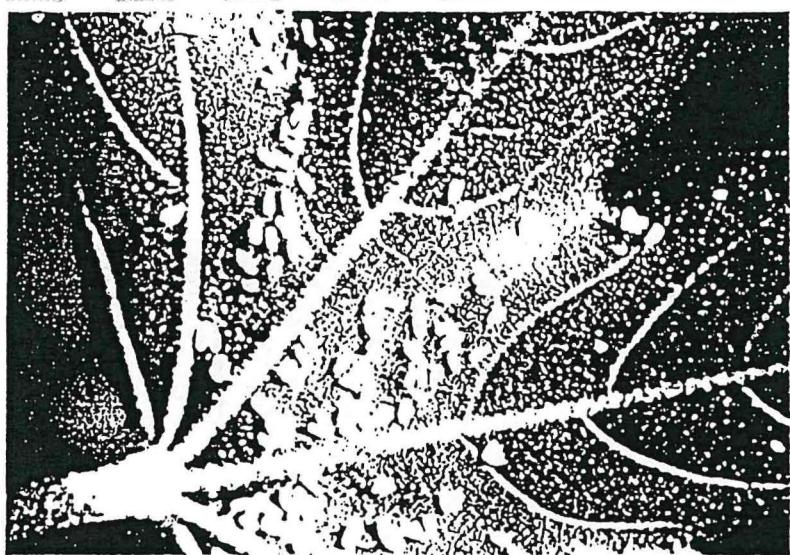


Figure 5: Adult whitefly (*Bemisia tabacii*)
on the underside of the leaves



Figure 6: Deposits of honeydew
on cotton leaves



Figure 7: Drops of honeydew
on cotton bolls



Figure 9: Fumagin on lint without contamination by honeydew



Figure 8: Heavy fumagin on lint contaminated
by honeydew



Figure 10: Drop of honeydew falling off a leaf



Figure 12: Different types of contamination

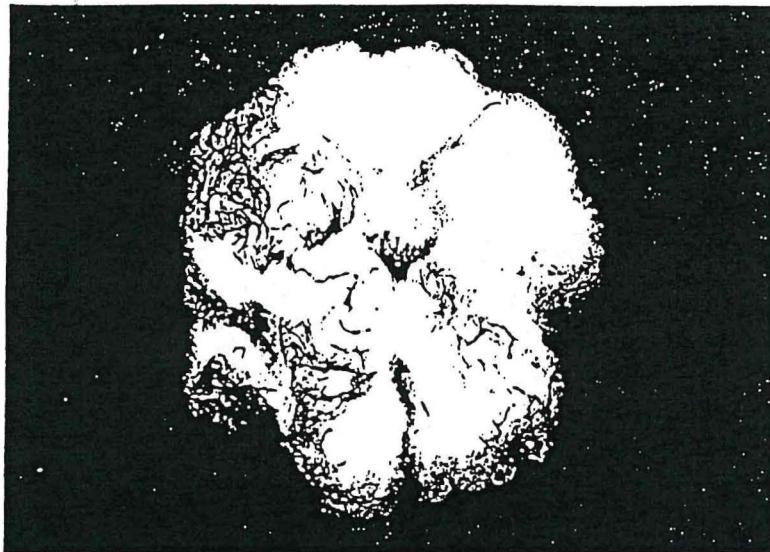


Figure 11: Honeydew on lint:
looks like burnt sugar



Figure 13 : Droplets scatter in the lint

Country	Number of SCT
Italy	11
France	9
Switzerland	8
Germany	3
Portugal	1
United Kingdom	1
Netherland	2
Czechoslovakia	1
Turkey	1
China	1
U.S.A.	1
Madagascar	5
Ivory Coast	1
Chad	2
Mali	2
Togo	2
Cameroon	1
Sénégal	1
Total	53

Figure 14: Sticky Cotton Thermodetector
Worldwide installations

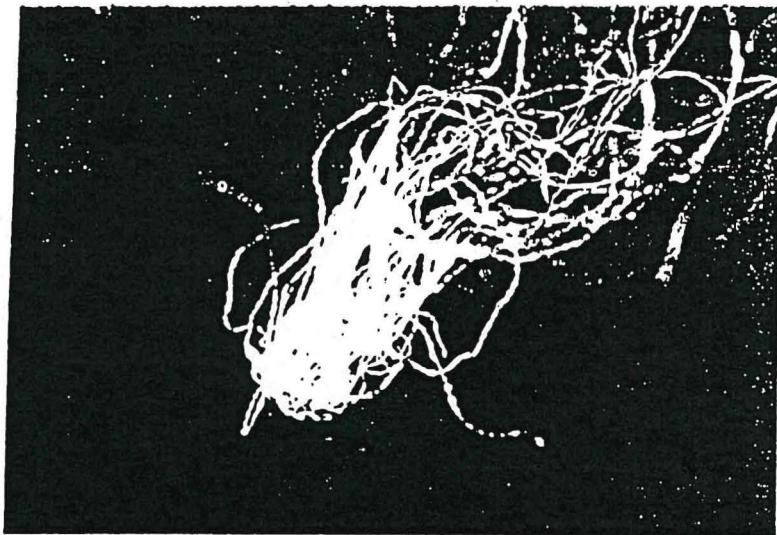


Figure 15: Small sticky spot
with attached fibers

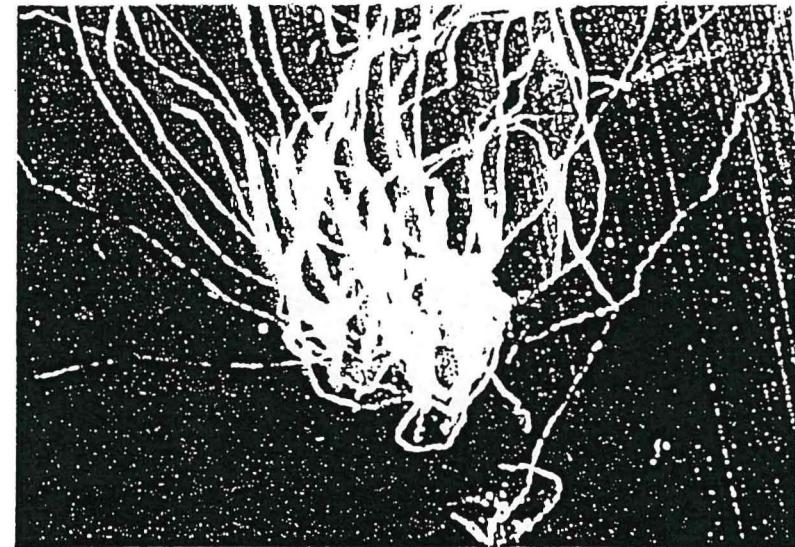


Figure 17: Sticky spot transparent type
with attached fibers

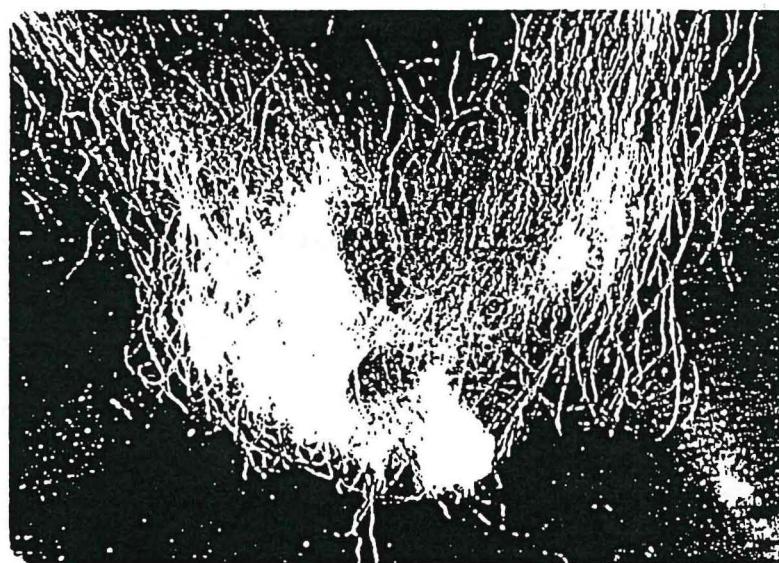


Figure 16: Group of two sticky spots
burnt sugar type with attached fibers

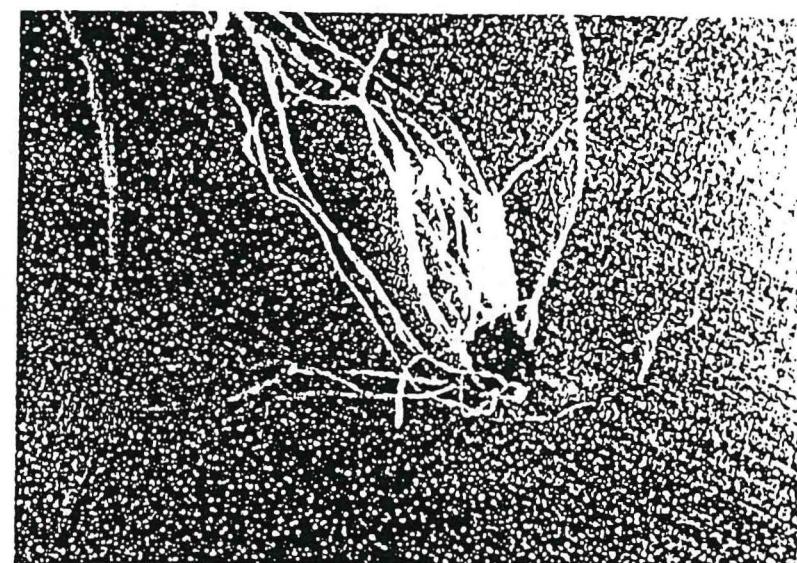


Figure 18: Small sticky spot
contaminated with fumagin

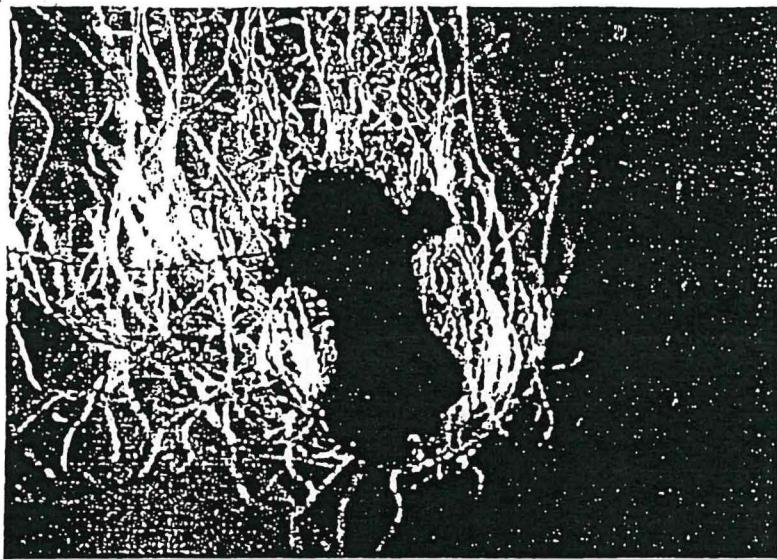


Figure 19: Big sticky spot
contaminated with sumagin

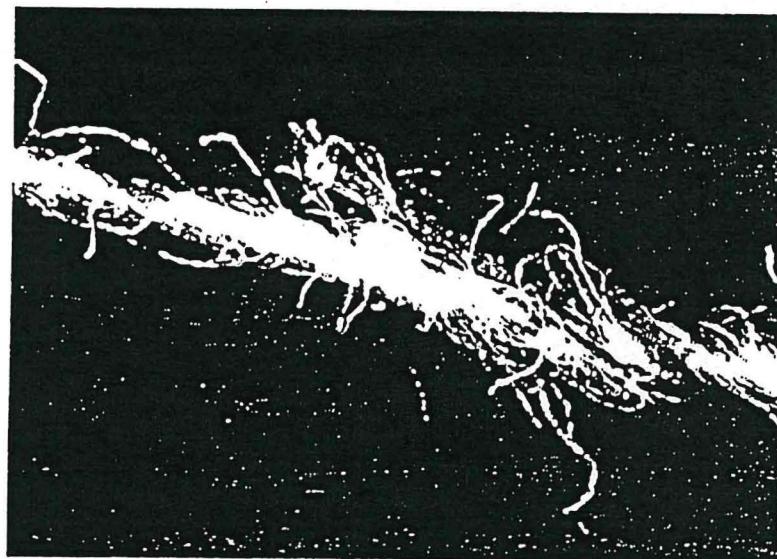


Figure 20: Yarn imperfection:
vegetal fragment

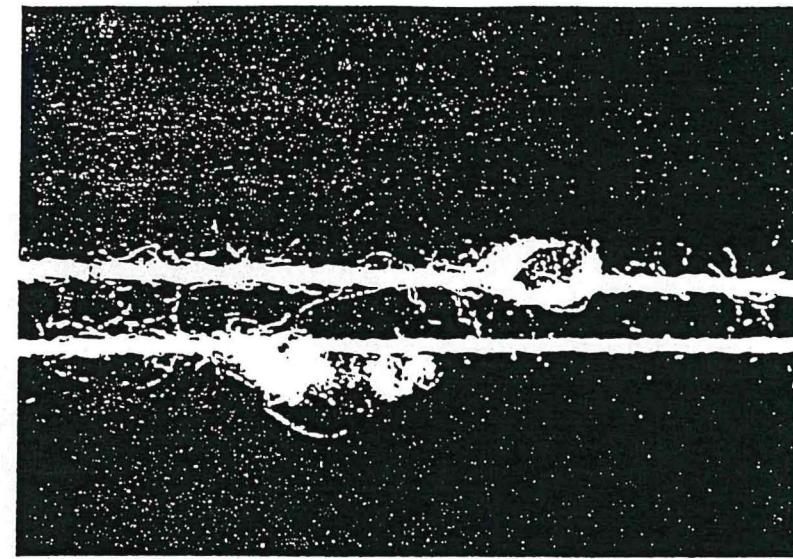


Figure 21: Yarn imperfection:
seed coat fragment

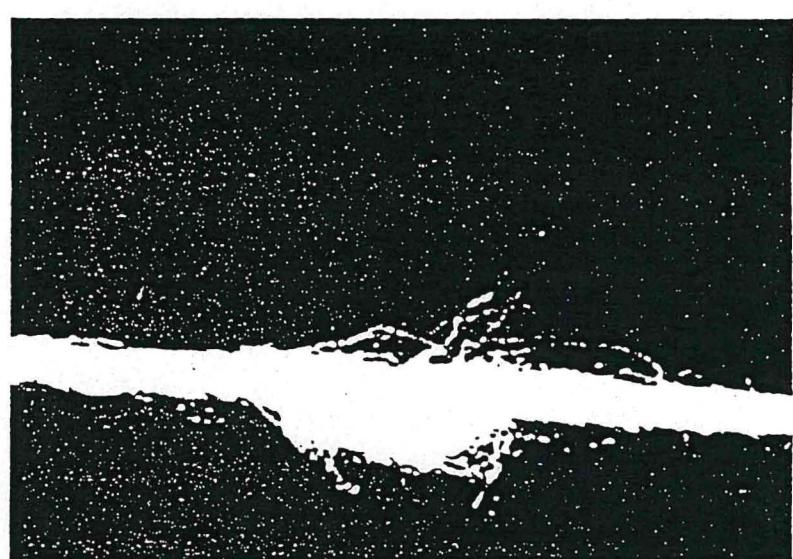


Figure 22: Yarn imperfection:
real fiber neps

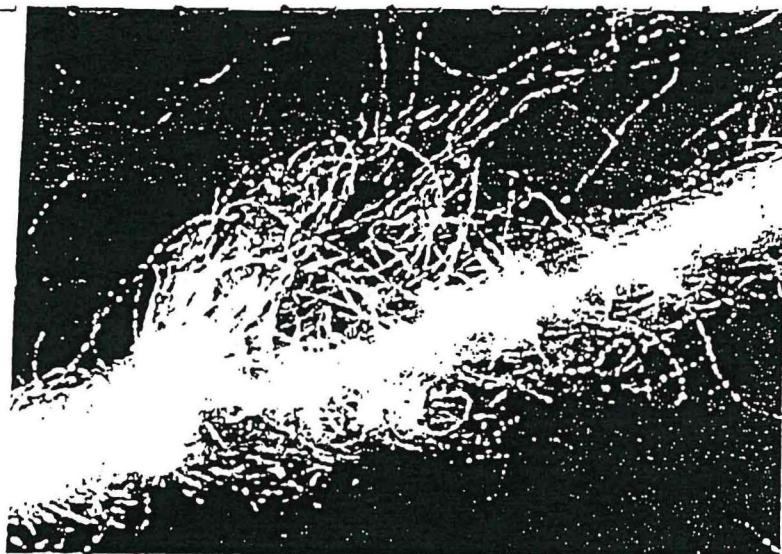


Figure 23: Yarn imperfection:
sticky neps

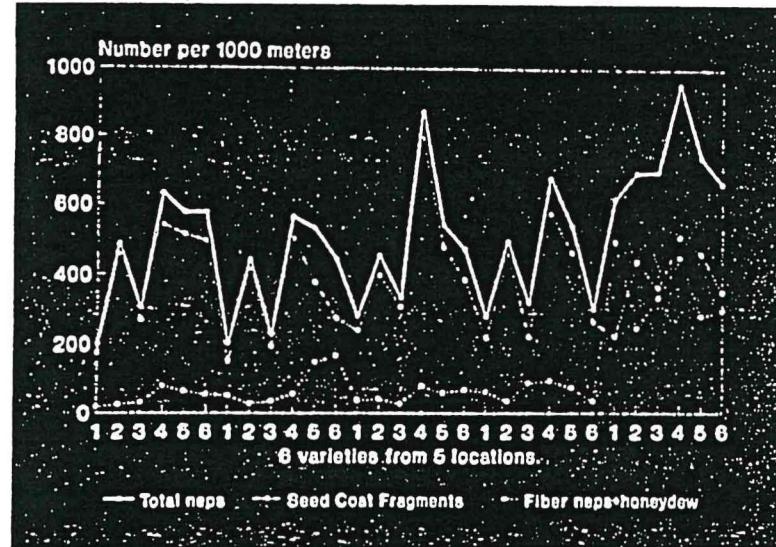


Figure 24: Effect of stickiness
on yarn neps content (USTER)

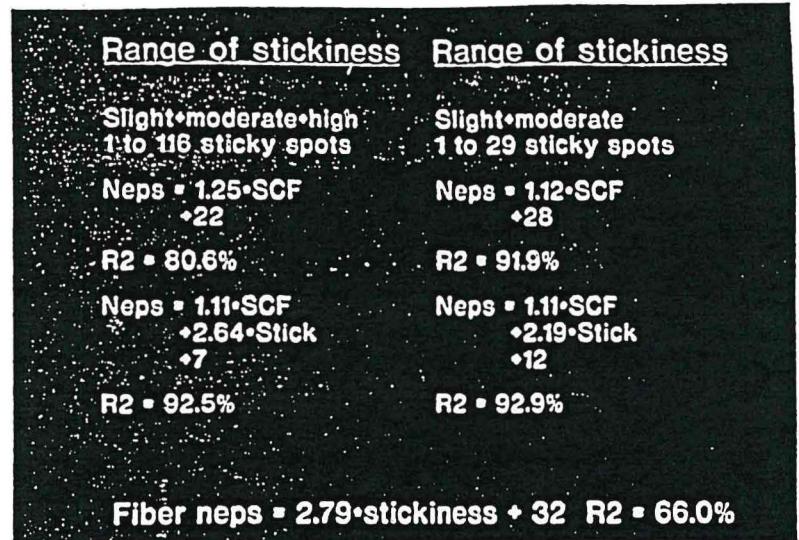


Figure 25 : Effect of stickiness
on yarn neps content

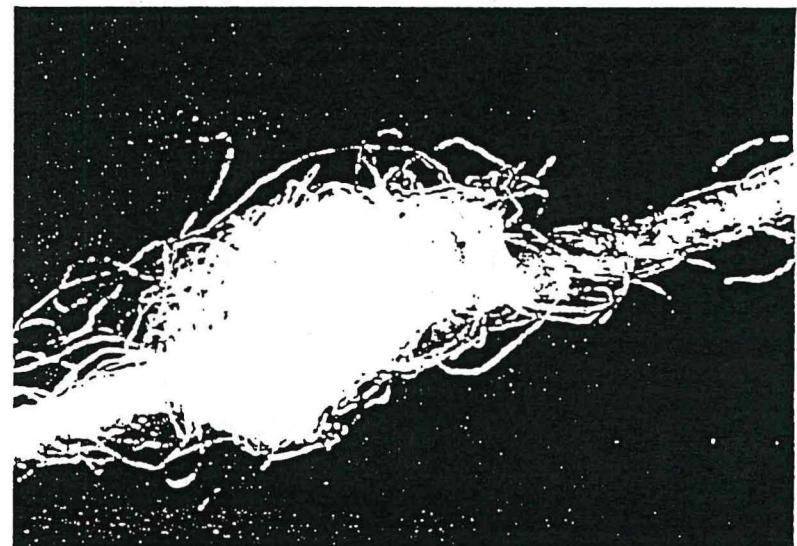


Figure 26 : Yarn neps produced by troubles
during the ring spinning process

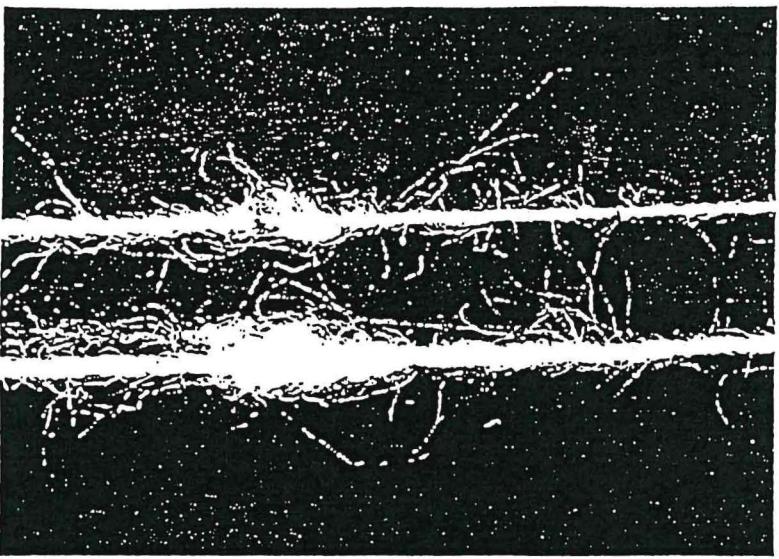


Figure 27: Yarn neps with small sticky spots

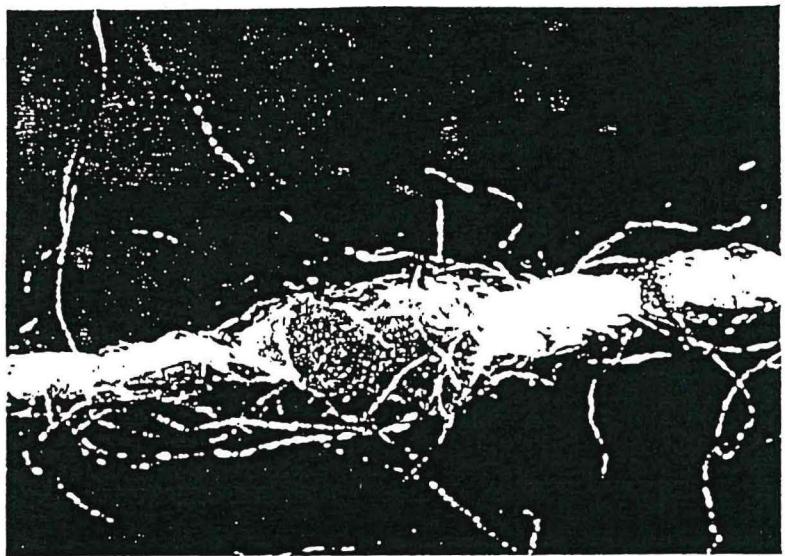


Figure 29: Yarn neps with big cristaline sticky spot



Figure 28: Yarn neps with big sticky spots

RELATIONSHIP BETWEEN SEED COAT FRAGMENT

CONTENT AND YARN STRENGTH DEPENDING

ON THE RANGE OF FIBER QUALITY

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Abstract

The hypothesis that fiber quality and the presence of seed coat fragments are related is put forward to explain the variability noted in yarn strength and was tested by selecting cottons from a population and evaluating their technological characteristics. Two cotton groups could be differentiated (so-called "good" and "poor" qualities) for ring-spun 20 tex yarn. The results obtained show that the higher the quality of the fibers, the more pronounced the negative impact of SCF on yarn structure.

Introduction

The market for textiles, and particularly that for cotton, is becoming increasingly competitive. In this context, the balance between product quality and profitable productivity constitutes an economic imperative. Spinners are aware of the problems caused by contaminants and are increasingly strict as concerns the cleanliness of their raw material. Thus, discounts of varying magnitudes are applied to cotton contaminated by foreign matter (Chen *et al.*, 1991).

The problem posed by cotton contamination has been exacerbated by the technical advances made in the cotton industry. The increasingly widespread use of mechanical methods at every step in cotton processing, particularly during harvesting, has had a negative impact on fiber cleanliness. This has required the introduction of new cotton cleaning steps, leading to higher fiber production costs without entirely solving the problem. In fact, the value of these operations is often limited by the negative effect they may have on the intrinsic properties of the cotton fibers, particularly on length which may be affected by excessively brutal mechanical processing (Gutknecht, 1960; Gutknecht and Roerich, 1963; Newton *et al.*, 1966; Chanselme and Lançon, 1988; Hughs and Bragg, 1991; Anthony, 1998).

Seed-coat fragments (SCF) are among the principal contaminants of cotton fiber, but although they correspond to a major source of yarn imperfections (Krifa *et al.*, 1999; 2000a) few studies have been conducted to investigate the effect of SCF on other yarn quality parameters such as strength.

According to several authors (Ramey *et al.*, 1977; Frydrych, 1992; May and Taylor, 1998), yarn strength is primarily dependent upon the technological properties of the fiber (strength, length, fineness, etc.).

Sawich-Towler and Rogers (Sawich-Towler and Rogers, 1997) compared the dynamometric properties of portions of rotor spun (OE) yarn, some of which contained fiber or SCF neps in the center. They noted that yarn breakages occurred frequently close to the neps and therefore concluded that the presence of such yarn defects contributed to the creation of weak points. However, they noted that this effect did not cause a significant decrease in the specific breakage load.

In the course of previous studies, (Krifa, 1997) conducted on a range of 15 cottons spun using rotor spinning (OE) and ring spinning (RS) for 20 tex yarn, the author noted a very highly significant relationship between yarn

strength and the Trashcam count of coat fragments in the fiber ($R^2: 0.76***$ for RS yarn and $0.78***$ for OE yarn). The Trashcam (Gourlot *et al.*, 1998; Frydrych *et al.*, 1999) is an image analysis tool developed to count and size SCF. The explanation of yarn strength as a function of various fiber characteristics is growing significantly clearer when including a count of the seed coat fragments present in the fiber. Matusiak *et al.* (Matusiak *et al.*, 2000), also observed the same trend in OE yarn (27 tex) in a separate correlation study.

The results of an experimental study conducted led us to put forward the following hypothesis: the effect of SCF on yarn strength is dependent upon the presence or absence of other weak points in the yarn structure which may show lower strength than that of the point associated with the SCF (Krifa *et al.*, 2000b). This effect is therefore dependent upon the general quality of the yarn structure, which itself is partly dependent upon the characteristics of the fiber.

Materials and methods

To support this hypothesis, we analyzed the data produced by 105 spinning tests for 20 tex yarn conducted over the last 3 campaigns and for which all the corresponding data were available, i.e. fiber characteristics, yarn characteristics and Trashcam analyses on yarn plates.

The data used were drawn from the SISTER database (Gourlot *et al.*, 1995) developed by the Cotton Technology Laboratory. Built around a database concept, SISTER allows users to input their information in a routine manner while authorizing general use of the data, e.g. extraction of the results of analyses performed on samples or the determination of analytical conditions and the calibration of measuring equipment.

Results

Table 1 presents the lowest and highest values for the characteristics of the 105 cottons tested.

Figure 1 illustrates the relationship between yarn strength and the SCF content of the 105 cottons.

The relationship between the two variables was seen to be non significant. As already mentioned, the hypothesis states that the higher the quality of the fibers, the more pronounced the impact of SCF on yarn strength. It was noted that the results for these 105 cottons could be divided into two clusters of points representing two different fiber property classes:

- 1- The first cluster (figure 2) corresponded to cottons where the values for one or two quality parameters were lower than the value corresponding to the 10% quantile of this parameter's distribution. The corresponding thresholds obtained for this cluster corresponded to HVI strength < 27.2 g/tex, H > 192 mtex, HS > 220 mtex, ML < 23 mm, UHML < 27.3 mm, UI < 82.2 %.

This cluster was composed of 35 cottons for which no relationship could be found between yarn strength and SCF content. It may therefore be stated that, for these samples of rather poor quality, SCF did not seem to have any effect on yarn strength.

- 2- Figure 3 shows the relationship for cottons with good fiber characteristics (the 70 remaining cottons), i.e. with thresholds corresponding to HVI strength > 27.2 g/tex, H < 192 mtex, HS < 220 mtex, ML > 23 mm, UHML > 27.3 mm, UI > 82.2 %. A very highly significant negative trend was observed here which is expressed for this group of cottons as a significant effect of SCF on yarn strength.

Discussion

The results produced by micro-spinning tests (RS 20 tex) conducted on a broad range of cotton samples were analyzed. When considering all 105 samples, the relationship between SCF content determined by Trashcam and yarn strength was not significant.

By contrast, different trends were observed when two groups were isolated on the basis of the technological properties of their fibers. Here, although the SCF count did not appear to be related to yarn strength in cottons with rather poor fiber quality characteristics, the relationship between SCF and yarn strength was very highly significant for the cottons showing better quality fibers (strength, fineness, length, etc.).

In addition, the various models used to predict yarn strength generally show that strength is increased when fibers are selected for their favorable technological characteristics. This in fact signifies that choosing good quality fibers results in yarn with less weak points.

According to our hypothesis, the presence of SCF in the yarn predisposes to the creation of other weak zones in addition to those due to the intrinsic quality of the fibers. The relationships described in this paper show that weak areas indeed appeared when SCF were present in the yarn. These weak areas are all the more problematic since only a few are present in the yarn, particularly when good quality fiber is used and where yarn of a very regular structure is expected. In this case, the probability of the SCF being the weakest point in the yarn is increased. Thus, the higher the SCF count in yarn spun from good quality fibers, the greater their impact on yarn strength (Krifa et al, 2000b).

Conclusion

These results support the hypothesis that the strength of yarn produced from high quality fiber is dependent upon the presence of seed coat fragments (Krifa et al, 2000b).

This conclusion also supports the theory that the presence of SCF leads to the creation of points that are even weaker than the weakest points naturally occurring in the structure of the yarn. The higher the quality of the fibers used, the greater the impact of the weak points caused by SCF.

The results obtained also demonstrate the importance of choosing a broad range of samples for experimental studies where interactions exist between several factors.

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Table 1. Fiber characteristics of the cottons analyzed: lowest and highest values.

Parameter	Min	Max
Fibers		
HVI strength (g / tex)	24.4	34.1
H (mtex): linear fineness	135	204
HS (mtex): standard fineness	154	245
ML (mm): Mean length	21.5	27.5
UHML (mm) Upper Half ML	25.9	32.2
UI (%): Uniformity Index	81.5	85.9
MR: Maturity Ratio	0.73	0.97
IM: Micronaire Index	3.18	4.71
Yarn		
Strength (cN/tex)	10.81	16.26
Trashcam SCF (SCF/km)	1100	6840
Total neps UT3/km	276	2423
Thick UT3/km	484	2071
Thin UT3/km	67	933

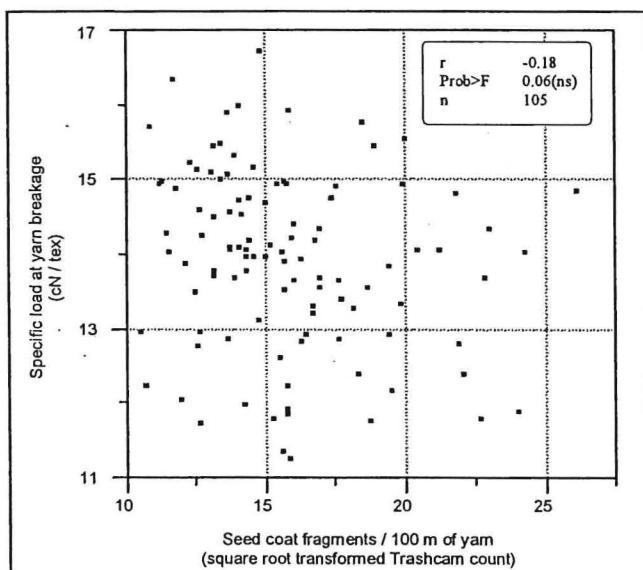


Figure 1. Relationship between yarn strength (RS 20 tex) and Trashcam SCF count (range of 105 cottons).

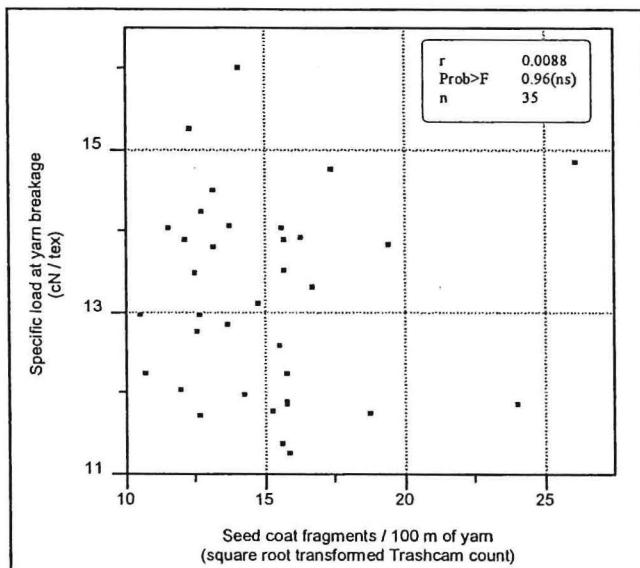


Figure 2. Relationship between yarn strength (RS 20 tex) and Trashcam SCF count (range of 35 "poor quality" cottons).

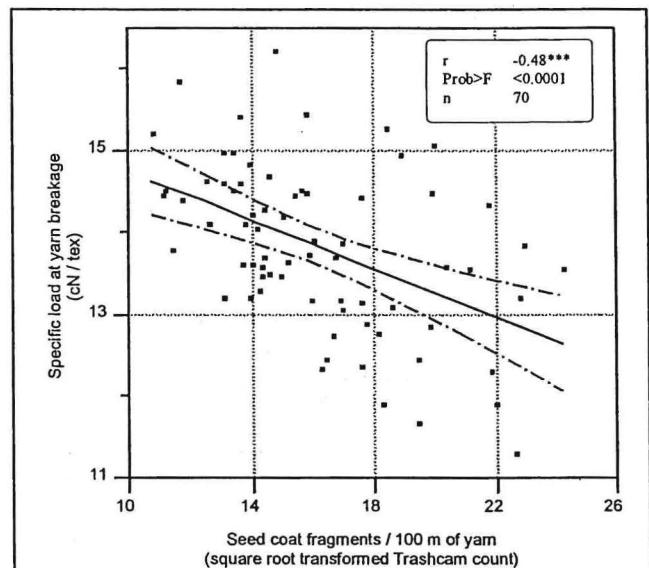
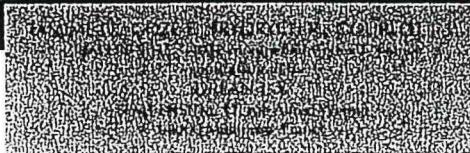


Figure 3. Relationship between yarn strength (RS 20 tex) and Trashcam SCF count (range of 70 "good quality" cottons).

Classement des balles de coton selon leur potentiel de collage mesuré par le High Speed Stickiness Detector (H2SD)



Introduction

Lors de la transformation du coton en fil, on observe de plus en plus souvent que les fibres adhèrent aux organes des machines, provoquant enroulements et encrassements. C'est le collage du coton, dû principalement aux miellats d'insectes qui polluent la fibre (photo 1). Sur le marché du coton, les productions réputées collantes subissent d'importantes décoûts sur le prix de vente. Nous avons étudié la faisabilité d'un classement qualitatif des balles selon leur potentiel de collage mesuré au H2SD (photo 2).



Photo 1. Capsule de coton polluée par le collage.

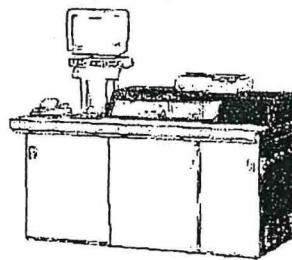


Photo 2. Appareil de mesure du collage H2SD.

Matériel et méthode

Après le nettoyage et l'égrenage, le coton est conditionné en balles compactes de 200 kg. Leur classement requiert des appareils de mesure de grande capacité. Le H2SD, mis au point par le CIRAD, permet une mesure quantitative du potentiel de collage par comptage des points collants révélés par thermodétection — chaleur combinée à la pression exercée sur le coton. Un échantillon est testé toutes les 25 s, pour obtenir le nombre de points collants et la distribution de leur taille. Le classement des balles peut être soit quantitatif — chaque balle est assortie d'un niveau de collage garanti —, soit qualitatif — les balles sont séparées en deux catégories, collante et non collante, par rapport à une limite fixée dite seuil critique de collage. Le classement qualitatif a été choisi pour son faible coût et sa simplicité. Une étude d'échantillonnage a permis de mettre en évidence la distribution intra-balle du nombre de points collants et de déduire le calcul du risque de litige assuré en classement qualitatif des balles.

Le litige survient lorsqu'une balle classée non collante est expertisée collante. Ce risque est le produit des probabilités de ces deux événements si $F(x)$ est la fonction de répartition de la moyenne M et t_s le seuil de collage, ce risque $LR(m)$ est :

$$LR(m) = F(t_s)(1 - F(t_s))$$

Ce risque de litige dépend de la distribution de probabilité du collage au sein de la balle et en particulier de son collage moyen. Cette distribution a été étudiée sur 100 balles de coton du Soudan ; l'échantillonnage a porté sur 16 niveaux par balle. Après avoir été conditionnés à 65 % d'humidité relative et à une température de 21 °C, les échantillons ont été testés au H2SD.

Résultats et discussion

La distribution intra-balle du collage

La forme quadratique de la relation moyenne-variance nous a orienté vers un ajustement de la distribution intra-balle à une loi binomiale négative dont la densité de probabilité est :

$$P(X=x) = \frac{\Gamma(k+x)n^x k^x}{\Gamma(x+1)\Gamma(k+n+k)^{k+x}}$$

avec gamma (Γ) l'intégrale généralisée définie par :

$$\Gamma k = \int_0^\infty x^{k-1} \exp(-x) dx$$

La moyenne arithmétique \bar{x} est une bonne estimation du paramètre m . En revanche, le paramètre de forme k peut être estimé de plusieurs façons, dont la méthode de maximum de vraisemblance est la plus précise. Un test de Chi₂, fondé sur le rapport de vraisemblances maximales, permet de vérifier l'homogénéité des coefficients k au sein d'un groupe de balles. Les résultats de l'analyse réalisée avec le logiciel SAS ont convergé vers une valeur de $k = 9,43$.

Classement de balles et risque de litige à l'expertise

L'enjeu d'un classement qualitatif est de fournir une balle de coton certifiée, avec un potentiel de collage inférieur à la limite tolérée par le filateur, tout en maîtrisant le risque de litige. Il est donc impératif de connaître la relation entre le risque de litige, le seuil critique de collage et le nombre de mesures par balle. Cette relation a été établie en partant des probabilités de classement et d'expertise d'une balle, exprimées en fonction du nombre de mesures, de la moyenne et du seuil critique de collage. Ce risque est maximum pour des seuils critiques au voisinage de la médiane du collage de la balle. Ce risque maximum, égal à 25 %, est trop important pour le classement car le coût des retours et des réclamations des acheteurs serait trop élevé. Pour le producteur, un des moyens de limiter ce risque est de se fixer un seuil au classement, inférieur au seuil critique exigé par l'acheteur — c'est la limite à l'expertise. En introduisant ce terme dans l'expression du risque de litige, nous avons établi des abaques donnant le seuil au classement en fonction de la limite à l'expertise (figure 1). Par exemple, pour garantir un degré de collage inférieur à 20 points collants à l'issue de 2 mesures par balle, la limite au classement est égale à 9 points collants pour un risque maximum de litige de 1 %.

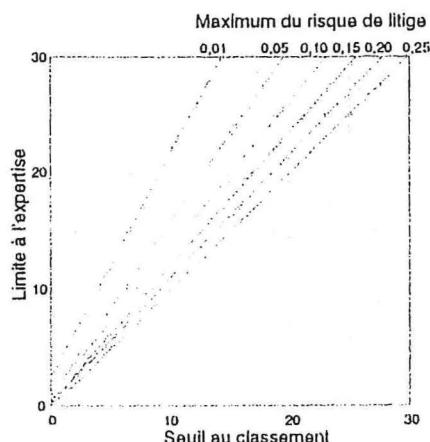


Figure 1. Résultats obtenus sur les 100-balles étudiées à raison de 2 mesures par balle : seuil au classement en fonction de la limite à l'expertise pour différents maxima de risque de litige (2 mesures de collage par balle dans le cas d'une loi binomiale négative $k = 9,43$).

Conclusion

Les résultats obtenus montrent la faisabilité du classement qualitatif du collage par le H2SD. Connaissant la distribution intra-balle du collage, le producteur peut se fixer un seuil de collage lui garantissant ces balles à un niveau inférieur aux limites exigées par les clients. L'efficacité de cette procédure de classement dépend directement de la distribution intra-balle du collage : il est impératif d'évaluer localement cette distribution qui pourrait changer d'une zone de production à une autre. Les seuils de collage discutés pourraient ne pas être suffisants pour la prévision du comportement des cotonns collants en filature. En effet, nous avons observé l'importance de la taille des points collants dans la marche d'une filature industrielle. Nous travaillons sur la combinaison du nombre de points collants et sur la distribution de leur taille obtenus par le H2SD pour mieux caractériser le potentiel de collage en corrélation avec le comportement du coton en filature.

BREVETS

BREVETS

[B1] - FRYDRYCH R., 1991. Brevet pour : procédé de traitement en ambiance humide du coton et installation pour la mise en oeuvre du procédé, priorité France n° 91 16464 du 30 décembre 1991.

[B2] - FRYDRYCH R., 1991. Brevet pour : procédé de traitement du coton par injection de vapeur d'eau chaude et installation pour la mise en oeuvre du procédé, priorité France n° 91 16463 du 30 décembre 1991.

[B3] - FRYDRYCH R., 1992. Brevet pour : procédé et installation pour l'évaluation du caractère collant de matières fibreuses végétales telles que des cotons et utilisation de ce procédé et de cette installation, priorité France n° 92 06142 du 20 mai 1992.

B.Et.3476

BREVET PCT
(EUROPE - U.S.A. - JAPON - AUSTRALIE - SOUDAN)

AU NOM DE :

CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR
LE DEVELOPPEMENT (CIRAD)

(Etablissement Public Industriel à Caractère Commercial)

EN : PCT/FR92/01230

DU 23 DECEMBRE 1992

Pour : "Procédé de traitement en ambiance humide du coton
et installation pour la mise en oeuvre du procédé"

Priorité France n°91 16464 du 30 DECEMBRE 1991

TRAITE DE COOPERATION EN MATIERE DE BREVETS

PCT

Expéditeur : l'OFFICE RECEPTEUR

NOTIFICATION DE RECEPTION DES DOCUMENTS SUPPOSES CONSTITUER UNE DEMANDE INTERNATIONALE

(instruction administrative 301 du PCT)

Date d'expédition
(jour/mois/année)

23 DEC. 1992

Référence du dossier du déposant ou du mandataire
B.Et.3476

NOTIFICATION IMPORTANTE

Demande internationale n°

PCT/FR 92 / 01230

Date de réception
(jour/mois/année)

23 DEC. 1992

Déposant : CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR LE DEVELOPPEMENT (CIRAD) avenue du Val de Montferrand BP 5035 34032 MONTPELLIER CEDEX

Titre de l'invention : "Procédé de traitement en ambiance humide du coton et installation pour la mise en oeuvre du procédé"

- Il est notifié au déposant que l'office récepteur a reçu à la date de réception indiquée ci-dessus des documents supposés constituer une demande internationale.
- L'attention du déposant est appelée sur le fait que l'office récepteur n'a pas encore vérifié si ces documents satisfont aux conditions de l'article 11.1), c'est-à-dire s'ils remplissent les conditions nécessaires pour que soit attribuée une date de dépôt international.
- Dès que l'office récepteur aura vérifié ces documents, il en avisera le déposant.
- Le numéro de demande internationale indiqué plus haut a été provisoirement attribué à ces documents. Le déposant est invité à mentionner ce numéro dans toute correspondance avec l'office récepteur.

Nombre d'exemplaires

Requête

Description

Revendications (9)

Dessin(s) (1)

Abrégé

Dessin abrégé

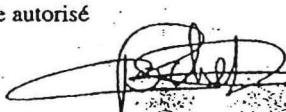
Pouvoir
(suivra)

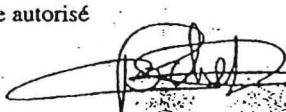
Document(s)
de priorité
(suivra)

Rapport de
recherche

versement des taxes
d'un montant de 15,290
(chèque barclays)

Autres documents

Nom et adresse postale de l'office récepteur <i>Institut National de la Propriété Industrielle 26bis, rue de Saint-Pétersbourg - 75800 Paris Cedex 08</i>	Fonctionnaire autorisé
n° de télécopieur : (1) 42 94 53 24	 M. ROCHET

Fonctionnaire autorisé
 M. ROCHET
n° de téléphone

REQUETE

Le soussigné requiert que la présente demande internationale soit traitée conformément au Traité de coopération en matière de brevets.

Réservé à l'office récepteur

Demande internationale n° _____

Date du dépôt international _____

Nom de l'office récepteur et "Demande internationale PCT"

Référence du dossier du déposant ou du mandataire (*facultatif*)
(12 caractères au maximum) B.Et.3476

Cadre n° I TITRE DE L'INVENTION

"Procédé de traitement en ambiance humide du coton et installation pour la mise en oeuvre du procédé"

Cadre n° II DEPOSANT

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)
CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT (CIRAD) (Etablissement
Public Industriel à Caractère Commercial)
Avenue du Val de Montferrand
B.P.5035
34032 MONTPELLIER CEDEX

 Cette personne est aussi inventeur.

n° de téléphone _____

n° de télécopieur _____

n° de télécopieur _____

Nationalité (nom de l'Etat) :

Française

Domicile (nom de l'Etat) :

FRANCE

Cette personne est tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Cadre n° III AUTRES DEPOSANTS OU (AUTRES) INVENTEURS

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)

Monsieur FRYDRYCH Richard
100 rue Laurent Chabry
34090 MONTPELLIER - FRANCE -

Cette personne est :

 déposant seulement déposant et inventeur inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) :

FRANCAISE

Domicile (nom de l'Etat) :

FRANCE

Cette personne est tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)

Cette personne est :

 déposant seulement déposant et inventeur inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) :

Domicile (nom de l'Etat) :

Cette personne est tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

D'autres déposants ou inventeurs sont indiqués sur une feuille annexe.

Cadre n° IV MANDATAIRE OU REPRESENTANT COMMUN: OU ADRESSE POUR LA CORRESPONDANCE

La personne dont l'identité est donnée ci-dessous est/a été désignée pour agir au nom du ou des déposants auprès des autorités internationales compétentes, comme : mandataire représentant commun

Nom et adresse : (*Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.*)

François LERNER ou Jean BRULLE
LERNER & BRULLE S.C.P.
05, rue Jules Lefèvre
75009 PARIS - FRANCE -

n° de téléphone
48 74 45 96

n° de télécopieur
42 81 49 77

n° de téleimprimeur

Cocher cette case lorsque aucun mandataire ni représentant commun n'est/n'a été désigné et que l'espace ci-dessus est utilisé pour indiquer une adresse spéciale à laquelle la correspondance doit être envoyée.

Cadre n° V DESIGNATION D'ETATS

Les désignations suivantes sont faites conformément à la règle 4.9.a) (*cocher les cases appropriées; une au moins doit l'être*):

Brevet régional

- EP Brevet européen : AT Autriche, BE Belgique, CH et LI Suisse et Liechtenstein, DE Allemagne, DK Danemark, ES Espagne, FR France, GB Royaume-Uni, GR Grèce, IT Italie, LU Luxembourg, MC Monaco, NL Pays-Bas, SE Suède et tout autre Etat qui est un Etat contractant de la Convention sur le brevet européen et du PCT
- OA Brevet OAPI : Bénin, Burkina Faso, Cameroun, Congo, Côte d'Ivoire, Gabon, Guinée, Mali, Mauritanie, République centrafricaine, Sénégal, Tchad, Togo et tout autre Etat qui est un Etat membre de l'OAPI et un Etat contractant du PCT (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*)

Brevet national (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*):

- | | |
|--|---|
| <input type="checkbox"/> AT Autriche | <input type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> AU Australie | <input type="checkbox"/> MN Mongolie |
| <input type="checkbox"/> BB Barbade | <input type="checkbox"/> MW Malawi |
| <input type="checkbox"/> BG Bulgarie | <input type="checkbox"/> NL Pays-Bas |
| <input type="checkbox"/> BR Brésil | <input type="checkbox"/> NO Norvège |
| <input type="checkbox"/> CA Canada | <input type="checkbox"/> PL Pologne |
| <input type="checkbox"/> CH et LI Suisse et Liechtenstein | <input type="checkbox"/> RO Roumanie |
| <input type="checkbox"/> CS Tchécoslovaquie | <input type="checkbox"/> RU Fédération de Russie |
| <input type="checkbox"/> DE Allemagne | <input checked="" type="checkbox"/> SD Soudan |
| <input type="checkbox"/> DK Danemark | <input type="checkbox"/> SE Suède |
| <input type="checkbox"/> ES Espagne | <input checked="" type="checkbox"/> US Etats-Unis d'Amérique |
| <input type="checkbox"/> FI Finlande ..... | ..... |
| <input type="checkbox"/> GB Royaume-Uni ..... | ..... |
| <input type="checkbox"/> HU Hongrie ..... | ..... |
| <input checked="" type="checkbox"/> JP Japon | Cases réservées pour la désignation (aux fins d'un brevet national) d'Etats qui sont devenus parties au PCT après la publication de la présente feuille : |
| <input type="checkbox"/> KP République populaire démocratique de Corée | <input type="checkbox"/> |
| <input type="checkbox"/> KR République de Corée | <input type="checkbox"/> |
| <input type="checkbox"/> LK Sri Lanka | <input type="checkbox"/> |
| <input type="checkbox"/> LU Luxembourg | <input type="checkbox"/> |

Outre les désignations faites ci-dessus, le déposant fait aussi conformément à la règle 4.9.b) toutes les désignations qui seraient autorisées en vertu du PCT, sauf la désignation de _____.

Le déposant déclare que ces désignations additionnelles sont faites sous réserve de confirmation et que toute désignation qui n'est pas confirmée avant l'expiration d'un délai de 15 mois à compter de la date de priorité doit être considérée comme retirée par le déposant à l'expiration de ce délai. (*Pour confirmer une désignation, il faut déposer une déclaration contenant la désignation en question et payer les taxes de désignation et de confirmation. La confirmation doit parvenir à l'office récepteur dans le délai de 15 mois.*)

Cadre n° VI REVENDICATION DE PRIORITED'autres revendications de priorité sont
indiquées dans le cadre supplémentaire

La priorité de la ou des demandes antérieures suivantes est revendiquée :

Pays (dans lequel ou pour lequel la demande a été déposée)	Date de dépôt (jour/mois/année)	Demande n°	Office de dépôt (seulement s'il s'agit d'une demande régionale ou internationale)
(1) FRANCE	30 décembre 1991	91 16464	
(2)			
(3)			

Cocher la case ci-dessous si la copie certifiée conforme de la demande antérieure doit être délivrée par l'office qui, aux fins de la présente demande internationale, est l'office récepteur (une taxe peut être exigée) : L'office récepteur est prié de transmettre au Bureau international une copie certifiée conforme de la ou des demandes antérieures indiquées ci-dessus au(x) point(s) :**Cadre n° VII RECHERCHE ANTERIEURE***Remplir si une recherche (internationale, de type international ou autre) a déjà été effectuée par l'administration chargée de la recherche internationale ou demandée à cette administration et si cette administration est maintenant priée de fonder la recherche internationale, dans la mesure du possible, sur les résultats de cette recherche antérieure. Pour permettre d'identifier cette recherche ou cette demande de recherche, donner les renseignements demandés ci-après pour la demande de brevet pertinente (ou sa traduction) ou pour la demande de recherche :*Pays (ou office régional) : Date (jour/mois/année) : Numéro :
FRANCE 30 septembre 1991 91 16464**Cadre n° VIII BORDEREAU**

La présente demande internationale comprend le nombre de feuilles suivant :

1. requête	:	3	feuilles
2. description	:	5	feuilles
3. revendications	:	2	feuilles
4. abrégé	:	1	feuilles
5. dessins	:	1	feuilles
Total	:	12	feuilles

Le ou les éléments cochés ci-après sont joints à la présente demande internationale :

- | | |
|---|--|
| 1. <input checked="" type="checkbox"/> pouvoir distinct signé (suivra) | 5. <input type="checkbox"/> feuille de calcul des taxes |
| 2. <input type="checkbox"/> copie du pouvoir général | 6. <input type="checkbox"/> indications séparées concernant des micro-organismes déposés |
| 3. <input type="checkbox"/> explication de l'absence d'une signature | 7. <input type="checkbox"/> listage de séquence de nucléotides ou d'acides aminés |
| 4. <input checked="" type="checkbox"/> document(s) de priorité (préciser): (suivra) | 8. <input checked="" type="checkbox"/> autres éléments (préciser): Recherche antérieure |

La figure n° T des dessins (le cas échéant) est proposée pour publication avec l'abréviation.

Cadre n° IX SIGNATURE DU DEPOSANT OU DU MANDATAIRE*A côté de chaque signature, indiquer le nom du signataire et, si cela n'apparaît pas clairement à la lecture de la requête, à quel titre l'intéressé signe.*François LERNERLERNER & BRULLE S.C.P.

Réservé à l'office récepteur

1. Date effective de réception des pièces supposées constituer la demande internationale :	2. Dessins : <input type="checkbox"/> reçus : <input type="checkbox"/> non reçus :
3. Date effective de réception, rectifiée en raison de la réception ultérieure, mais dans les délais, de documents ou de dessins complétant ce qui est supposé constituer la demande internationale :	
4. Date de réception, dans les délais, des corrections demandées selon l'article 11.2) du PCT :	
5. Administration chargée de la recherche internationale indiquée par le déposant : ISA /	6. <input type="checkbox"/> Transmission de la copie de recherche différée jusqu'au paiement de la taxe de recherche

Réservé au Bureau international

Date de réception de l'exemplaire original par le Bureau international :

PCT

FEUILLE DE CALCUL DES TAXES
Annexe de la requête

Réserve à l'office récepteur

Demande internationale n°

PCT/FR 92/01230

Référence du dossier du déposant ou du mandataire B.Et.3476

Timbre à date de l'office récepteur

Deposant CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR LE DEVELOPPEMENT (CIRAD) (Etablissement Public Industriel à Caractère Commercial)

CALCUL DES TAXES PRÉSCRITES

1. TAXE DE TRANSMISSION

400

T

8230

S

2. TAXE DE RECHERCHE

Recherche internationale à effectuer par JEB

(Si plusieurs administrations chargées de la recherche internationale sont compétentes en ce qui concerne la demande internationale, inscrire le nom de celle qui est choisie pour la recherche internationale.)

3. TAXE INTERNATIONALE

Taxe de base

La demande internationale contient 9 feuillets.

30 premières feuillets 3010

b₁

feuilles suivantes montant additionnel

=

b₂

Additionner les montants portés dans les cadres b₁ et b₂ et inscrire le total dans le cadre B

3010

B

Taxe de désignation

730 x 5 = 3650

D

nombre de désignations montant de la taxe de désignation

(Si ce produit dépasse le montant correspondant à dix fois la taxe de désignation, porter ce dernier montant dans le cadre D.)

Additionner les montants portés dans les cadres B et D, et inscrire le total dans le cadre I

6660

I

P

4. TAXE AFFERENTE AU DOCUMENT DE PRIORITÉ

5. TOTAL DES TAXES DUES

Additionner les montants portés dans les cadres T, S, I et P, et inscrire le résultat dans le cadre TOTAL

15 290

TOTAL

La taxe de désignation sera payée ultérieurement.

MODE DE PAIEMENT

autorisation de débiter un compte de dépôt (voir ci-dessous)

traite bancaire

coupons

chèque

espèces

autres (préciser):

mandat postal

timbres fiscaux

AUTORISATION CONCERNANT UN COMPTE DE DÉPÔT

L'office récepteur/ est autorisé à débiter mon compte de dépôt du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt de tout montant manquant – ou à le créditer de tout excédent – dans le paiement du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt du montant de la taxe afférante à l'établissement du document de priorité et à sa transmission au Bureau international de l'OMPI.

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22 décembre 1992

François LERNER

Numéro du compte de dépôt

Date (jour/mois/année)

Signature

La présente invention a pour objet un procédé de traitement du coton en vue de sa filature ainsi qu'une installation pour la mise en oeuvre du procédé.

Le coton, depuis ces dernières années, se trouve 5 fortement pollué par des miellats d'insectes qui lui confèrent un pouvoir collant rendant difficile sa filature.

Divers procédés et installations ont été proposés pour réduire le pouvoir collant du coton ainsi pollué, ces procédés consistant essentiellement à déshydrater les miellats 10 pour permettre leur élimination et/ou anihiler leur pouvoir collant.

Ainsi par exemple, selon le brevet européen EP 0 344 631, on neutralise les miellats en formant le coton en une nappe qui est pressée entre des rouleaux chauffés à haute 15 température et, simultanément, on déshydrate la nappe de coton.

Selon les brevets européens 0 303 575 et 0 344 729, la déshydratation de la nappe de coton se fait dans un four tunnel à micro-ondes, la déshydratation qui s'ensuit des miellats réduisant leur pouvoir de collage.

En pratique cependant, ces procédés et 20 installations connus, d'une part sont relativement coûteux, et d'autre part ne conduisent pas généralement à l'extraction des miellats mais simplement à leur déshydratation temporaire, exigeant donc que la filature soit effectuée quasiment en 25 continu avec le traitement préalable de la nappe de coton.

L'invention a pour objet de résoudre le problème posé par les cotons pollués par des miellats en procédant en quelque sorte de façon très différente, permettant d'obtenir de bons résultats et de façon économique.

Comme il est connu, le pouvoir collant des miellats 30 s'accroît avec le degré d'humidité. L'invention tire avantage de cette caractéristique en procédant en quelque sorte de façon inverse des techniques connues évoquées ci-dessus.

De façon précise, le procédé de traitement du coton 35 pollué par des miellats, en vue d'en réduire le pouvoir collant avant filature, se caractérise selon l'invention en ce que :

- on conforme le coton préalablement en une nappe,
 - on soumet la nappe à une ambiance présentant un taux d'humidité élevé, dans laquelle ambiance la nappe est entraînée, puis on amène la nappe en pression à température ambiante contre des organes sur lesquels se déposent les miellats ainsi que les fibres de coton pouvant être entraînées par ces miellats.

On comprend que de la sorte, contrairement à l'art antérieur, au lieu d'assécher la nappe de coton que l'on traite, on l'humidifie, rendant encore plus collant les miellats et l'on tire avantage de cette augmentation du pouvoir collant des miellats pour les extraire par simple pression sur des organes maintenus à température ambiante.

Avantageusement, le procédé est mis en oeuvre avec un taux d'humidité qui sera compris entre 55 % et 75 %.

Un taux d'humidité trop faible conduit à des miellats qui ne sont pas assez collants et qui ne se déposeront pas de façon satisfaisante sur les rouleaux ; de même un taux d'humidité trop élevé conduit à des miellats d'une teneur en humidité trop élevée qui favorise leur retour dans la nappe.

Avantageusement, la fibre avant traitement présentera une teneur en humidité comprise entre 5,5 % et 12,2 % et de préférence entre 6,8 % et 9,5 %, ce qui permettra aux miellats de se situer dans des conditions optimales d'adhérence aux rouleaux.

Si la teneur en humidité des fibres est dans la fourchette basse, par exemple entre 5,5 et 7,5 %, alors on utilisera avantageusement une ambiance à taux d'humidité dans la fourchette haute, vers 75 %, et inversement, si la teneur en humidité de la fibre est dans la fourchette haute, c'est-à-dire entre 9,5 % et 12,2 %, alors on utilisera avantageusement une ambiance dont le taux d'humidité sera dans la fourchette basse, c'est-à-dire vers 55 %.

Bien entendu, l'homme de l'art sera à même de régler le taux d'humidité aussi bien de l'ambiance que de la fibre, de façon à obtenir le dépôt optimum des miellats sur les

organes de pression qui recueillent les miellats.

L'invention concerne également une installation pour la mise en oeuvre du procédé, cette installation se caractérisant en ce qu'elle comprend :

5

- un dispositif de conformation du coton en une nappe,

- une cellule de traitement dans laquelle est créée une ambiance présentant un taux d'humidité élevé et dans laquelle nappe est introduite et y est entraînée vers une extrémité de sortie par au moins un groupe d'organes presseurs rotatifs venant en pression contre la nappe, de part et d'autre de cette dernière, et

- au moins un organe nettoyeur étant associé à chacun desdits groupes d'organes presseurs.

15

L'invention et sa mise en oeuvre apparaîtront plus clairement à l'aide de la description qui va suivre faite en référence avec la figure 1 unique illustrant schématiquement à titre d'exemple une telle installation.

20

L'installation, référencée 10 dans son ensemble, comprend à l'entrée un dispositif classique 7 de conformation du coton, amené généralement en balles (non représentées) à l'entrée de l'installation.

25

En 6, on a schématisé une carte dont le chapeau de l'ouvreuse ou grand rouleau présentera un surface interne lisse.

Conformément à l'invention, l'installation comporte essentiellement une cellule de traitement 1 dans laquelle est créée, par tous moyens appropriés, tels qu'un générateur de vapeur (non représenté), une ambiance avec un taux d'humidité relatif élevé, lequel taux est avantageusement, comme il a été indiqué ci-dessus, maintenu dans la fourchette préférentielle entre 55 % et 75 %.

La nappe 11 qui vient de la carte 6 est entraînée après passage dans cette cellule de traitement 1, vers des groupes d'organes presseurs 2 entre lesquels la nappe est tirée de l'extrémité d'entrée 8 jusqu'à l'extrémité de sortie 12.

Dans l'exemple illustré, les groupes d'organes presseurs référencés dans leur ensemble 13 sont au nombre de quatre, référencés chacun 2 comprenant un grand rouleau 4 et deux petits rouleaux 5. La nappe 11 passe dans chaque groupe 5 d'organes presseurs 2 entre le grand rouleau 4 et les deux petits rouleaux 5 entre lesquels la nappe est pressée.

La pression appliquée peut bien entendu être variable ; de bons résultats ont été obtenus avec une pression de l'ordre de 20 bars.

10 La pression dépendra de la nature du coton et également de son degré de pollution.

Avantageusement, les rouleaux presseurs sont montés de telle façon que l'on puisse régler la pression de contact des rouleaux.

15 La pression accélère le processus d'extraction des miellats.

En opérant dans de telles conditions, la nappe 11 subit, entre l'extrémité d'entrée 8 et l'extrémité de sortie 12 des organes presseurs 13, un certain étirement.

20 En conséquence pour conserver une bonne tension de la nappe sur son parcours, la vitesse circonférentielle des groupes presseurs 2 ira en croissant, de l'extrémité d'entrée 8, jusqu'à l'extrémité de sortie 12, en relation directe et proportionnelle avec la variation d'épaisseur de la nappe entre 25 ces deux extrémités.

En 3, on a illustré des organes tels que des raclettes qui sont avantageusement prévues au niveau de chacun des organes presseurs, ces raclettes ayant pour objet de recueillir et éliminer les miellats qui sont venus se coller 30 sur les rouleaux 4 et 5.

Tous moyens appropriés de récupération de ces miellats, par exemple par aspiration au niveau des raclettes, peuvent être avantageusement prévus (non représentés).

Le fonctionnement de l'installation se déduit 35 clairement de la description qui précède.

Le coton est conformé en une nappe 11 qui, dans la

cellule de traitement 1, est amenée à un taux d'humidité suffisamment élevé pour rendre les miellats de cette nappe à la sortie de la cellule de traitement 1 extrêmement collants.

La nappe arrivant ainsi à l'extrémité d'entrée 8 de 5 l'unité 13 d'organes presseurs 2 est pressée entre des jeux de rouleaux successifs 4, 5 qui permettent d'extraire les miellats collants qui se déposent successivement sur les rouleaux 4 et 5 dont ils sont éliminés par les raclettes 3.

Au fur et à mesure de son avancement vers 10 l'extrémité de sortie 12 de cette unité, la nappe 11 s'amincit et s'appauvrit en miellats.

A sa sortie, la nappe est suffisamment débarrassée des miellats pour que le coton puisse être filé sans plus de problème.

En ce qui concerne l'épaisseur de la nappe traitée, 15 on notera que celle-ci varie notamment en fonction du nombre de groupes 2 d'organes presseurs utilisés, la nappe pouvant être d'autant plus épaisse qu'on utilisera un nombre de groupes plus grand.

Ainsi selon le cas, on pourra utiliser des nappes 20 de coton dont la masse surfacique pourra varier largement, par exemple entre 3 grammes et 100 grammes par mètre carré.

L'installation fonctionne avantageusement à température ambiante, le paramètre de la température ne 25 modifiant que très peu les conditions de fonctionnement de l'installation ; en effet, le paramètre essentiel reste celui du taux d'humidité relatif de l'ambiance.

On notera que de nombreuses variantes peuvent être apportées au mode de fonctionnement décrit. Ainsi, par exemple, 30 à la place des rouleaux presseurs, on pourrait utiliser comme moyens de pression des bandes sans fin tendues entre des rouleaux menant et mené et coopérant avec des organes presseurs de place en place de façon à maintenir la nappe en pression ; bien entendu dans ce cas, les raclettes de nettoyage seraient 35 associées à cesdites bandes sans fin.

REVENDICATIONS

1 - Procédé de traitement de coton pollué par des miellats en vue d'en réduire le pouvoir collant avant filature,
5 caractérisé en ce que :

- on conforme le coton préalablement en une nappe
(11),

10 - on soumet la nappe à une ambiance (1) présentant un taux d'humidité élevé, dans laquelle ambiance, la nappe est entraînée,

- puis, on amène la nappe en pression, à température ambiante, contre des organes 4, 5 sur lesquels se déposent les miellats ainsi que les fibres de coton pouvant être entraînées par ces miellats.

15 2 - Procédé de traitement selon la revendication 1, caractérisé en ce que le taux d'humidité est compris entre 55 % et 75 %.

20 3 - Procédé de traitement selon la revendication 1 ou la revendication 2, caractérisé en ce que la fibre avant traitement présente une teneur en humidité comprise entre 5,5 % et 12,2 %.

4 - Procédé de traitement selon la revendication 3 caractérisé en ce que la teneur en humidité de la fibre est comprise entre 6,8 % et 9,5 %.

25 5 - Installation de traitement pour la mise en œuvre du procédé selon l'une quelconque des revendications précédentes caractérisée en ce qu'elle comprend :

- un dispositif (6, 7) de conformation du coton en une nappe (8),

30 - une cellule de traitement (1) dans laquelle est créée une ambiance présentant un taux d'humidité élevé et dans laquelle la nappe (11) est introduite et y est entraînée vers une extrémité de sortie (8) par au moins un groupe (2) d'organes presseurs (4, 5) venant en pression contre la nappe de part et d'autre de cette dernière,

- au moins un organe nettoyeur (3) étant associé à

chacun desdits groupes (2) d'organes presseurs.

6 - Installation selon la revendication 5 caractérisée en ce que lesdits organes presseurs (4, 5) sont des rouleaux.

5 7 - Installation selon la revendication 6 caractérisée en ce que la vitesse circonférentielle des organes presseurs (4, 5) de chaque groupe (2) en considérant le sens de défilement de la nappe est croissante d'un groupe au suivant étant fonction de l'épaisseur de la nappe à l'entrée de chacun 10 desdits groupes (2).

15 8 - Installation selon la revendication 6 ou la revendication 7 caractérisée en ce que chaque groupe (2) d'organes presseurs comprend au moins un grand rouleau (4) associé à au moins deux petits rouleaux (5) qui appuient contre le grand rouleau (4).

9 - Installation selon l'une des revendications 5 à 8 caractérisée en ce que l'organe nettoyeur (3) des organes presseurs (4, 5) est une raclette qui agit en pression contre lesdits organes presseurs.

PROCEDE DE TRAITEMENT EN AMBIANCE HUMIDE DU COTON ET
INSTALLATION POUR LA MISE EN OEUVRE DU PROCEDE

=====

AU NOM DE : CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR
LE DEVELOPPEMENT (CIRAD)
(Etablissement Public Industriel à Caractère Commercial)

=====

ABREGE DESCRIPTIF

=====

L'invention se rapporte à un procédé et à une installation pour le traitement du coton pollué par des miellats.

Selon l'invention, le coton, préalablement conformé en une nappe (11) est traité en ambiance humide et ensuite est amené entre des organes presseurs (2) qui permettent d'extraire les miellats que contient la nappe qui quitte ainsi en (12) l'installation après avoir été débarrassée de ces miellats.

L'invention s'applique au traitement des cotons pollués par des miellats avant leur filature.

Figure unique.

1/1

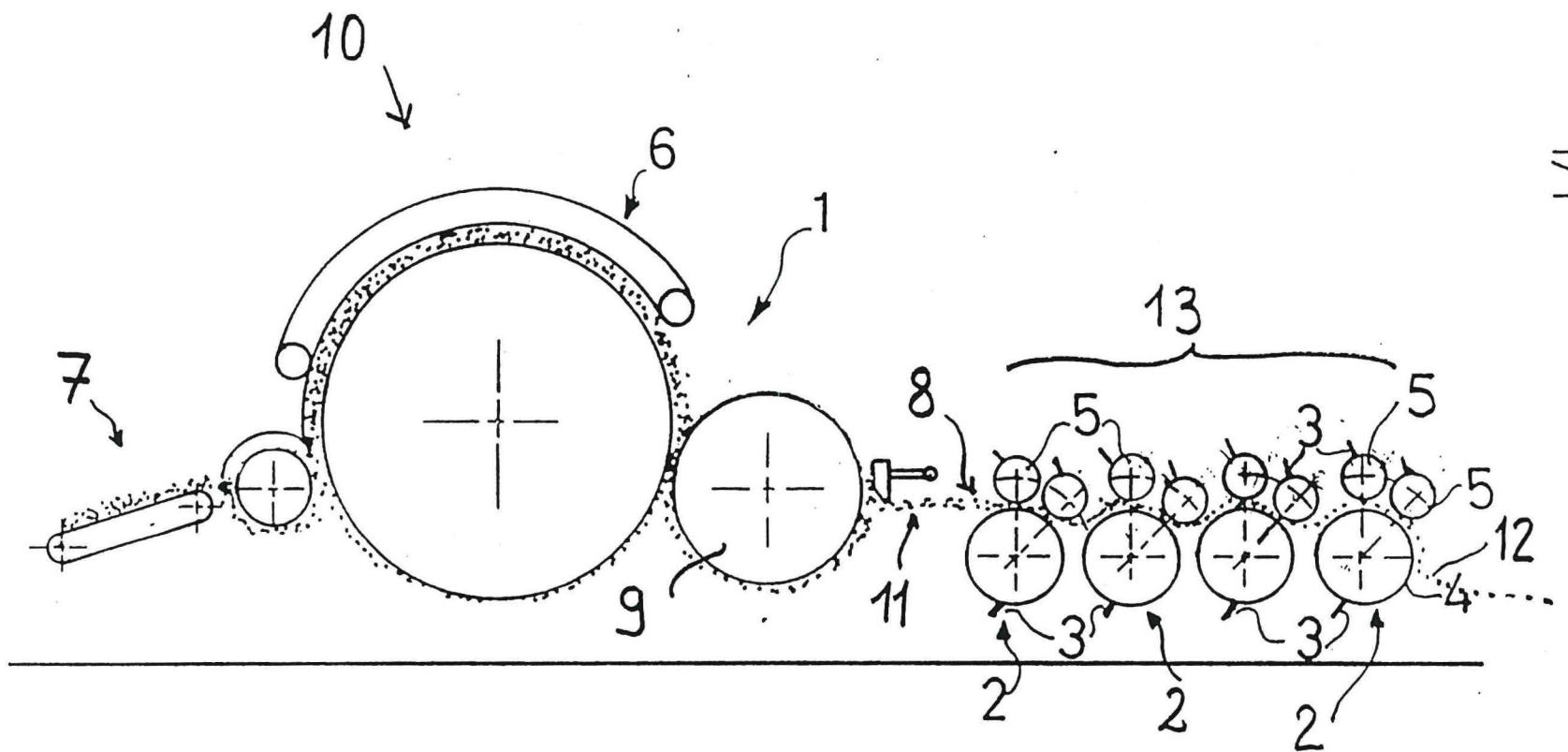


FIG 1

B.Et.3475

BREVET PCT
(EUROPE - U.S.A. - JAPON - AUSTRALIE - CANADA - SOUDAN)

AU NOM DE :

CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR
LE DEVELOPPEMENT (CIRAD)

(Etablissement Public Industriel à Caractère Commercial)

EN : PCT/FR92/01231

DU 23 DECEMBRE 1992

Pour : "Procédé de traitement du coton par injection
de vapeur d'eau chaude et installation pour
la mise en oeuvre du procédé"

Priorité France n°91 16463 du 30 DECEMBRE 1991

TRAITE DE COOPERATION EN MATIERE DE BREVETS

PCT

NOTIFICATION DE RECEPTION DES DOCUMENTS SUPPOSES CONSTITUER UNE DEMANDE INTERNATIONALE

(instruction administrative 301 du PCT)

Expéditeur : l'OFFICE RECEPTEUR

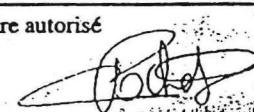
Destinataire

LERNER & BRULLE S.C.P.

05, rue Jules Lefèvre

75009 PARIS - FRANCE -

Date d'expédition (jour/mois/année)	23 DEC. 1992								
Référence du dossier du déposant ou du mandataire B.Et.3475	NOTIFICATION IMPORTANTE								
Demande internationale n° PCT/FR 92 / 01231	Date de réception (jour/mois/année)	23 DEC. 1992							
Déposant CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR LE DEVELOPPEMENT (CIRAD) (ETABLISSEMENT PUBLIC INDUSTRIEL A CARACTERE COMMERCIAL)									
Titre de l'invention "Procédé de traitement du coton par injection de vapeur d'eau chaude et installation pour la mise en oeuvre du procédé"									
<p>1. Il est notifié au déposant que l'office récepteur a reçu à la date de réception indiquée ci-dessus des documents supposés constituer une demande internationale.</p> <p>2. L'attention du déposant est appelée sur le fait que l'office récepteur n'a pas encore vérifié si ces documents satisfont aux conditions de l'article 11.1), c'est-à-dire s'ils remplissent les conditions nécessaires pour que soit attribuée une date de dépôt international.</p> <p>3. Dès que l'office récepteur aura vérifié ces documents, il en avisera le déposant.</p> <p>4. Le numéro de demande internationale indiqué plus haut a été provisoirement attribué à ces documents. Le déposant est invité à mentionner ce numéro dans toute correspondance avec l'office récepteur.</p>									
<p>Nombre d'exemplaires</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; vertical-align: top;"> <input type="checkbox"/> Requête <input checked="" type="checkbox"/> Description <input checked="" type="checkbox"/> Revendications (15) <input checked="" type="checkbox"/> Dessin(s) (2) <input type="checkbox"/> Abrégé <input type="checkbox"/> Dessin abrégé </td> <td style="width: 33%; vertical-align: top;"> <input checked="" type="checkbox"/> Pouvoir (suivra) <input checked="" type="checkbox"/> Document(s) de priorité (suivra) <input checked="" type="checkbox"/> Rapport de recherche </td> <td style="width: 33%; vertical-align: top;"> <input checked="" type="checkbox"/> versement des taxes d'un montant de : 16 020 <input checked="" type="checkbox"/> Chèque Barclays </td> </tr> <tr> <td colspan="3"> <input type="checkbox"/> Autres documents </td> </tr> </table>				<input type="checkbox"/> Requête <input checked="" type="checkbox"/> Description <input checked="" type="checkbox"/> Revendications (15) <input checked="" type="checkbox"/> Dessin(s) (2) <input type="checkbox"/> Abrégé <input type="checkbox"/> Dessin abrégé	<input checked="" type="checkbox"/> Pouvoir (suivra) <input checked="" type="checkbox"/> Document(s) de priorité (suivra) <input checked="" type="checkbox"/> Rapport de recherche	<input checked="" type="checkbox"/> versement des taxes d'un montant de : 16 020 <input checked="" type="checkbox"/> Chèque Barclays	<input type="checkbox"/> Autres documents		
<input type="checkbox"/> Requête <input checked="" type="checkbox"/> Description <input checked="" type="checkbox"/> Revendications (15) <input checked="" type="checkbox"/> Dessin(s) (2) <input type="checkbox"/> Abrégé <input type="checkbox"/> Dessin abrégé	<input checked="" type="checkbox"/> Pouvoir (suivra) <input checked="" type="checkbox"/> Document(s) de priorité (suivra) <input checked="" type="checkbox"/> Rapport de recherche	<input checked="" type="checkbox"/> versement des taxes d'un montant de : 16 020 <input checked="" type="checkbox"/> Chèque Barclays							
<input type="checkbox"/> Autres documents									

Nom et adresse postale de l'office récepteur Institut National de la Propriété Industrielle 26bis, rue de Saint-Pétersbourg - 75800 Paris Cedex 08 n° de télécopieur : (1) 42 94 53 24	Fonctionnaire autorisé  M. ROCHET n° de téléphone
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PCT

REQUETE

Le soussigné requiert que la présente demande internationale soit traitée conformément au Traité de coopération en matière de brevets.

Réservé à l'office récepteur

Demande internationale n°

Date du dépôt international

Nom de l'office récepteur et "Demande internationale PCT"

Référence du dossier du déposant ou du mandataire (*facultatif*)
(12 caractères au maximum)

Cadre n° I TITRE DE L'INVENTION : Procédé de traitement du coton par injection de vapeur d'eau chaude et installation pour la mise en œuvre du procédé"

Cadre n° II DEPOSANT

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)
CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT (CIRAD) (Etablissement
Public Industriel à Caractère Commercial)
Avenue du Val de Montferrand
B.P. 5035
34032 MONTPELLIER CEDEX

Cette personne est aussi inventeur.

n° de téléphone

n° de télécopieur

n° de téleimprimeur

Nationalité (nom de l'Etat) : Française

Domicile (nom de l'Etat) : FRANCE

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Cadre n° III AUTRES DEPOSANTS OU (AUTRES) INVENTEURS

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)

Monsieur FRYDRYCH Richard
100 rue Laurent Chabry
34090 MONTPELLIER

Cette personne est :

déposant seulement

déposant et inventeur

inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) :

Française

Domicile (nom de l'Etat) :

FRANCE

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Nom et adresse : (Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.)

Cette personne est :

déposant seulement

déposant et inventeur

inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) :

Domicile (nom de l'Etat) :

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

D'autres déposants ou inventeurs sont indiqués sur une feuille annexe.

Cadre n° IV MANDATAIRE OU REPRESENTANT COMMUN: OU ADRESSE POUR LA CORRESPONDANCE

La personne dont l'identité est donnée ci-dessous est/a été désignée pour agir au nom du ou des déposants auprès des autorités internationales compétentes, comme : mandataire représentant commun

Nom et adresse : (<i>Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.</i>) François LERNER ou Jean BRULLE LERNER & BRULLE S.C.P. 05, rue Jules Lefèvre 75009 PARIS - FRANCE	n° de téléphone 48 74 45 96
	n° de télécopieur 42 81 49 77
	n° de télécopieur

Cocher cette case lorsque aucun mandataire ni représentant commun n'est/n'a été désigné et que l'espace ci-dessus est utilisé pour indiquer une adresse spéciale à laquelle la correspondance doit être envoyée.

Cadre n° V DESIGNATION D'ETATS

Les désignations suivantes sont faites conformément à la règle 4.9.a) (*cocher les cases appropriées: une au moins doit l'être*) :

Brevet régional

- EP Brevet européen : AT Autriche, BE Belgique, CH et LI Suisse et Liechtenstein, DE Allemagne, DK Danemark, ES Espagne, FR France, GB Royaume-Uni, GR Grèce, IT Italie, LU Luxembourg, MC Monaco, NL Pays-Bas, SE Suède et tout autre Etat qui est un Etat contractant de la Convention sur le brevet européen et du PCT
- OA Brevet OAPI : Bénin, Burkina Faso, Cameroun, Congo, Côte d'Ivoire, Gabon, Guinée, Mali, Mauritanie, République centrafricaine, Sénégal, Tchad, Togo et tout autre Etat qui est un Etat membre de l'OAPI et un Etat contractant du PCT (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*)

Brevet national (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*) :

- | | |
|--|--|
| <input type="checkbox"/> AT Autriche | <input type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> AU Australie | <input type="checkbox"/> MN Mongolie |
| <input type="checkbox"/> BB Barbade | <input type="checkbox"/> MW Malawi |
| <input type="checkbox"/> BG Bulgarie | <input type="checkbox"/> NL Pays-Bas |
| <input type="checkbox"/> BR Brésil | <input type="checkbox"/> NO Norvège |
| <input checked="" type="checkbox"/> CA Canada | <input type="checkbox"/> PL Pologne |
| <input type="checkbox"/> CH et LI Suisse et Liechtenstein | <input type="checkbox"/> RO Roumanie |
| <input type="checkbox"/> CS Tchécoslovaquie | <input type="checkbox"/> RU Fédération de Russie |
| <input type="checkbox"/> DE Allemagne | <input checked="" type="checkbox"/> SD Soudan |
| <input type="checkbox"/> DK Danemark | <input type="checkbox"/> SE Suède |
| <input type="checkbox"/> ES Espagne | <input checked="" type="checkbox"/> US Etats-Unis d'Amérique |
| <input type="checkbox"/> FI Finlande | |
| <input type="checkbox"/> GB Royaume-Uni | |
| <input type="checkbox"/> HU Hongrie | |
| <input checked="" type="checkbox"/> JP Japon | |
| <input type="checkbox"/> KP République populaire démocratique de Corée | |
| <input type="checkbox"/> KR République de Corée | |
| <input type="checkbox"/> LK Sri Lanka | |
| <input type="checkbox"/> LU Luxembourg | |

Cases réservées pour la désignation (aux fins d'un brevet national) d'Etats qui sont devenus parties au PCT après la publication de la présente feuille :

-
-
-
-

Outre les désignations faites ci-dessus, le déposant fait aussi conformément à la règle 4.9.b) toutes les désignations qui seraient autorisées en vertu du PCT, sauf la désignation de

Le déposant déclare que ces désignations additionnelles sont faites sous réserve de confirmation et que toute désignation qui n'est pas confirmée avant l'expiration d'un délai de 15 mois à compter de la date de priorité doit être considérée comme retirée par le déposant à l'expiration de ce délai. (*Pour confirmer une désignation, il faut déposer une déclaration contenant la désignation en question et payer les taxes de désignation et de confirmation. La confirmation doit parvenir à l'office récepteur dans le délai de 15 mois.*)

Cadre n° VI REVENDICATION DE PRIORITED'autres revendications de priorité sont indiquées dans le cadre supplémentaire

La priorité de la ou des demandes antérieures suivantes est revendiquée :

Pays (dans lequel ou pour lequel la demande a été déposée)	Date de dépôt (jour/mois/année)	Demande n°	Office de dépôt (seulement s'il s'agit d'une demande régionale ou internationale)
(1) FRANCE	30 décembre 1991	91 16463	
(2)			
(3)			

Cocher la case ci-dessous si la copie certifiée conforme de la demande antérieure doit être délivrée par l'office qui, aux fins de la présente demande internationale, est l'office récepteur (une taxe peut être exigée) :

L'office récepteur est prié de transmettre au Bureau international une copie certifiée conforme de la ou des demandes antérieures indiquées ci-dessus au(x) point(s) : _____

Cadre n° VII RECHERCHE ANTERIEURE

Remplir si une recherche (internationale, de type international ou autre) a déjà été effectuée par l'administration chargée de la recherche internationale ou demandée à cette administration et si cette administration est maintenant priée de fonder la recherche internationale, dans la mesure du possible, sur les résultats de cette recherche antérieure. Pour permettre d'identifier cette recherche ou cette demande de recherche, donner les renseignements demandés ci-après pour la demande de brevet pertinente (ou sa traduction) ou pour la demande de recherche :

Pays (ou office régional) : Date (jour/mois/année) : Numéro :

FRANCE 30 septembre 91 16463

Cadre n° VIII BORDEREAU

La présente demande internationale comprend le nombre de feuillets suivant :

- | | | |
|-------------------|-----|-------------|
| 1. requête | : 3 | feuilles |
| 2. description | : 8 | feuilles |
| 3. revendications | : 2 | feuilles |
| 4. abrégé | : 1 | feuilles |
| 5. dessins | : 2 | feuilles |
| Total | : | 16 feuilles |

- Le ou les éléments cochés ci-après sont joints à la présente demande internationale :
- | | |
|--|--|
| 1. <input checked="" type="checkbox"/> pouvoir distinct signé (suivra) | 5. <input checked="" type="checkbox"/> feuille de calcul des taxes |
| 2. <input type="checkbox"/> copie du pouvoir général | 6. <input type="checkbox"/> indications séparées concernant des micro-organismes déposés |
| 3. <input type="checkbox"/> explication de l'absence d'une signature | 7. <input type="checkbox"/> listage de séquence de nucléotides ou d'acides aminés |
| 4. <input checked="" type="checkbox"/> document(s) de priorité (préciser): | 8. <input checked="" type="checkbox"/> autres éléments Recherche antérieure (préciser): |

La figure n° A des dessins (le cas échéant) est proposée pour publication avec l'abréviation.

Cadre n° IX SIGNATURE DU DEPOSANT OU DU MANDATAIRE

A côté de chaque signature, indiquer le nom du signataire et, si cela n'apparaît pas clairement à la lecture de la requête, à quel titre l'intéressé signe.

François LERNER

LERNER & BRULLE S.C.P.

Réserve à l'office récepteur

1. Date effective de réception des pièces supposées constituer la demande internationale :	2. Dessins : <input type="checkbox"/> reçus : <input type="checkbox"/> non reçus :
3. Date effective de réception, rectifiée en raison de la réception ultérieure, mais dans les délais, de documents ou de dessins complétant ce qui est supposé constituer la demande internationale :	
4. Date de réception, dans les délais, des corrections demandées selon l'article 11.2) du PCT :	
5. Administration chargée de la recherche internationale indiquée par le déposant : ISA /	6. <input type="checkbox"/> Transmission de la copie de recherche différée jusqu'au paiement de la taxe de recherche

Réserve au Bureau international

Date de réception de l'exemplaire original par le Bureau international :

Cette feuille ne fait pas partie de la demande internationale ni ne compte comme une feuille de celle-ci.

PCT

FEUILLE DE CALCUL DES TAXES Annexe de la requête

Réserve à l'office récepteur

Demande internationale n°

PCT/FR 92 / 01231

Référence du dossier du déposant ou du mandataire B.Et.3475

Timbre à date de l'office récepteur

Déposant CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR LE DEVELOPPEMENT (CIRAD) (ETABLISSEMENT PUBLIC INDUSTRIEL A CARACTÈRE COMMERCIAL)

CALCUL DES TAXES PRÉSCRITES

1. TAXE DE TRANSMISSION

400

T

2. TAXE DE RECHERCHE

8230

S

Recherche internationale à effectuer par OEB

(Si plusieurs administrations chargées de la recherche internationale sont compétentes en ce qui concerne la demande internationale, inscrire le nom de celle qui est choisie pour la recherche internationale.)

3. TAXE INTERNATIONALE

Taxe de base

La demande internationale contient 13 feuilles.

30 premières feuilles 3010

b₁

feuilles suivantes montant additionnel

= b₂

Additionner les montants portés dans les cadres b₁ et b₂ et inscrire le total dans le cadre B

3010

B

Taxe de désignation

730

x 6

= 4380

D

nombre de désignations montant de la taxe de désignation

(Si ce produit dépasse le montant correspondant à dix fois la taxe de désignation, porter ce dernier montant dans le cadre D.)

Additionner les montants portés dans les cadres B et D, et inscrire le total dans le cadre I

7390

I

P

4. TAXE AFFERENTE AU DOCUMENT DE PRIORITÉ

5. TOTAL DES TAXES DUES

Additionner les montants portés dans les cadres T, S, I et P, et inscrire le résultat dans le cadre TOTAL

16 020

TOTAL

La taxe de désignation sera payée ultérieurement.

MODE DE PAIEMENT

autorisation de débiter un compte de dépôt (voir ci-dessous)

traite bancaire

coupons

chèque Barclays

espèces

autres (préciser):

mandat postal

timbres fiscaux

AUTORISATION CONCERNANT UN COMPTE DE DÉPÔT

L'office récepteur/ est autorisé à débiter mon compte de dépôt du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt de tout montant manquant - ou à le créditer de tout excédent - dans le paiement du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt du montant de la taxe afférante à l'établissement du document de priorité et à sa transmission au Bureau international de l'OMPI.

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22 décembre 1992

François LERNER

Numéro du compte de dépôt

Date (jour/mois/année)

Signature

La présente invention a pour objet un procédé de traitement du coton en vue de sa filature ainsi qu'une installation pour la mise en oeuvre du procédé.

Le coton, depuis ces dernières années, se trouve 5 fortement pollué par des miellats d'insectes qui lui confèrent un pouvoir collant rendant difficile sa filature.

Divers procédés et installations ont été proposés pour réduire le pouvoir collant du coton ainsi pollué, ces procédés consistant essentiellement à déshydrater les miellats 10 pour permettre leur élimination et/ou anihiler leur pouvoir collant.

Ainsi par exemple, selon le brevet européen EP 0 344 631, on neutralise les miellats en formant le coton en une nappe qui est pressée entre des rouleaux chauffés à haute 15 température et, simultanément, on déhydrate la nappe de coton.

Selon les brevets européens 0 303 575 et 0 344 729, la déshydratation de la nappe de coton se fait dans un four tunnel à micro-ondes, la déshydratation qui s'ensuit des miellats réduisant leur pouvoir de collage.

En pratique cependant, ces procédés et 20 installations connus, d'une part sont relativement coûteux, et d'autre part ne conduisent pas généralement à l'extraction des miellats mais simplement à leur déshydratation temporaire, exigeant donc que la filature soit effectuée quasiment en 25 continu avec le traitement préalable de la nappe de coton.

L'invention a pour objet de résoudre le problème posé par les cotons pollués par des miellats en procédant de façon très différente, permettant d'obtenir de bons résultats et donc de filer les cotons en ambiance de filature sans 30 problème.

Selon l'invention, le nouveau traitement du coton conduit à une réduction du pouvoir collant par transformation et éventuellement retrait partiel des miellats.

De façon précise, le procédé de traitement du coton 35 pollué par des miellats, en vue d'en réduire le pouvoir collant avant filature, se caractérise selon l'invention en ce qu'on

conforme le coton à traiter sous forme d'une nappe, après quoi, on fait passer cette nappe entre des organes de guidage puis on effectue une injection de vapeur d'eau chaude dans la nappe.

De préférence, pour effectuer le guidage de la
5 nappe, on utilise des organes de compression, de sorte que la nappe traitée est comprimée.

Ainsi, sous les effets de l'injection de vapeur
d'eau chaude dans la nappe, lesquels effets sont
avantageusement amplifiés par la compression que l'on fait
10 subir à la nappe, les miellats se ramollissent et subissent une transformation qui en amoindrit le pouvoir collant.

La vapeur d'eau chaude qui circule au sein de la
nappe entre les fibres fait office d'agent mouillant et
ramollit les miellats situés dans l'épaisseur de la nappe et
15 les transforme.

Selon un mode de mise en oeuvre qui a donné toute satisfaction, l'injection de vapeur d'eau chaude est réalisée par amenée, en contact avec la nappe, d'au moins un élément chargé en humidité, cet élément pouvant être constitué par une
20 bande de tissu humide.

Les miellats qui ne se présentent plus sous forme de billes de sucre mais en sucre dissout sont extraits par la compression que subit la nappe et se déposent en majorité sur l'élément chargé en humidité, et résiduellement dans
25 l'épaisseur de la nappe ; ainsi, une partie des miellats est éliminée dans l'élément chargé en humidité, tandis que les résidus de miellats, qui restent dans la nappe, y sont dispersés, et, du fait de leur transformation, c'est-à-dire de la modification de leur structure chimique, ne perturbent plus
30 en pratique les opérations subséquentes de filage.

Dans cette réalisation, évidemment, l'élément chargé en humidité est ensuite nettoyé, par exemple par lavage à l'eau pour être débarrassé des miellats qu'il contient..

L'invention concerne également une installation
35 pour la mise en oeuvre du procédé précédemment décrit, cette installation se caractérisant en ce qu'elle comprend :

- un dispositif de conformation en nappe du coton,
- et au moins un premier poste de traitement de la nappe comprenant :

- 5 . des moyens de guidage de la nappe à travers
ledit poste,
. et au moins un moyen producteur de vapeur
d'eau chaude injectant de la vapeur d'eau chaude dans la nappe.

10 Avantageusement, les moyens de guidage précités
sont constitués par des organes de compression entre lesquels
la nappe est comprimée et entraînée, ce qui augmente
l'efficacité du traitement.

15 Selon un mode de mise en oeuvre, l'installation
comprend en tant que moyen producteur de vapeur d'eau chaude,
une bande d'une matière spongieuse, telle qu'un tissu humide et
qui est chauffée et pressée contre la nappe de coton.

Avantageusement deux telles bandes humides sont utilisées, la
nappe de coton étant placée et comprimée entre ces deux bandes.

20 Par de tels moyens, on réalise une injection de
vapeur d'eau chaude efficace et à la température la plus
appropriée au sein de la nappe de coton traitée et
simultanément, on assure l'élimination d'une grande partie des
miellats contenus dans la nappe de coton.

25 L'invention et sa mise en oeuvre apparaîtront plus
clairement à l'aide de la description qui va suivre faite en
référence aux dessins annexés dans lesquels :

la figure 1 montre de manière schématique une
installation conforme à l'invention ;

la figure 2 montre de manière schématique une
variante d'exécution d'une telle installation.

30 Telle que représentée à la figure 1, l'installation
conforme à l'invention comprend un dispositif 1 destiné à
conformer le coton sous forme de nappe, en aval duquel, en
considérant le trajet de la nappe à travers l'installation, est
disposé au moins un premier poste 2 de traitement de la nappe
de coton.

35 Dans l'exemple schématisé à la figure 1, le

dispositif pour conformer le coton est une ouvreuse, de type cardé, ayant été modifiée, pourvue comme connu d'un rouleau briseur 20 qui reçoit le coton d'un tapis sans fin et le distribue à un tambour denté 5 ou ouvreuse surmonté d'un chapeau de surface intérieure lisse 7. La nappe de coton formée entre l'ouvreuse 5 et son chapeau 7 est amenée à un tapis 6 d'alimentation du poste de traitement 2.

Dans l'exemple illustré à la figure 1, le premier poste 2 de traitement de la nappe 21 est constitué par deux moyens 3, 3' qui guident la nappe entre son extrémité d'entrée 22 et son extrémité de sortie 23 de l'installation.

Les moyens 3, 3' sont disposés de part et d'autre de la nappe et la compriment.

La compression de la nappe 21 entre les moyens 3, 3' se fait, dans l'exemple illustré, avec interposition de deux bandes d'une matière spongieuse 4, 4' telles qu'un tissu humide, la nappe de coton 21 étant donc pressée entre ces deux bandes humides 4, 4'.

Les bandes 4 et 4' peuvent être constituées par exemple en un tissu de coton.

Chaque bande 4, 4' est entraînée en mouvement, dans le sens des flèches, en étant guidée et entraînée autour de rouleaux d'entraînement et de guidage tels que référencés en 8, 8'.

En 9, 9', on a illustré schématiquement deux dispositifs de nettoyage et d'humidification des bandes 4, 4', par exemple des bacs dans lesquels les bandes 4, 4', après avoir traversé l'installation, reçoivent une aspersion d'eau par des buses 24, 24'.

Les moyens presseurs 3, 3' peuvent être constitués par des plateaux métalliques réunis et articulés les uns aux autres comme les patins d'une chenille d'engin motorisé. Les vitesses d'avancement des moyens 3, 3', comme indiqué par les flèches et les vitesses d'avancement des bandes de tissus 4, 4', sont avantageusement identiques.

Les patins qui constituent les moyens presseurs 3,

3' sont chauffés de l'intérieur par exemple par des résistances électriques ou tout autre système tel que schématisé en 25, 25'.

5 Les patins 10 peuvent également être des plateaux chauffants auxquels sont distribués les moyens de chauffage appropriés : électricité, vapeur, etc...

Vers l'extrémité 23 de sortie de l'installation, la nappe de coton traitée 21 passe sur un poste de séchage 13 pour enlever l'excès d'humidité du coton créé par le traitement.

10 Le fonctionnement de l'installation qui vient d'être décrit est le suivant.

Le dispositif 1 de conformation du coton prépare une nappe de coton de masse surfacique appropriée, par exemple comprise entre 50 gr/m₂ et 200 gr/m₂.

15 La masse surfacique de la nappe sera fonction de plusieurs paramètres et notamment : le degré de pollution du coton, la pression à laquelle la nappe est soumise au poste de traitement 2, la durée du traitement et le type de dispositif 1 de conformation de la nappe.

20 Pour obtenir un traitement satisfaisant, on pourra jouer sur ces paramètres en augmentant par exemple la valeur de la pression ou la durée du traitement si les cotons sont très pollués ou en diminuant l'épaisseur de la nappe traitée.

25 Tous ces paramètres pourront être déterminés par l'homme de l'art, par simple expérimentation directe.

De façon générale, on utilisera avantageusement des durées de traitement dans l'installation variant entre quelques secondes et une ou deux minutes, la durée de passage pouvant être réglée par modification de la vitesse de défilement des 30 moyens 3, 3' et des bandes 4, 4' qui leur sont associées.

De même, la pression sera avantageusement maintenue à des valeurs de l'ordre de quelques bars, par exemple de 5 à 20 bars.

35 Pour obtenir un traitement convenable de la nappe de coton, il faut injecter à l'intérieur de cette nappe, de façon efficace de la vapeur d'eau, à température moyenne,

généralement à température comprise entre 70°C et 200°C, et de préférence entre 90°C et 160°C.

5 Pour ce faire, il suffit que les plateaux chauffants 10 soient à température suffisamment élevée, c'est-à-dire à 10 ou 20°C au-dessus de la température à laquelle on veut produire la vapeur.

10 La vapeur d'eau pénétrant à travers les fibres de la nappe de coton 21 entraîne et transforme les miellats dont la plus grande partie vient se dissoudre et est recueillie sur les bandes 4, 4' sur lesquelles peuvent se déposer les autres substances qui polluent le coton telles que : feuilles, débris d'amandes, amas de fibres, coques, etc...

15 Les bandes 4, 4' sont ensuite nettoyées, lavées et humidifiées au niveau convenable dans les installations 9, 9' et pourront à nouveau remplir leur rôle de moyen formateur de vapeur (en relation avec les plateaux chauffants 10) et de moyen d'entraînement et d'extraction des miellats transformés et dissous par l'action de la vapeur.

20 Les résidus de miellats qui restent dans la nappe 21 qui sort à l'extrémité 23 de sortie du poste 2, du fait de leur transformation structurelle n'ont, comme le montre l'expérience, en pratique plus d'effet défavorable sur le filage subséquent du coton.

25 En outre, la vapeur de traitement étant une vapeur à température relativement basse, le coton ne subit aucun jaunissement.

30 Pour le réglage de la pression dans l'installation illustrée à la figure 1, on pourra prévoir par exemple que l'une des structures 3 sera montée flottante et coopérera avec des moyens de pressage tarés tels que des poids ou ressorts.

35 Selon la variante de réalisation illustrée à la figure 2 et dans laquelle les mêmes repères correspondent aux pièces semblables qui se retrouvent dans les deux figures, les organes presseurs 3, 3' constitués des plateaux presseurs 10 ont été remplacés par des jeux de cylindres 11, 12.

Avantageusement, comme illustré, les moyens

5 presseurs sont constitués par des groupes (deux groupes dans l'exemple illustré) comprenant chacun un cylindre de grand diamètre 11 et une pluralité de cylindres 12 de plus faible diamètre répartis régulièrement autour du grand cylindre en arc de cercle de façon que la nappe 21 comprise entre les deux bandes de tissu 4, 4' puisse être convenablement guidée et pressée depuis sensiblement l'extrémité d'entrée 22 dans le poste de traitement 2 jusqu'à l'extrémité 23 de sortie du même poste.

10 Dans l'exemple illustré, la vapeur d'eau nécessaire au traitement est fournie là encore par les bandes humides 4, 4' qui sont chauffées au contact des rouleaux presseurs chauffants 11, 12.

15 Les cylindres 11, 12 sont chauffés par tout moyen approprié, électrique, à la vapeur, etc...

20 Bien sûr, comme dans le mode de réalisation de la figure 1, les vitesses circonférentielles d'entraînement des rouleaux et de déplacement des bandes 4, 4' sont choisies égales pour éviter tout déchirement et déformation de la nappe de coton traitée entre les deux bandes de tissus 4, 4'.

De nombreuses variantes peuvent être apportées aux modes de réalisation qui viennent d'être décrits.

25 Ainsi par exemple, on pourra adjoindre aux moyens presseurs et chauffants, tels par exemple que les cylindres de l'installation de la figure 2, une bande métallique sans fin tendue entre le cylindre 12a situé en amont et le cylindre 12b situé en aval, de façon à obtenir un meilleur guidage encore de la nappe de coton dans le poste de traitement.

30 Ces bandes métalliques assureront également une meilleure action de continuité de la pression et de la chaleur dans le poste de traitement.

Bien que dans les deux exemples décrits et illustrés, on ait utilisé pour créer la vapeur et l'injecter dans la nappe de coton 21 des bandes spongieuses humides, 35 telles que des bandes de tissu en coton, il est possible selon l'invention d'omettre ces bandes et d'effectuer seulement une

injection de vapeur dans la nappe de coton qui subit une pression plus ou moins importante lors de la traversée de l'installation.

5 Dans ce cas, on notera qu'il n'y aura pratiquement pas d'extraction des miellats, mais seulement transformation de leur nature.

Dans le cas de cotons pas trop pollués, de tels moyens peuvent se révéler parfaitement efficaces et suffisants.

REVENDICATIONS

1 - Procédé de traitement de coton pollué par des miellats afin de réduire le pouvoir collant de ce dernier, avant filature, caractérisé en ce qu'il consiste à conformer le 5 coton à traiter sous forme d'une nappe (21), à faire passer cette nappe entre des organes de guidage (3, 3' ; 11, 12), puis à effectuer une injection de vapeur d'eau chaude dans la nappe.

2 - Procédé selon la revendication 1 caractérisé en ce que lesdits organes de guidage (3, 3' ; 11, 12) étant des 10 organes de compression, on comprime la nappe traitée.

3 - Procédé selon la revendication 1 ou la revendication 2 caractérisé en ce que l'injection de vapeur d'eau chaude est réalisée par amenée, en contact avec la nappe, d'au moins un élément (4, 4') chargé en humidité.

4 - Procédé selon la revendication 3 caractérisé en ce que ledit élément chargé en humidité (4, 4') est une bande de tissu humide ou analogue.

5 - Procédé de traitement selon l'une quelconque des revendications 2 à 4 caractérisé en ce que la compression 20 de la nappe est avantageusement effectuée entre 5 et 20 bars.

6 - Procédé de traitement selon l'une des revendications précédentes caractérisé en ce que la vapeur d'eau chaude est à une température comprise entre 70°C et 200°C.

7 - Installation de traitement de coton pour la mise en oeuvre du procédé selon l'une quelconque des revendications précédentes caractérisé en ce qu'elle comprend :
- un dispositif (1) de conformation en nappe (21) du coton,

- et au moins un premier poste (2) de traitement de la nappe (21) à travers ledit poste :

. des moyens (3, 3' ; 11, 12) de guidage de la nappe (21) à travers ledit poste,

. et au moins un moyen producteur de vapeur d'eau chaude injectant de la vapeur d'eau chaude dans la nappe.

8 - Installation de traitement selon la

revendication 7 caractérisée en ce que lesdits moyens de guidage (3, 3' ; 11, 12) sont constitués par des organes de compression entre lesquels la nappe est comprimée et entraînée.

9 - Installation de traitement selon la

5 revendication 7 ou la revendication 8 caractérisée en ce que le moyen producteur de vapeur d'eau chaude est une bande (4, 4') d'une matière spongieuse, telle qu'un tissu humide, et qui est chauffée et pressée contre la nappe de coton.

10 10 - Installation de traitement selon la

revendication 9 caractérisée en ce qu'elle comprend des plateaux (10) presseurs et chauffants contre lesquels vient en contact ladite bande humide (4, 4').

15 11 - Installation de traitement selon la revendication 9 caractérisée en ce qu'elle comprend des cylindres chauffants (11, 12), rotatifs, comprimant entre eux ladite bande humide (4, 4') en contact avec ladite nappe (21) de coton.

20 12 - Installation de traitement selon la revendication 11 caractérisée en ce que l'un des cylindres presseurs (11) est de grand diamètre et les autres sont constitués par une pluralité de cylindres (12) de plus faible diamètre qui viennent comprimer entre eux et ledit cylindre (11) de grand diamètre, ladite bande humide (4, 4') en contact avec ladite nappe (21) de coton.

25 13 - Installation selon l'une des revendications 9 à 12 caractérisée en ce que la nappe (21) de coton est placée entre deux bandes humides (4, 4') précitées.

30 14 - Installation de traitement selon l'une des revendications 9 à 13 caractérisée en ce qu'à chaque bande humide (4, 4') est associé un moyen de nettoyage (9, 9') et d'humidification (24, 24'), ledit moyen de nettoyage, en considérant le trajet de la nappe de coton à travers l'installation, étant disposé en aval de ce trajet.

35 15 - Installation selon la revendication 7 ou 8 caractérisée en ce que ledit moyen producteur de vapeur d'eau chaude comprend un générateur de vapeur alimenté indépendamment.

PROCEDE DE TRAITEMENT DU COTON PAR INJECTION DE VAPEUR D'EAU
CHAUDE ET INSTALLATION POUR LA MISE EN OEUVRE DU PROCEDE

=====

AU NOM DE : CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR
LE DEVELOPPEMENT (CIRAD)
(ETABLISSEMENT PUBLIC INDUSTRIEL A CARACTERE COMMERCIAL)

=====

ABREGE DESCRIPTIF

=====

L'invention se rapporte à un procédé et à une installation permettant le traitement des cotons pollués par des miellats en vue d'en faciliter la filature.

Selon l'invention, on conforme le coton à traiter sous forme d'une nappe (21) que l'on fait passer entre des organes de guidage (3, 3') entre lesquels est effectuée une injection de vapeur d'eau chaude, de préférence sous compression de la nappe.

L'invention s'applique au traitement des cotons pollués par des miellats.

Figure 1.

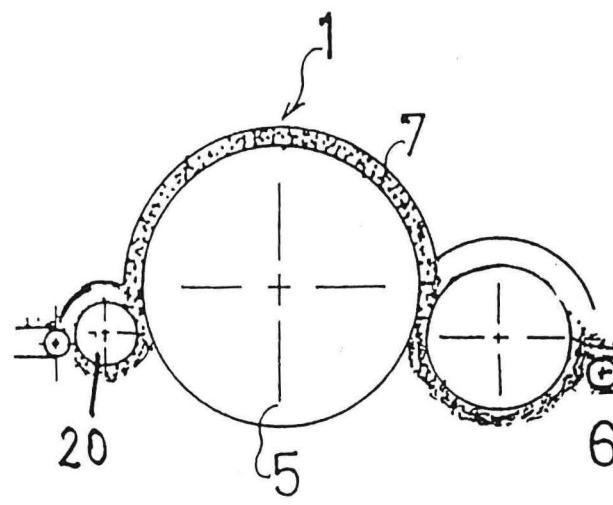
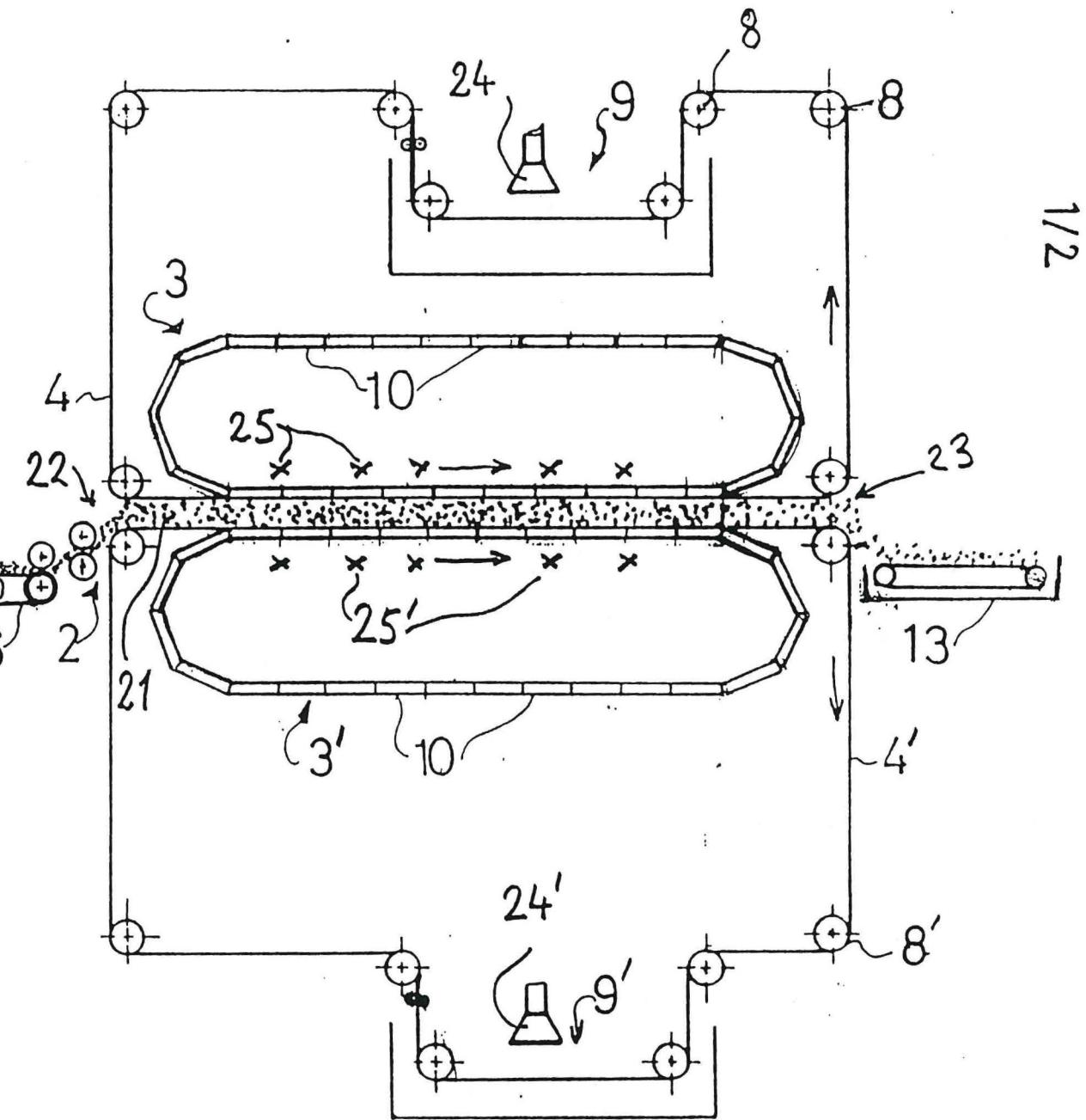


FIG 1



2/2

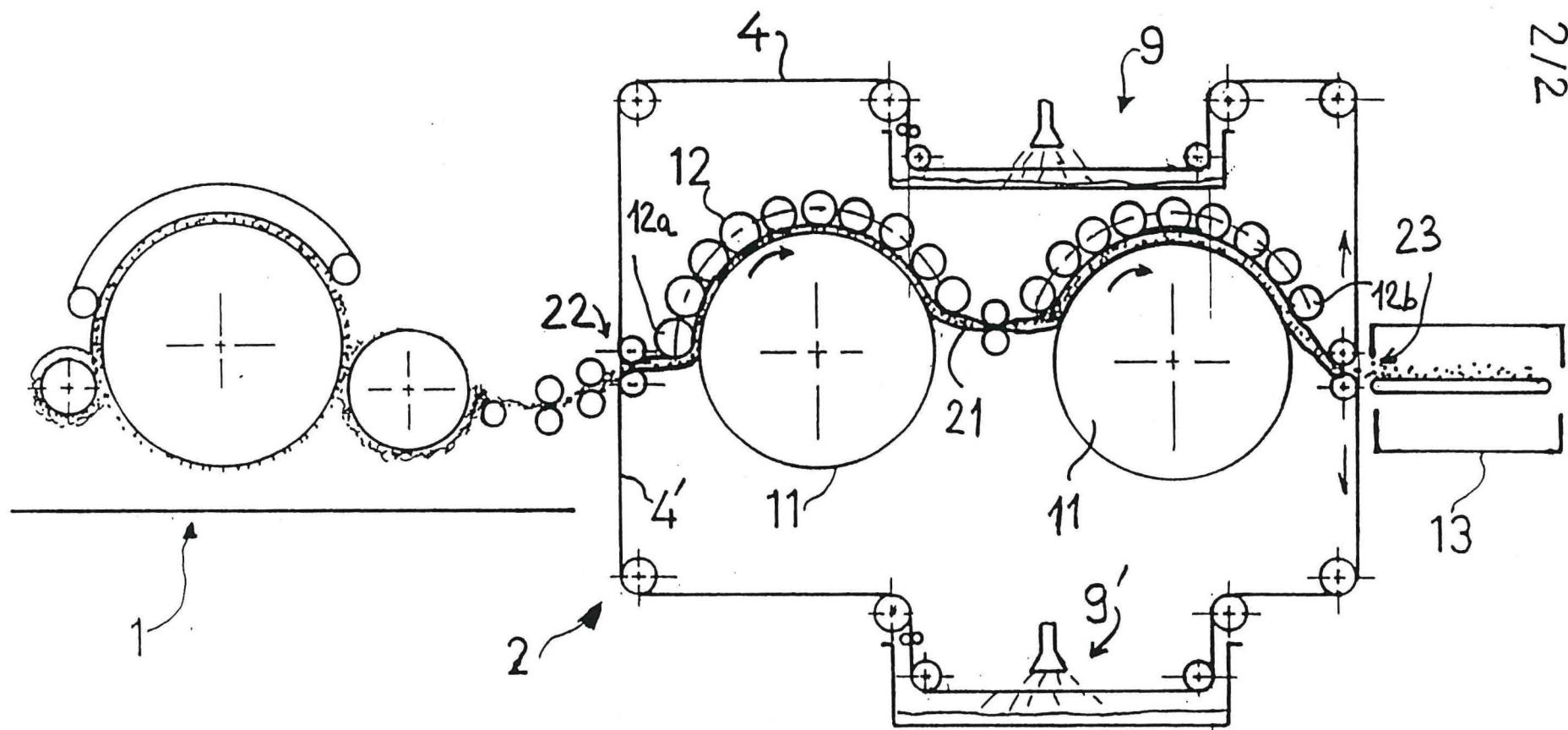


FIG 2

B.Et.3580

BREVET PCT

(EUROPE - U.S.A. - CANADA - FEDERATION DE RUSSIE,
AUSTRALIE, JAPON)

AU NOM DE :

CENTRE INTERNATIONAL DE RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT (C.I.R.A.D.)

EN : PCT/FR93/00457

DU 11 mai 1993

Pour : "Procédé et installation pour l'évaluation du caractère collant de matières fibreuses végétales telles que des cotons et utilisation de ce procédé et de cette installation"

Priorité France n°92 06142 du 20 mai 1992

TRAITE DE COOPERATION EN MATIERE DE BREVETS

PCT

NOTIFICATION DE RECEPTION DES DOCUMENTS SUPPOSES CONSTITUER UNE DEMANDE INTERNATIONALE

(instruction administrative 301 du PCT)

Expéditeur : l'OFFICE RECEPTEUR

Destinataire

Centre International de Recherche Agronomique pour le Développement
B.P. 3580
75009 Paris

Date d'expédition (jour/mois/année)	11 MAI 1993	
Référence du dossier du déposant ou du mandataire B.Et.3580	NOTIFICATION IMPORTANTE	
Demande internationale n° PCT/FR 93 / 00457	Date de réception (jour/mois/année)	11 MAI 1993
Déposant CENTRE INTERNATIONAL DE RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT (C.I.R.A.D.)		
Titre de l'invention "Procédé et installation pour l'évaluation du caractère collant de matières fibreuses végétales telles que des cotons et utilisation de ce procédé et de cette installation"		

- Il est notifié au déposant que l'office récepteur a reçu à la date de réception indiquée ci-dessus des documents supposés constituer une demande internationale.
- L'attention du déposant est appelée sur le fait que l'office récepteur n'a pas encore vérifié si ces documents satisfont aux conditions de l'article 11.1), c'est-à-dire s'ils remplissent les conditions nécessaires pour que soit attribuée une date de dépôt international.
- Dès que l'office récepteur aura vérifié ces documents, il en avisera le déposant.
- Le numéro de demande internationale indiqué plus haut a été provisoirement attribué à ces documents. Le déposant est invité à mentionner ce numéro dans toute correspondance avec l'office récepteur.

Nombre d'exemplaires

- 1 Requête
- 3 Description
- 3 Revendications (11)
- 3 Dessin(s) (1)
- 3 Abrégé
- Dessin abrégé

- Pouvoir (suivant)
- Document(s) de priorité (suivra)
- Rapport de recherche

- versement des taxes d'un montant de : 16 120 (Chèque Barclays) dont 100 F C.O.
- Autres documents

Nom et adresse postale de l'office récepteur <i>Institut National de la Propriété Industrielle 26bis, rue de Saint-Pétersbourg - 75800 Paris Cedex 08</i>	Fonctionnaire autorisé M. MARTIN
n° de télécopieur : (1) 42 94 53 24	n° de téléphone

RÉCÉPISSÉ DE REDEVANCES DE PROCÉDURE

11/05/93 11/05/93 4716899

22.3530 DEMANDE INTERNATIONALE

SELON LE TRAITÉ DE COOPÉRATION
EN MATIÈRE DE BREVETS (PCT)

N° D'USAGER OU COMPTE CLIENT 2 7 3

Signature du représentant autorisant le prélèvement sur compte client

NOM et ADRESSE de la personne à qui doit être adressé le récépissé

LERNER & BRULLE S.C.P.

057 Rue Jules Lefèvre

75009 PARIS

PCT / FR

DATE DE DÉPÔT

AU NOM DE :

CENTRE INTERNATIONAL EN RECHERCHE AGRONOMIQUE POUR LE
DEVELOPPEMENT (C.I.R.R.A.D.)Nombre de désignations
de brevet nationaux

+

Nombre de désignations
de brevet régionaux

= Nombre total de désignations

DÉCOMPTE DES REDEVANCES DE PROCÉDURE (cocher éventuellement la case et remplir le tableau)

Complément de versement

CODE	OBJET DU VERSEMENT	QUANTITÉ	PRIX UNITAIRE	TOTAL
REDEVANCES DE PROCÉDURE NATIONALE				
1 7 0	Redevance de procédure de transmission	1	* 400,-	400,-
1 7 1	Redevance de procédure de préparation par l'INPI des copies manquantes : par page			
TAXES INTERNATIONALES				
1 7 2	Taxe de recherche	1	8230,-	8230,-
1 7 3	Taxe de base jusqu'à 30 feuilles	1		3010,-
1 7 3	Taxe de base au delà de 30 feuilles , par feuille supplémentaire			
1 7 3	Taxe de désignations , nombre total de désignations à payer *	6	730	4380,-
* IMPORTANT : toute désignation à partir de la 11ème est gratuite				MONTANT DU RÉCÉPISSÉ 16020,-

Signature de l' Agent comptable de l' INPI ou du Régisseur

LES ZONES TRAMÉES SONT RÉSERVÉES A L'INPI



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PCT

REQUETE

Le soussigné requiert que la présente demande internationale soit traitée conformément au Traité de coopération en matière de brevets.

Réservé à l'office récepteur

Demande internationale n° _____

Date du dépôt international _____

Nom de l'office récepteur et "Demande internationale PCT"

Référence du dossier du déposant ou du mandataire (*facultatif*)
(12 caractères au maximum)

Cadre n° I TITRE DE L'INVENTION "Procédé et installation pour l'évaluation du caractère collant de matières fibreuses végétales telles que des cotons et utilisation de ce procédé et de cette installation".

Cadre n° II DEPOSANT

Nom et adresse : (*Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.*)

CENTRE INTERNATIONAL DE RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT (C.I.R.A.D.)
Avenue du Val de Montferrand B.P.5035
34032 MONTPELLIER FRANCE

Cette personne est aussi inventeur.

n° de téléphone

n° de télécopieur

n° de téléimprimeur

Nationalité (nom de l'Etat) : FRANCE

Domicile (nom de l'Etat) : FRANCE

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Cadre n° III AUTRES DEPOSANTS OU (AUTRES) INVENTEURS

Nom et adresse : (*Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.*)

FRYDRYCH Richard
100, rue Laurent Chabry
34090 MONTPELLIER FRANCE

Cette personne est :

déposant seulement

déposant et inventeur

inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) : FRANCE

Domicile (nom de l'Etat) : FRANCE

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

Nom et adresse : (*Nom de famille suivi du prénom; pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.*)

Cette personne est :

déposant seulement

déposant et inventeur

inventeur seulement
(Si cette case est cochée,
ne pas remplir la suite.)

Nationalité (nom de l'Etat) :

Domicile (nom de l'Etat) :

Cette personne est déposant pour : tous les Etats désignés tous les Etats désignés sauf les Etats-Unis d'Amérique les Etats-Unis d'Amérique seulement les Etats indiqués dans le cadre supplémentaire

D'autres déposants ou inventeurs sont indiqués sur une feuille annexe.

Cadre n° IV MANDATAIRE OU REPRESENTANT COMMUN: OU ADRESSE POUR LA CORRESPONDANCE

La personne dont l'identité est donnée ci-dessous est/a été désignée pour agir au nom du ou des déposants auprès des autorités internationales compétentes, comme :

 mandataire représentant commun

Nom et adresse : (*Nom de famille suivi du prénom: pour une personne morale, désignation officielle complète. L'adresse doit comprendre le code postal et le nom du pays.*)

LERNER François ou BRULLE Jean
LERNER & BRULLE S.C.P.
05, rue Jules Lefèvre
75009 PARIS - FRANCE -

n° de téléphone

48 74 45 96

n° de télécopieur

42 81 49 77

n° de téléimprimeur

Cocher cette case lorsque aucun mandataire ni représentant commun n'est/n'a été désigné et que l'espace ci-dessus est utilisé pour indiquer une adresse spéciale à laquelle la correspondance doit être envoyée.

Cadre n° V DESIGNATION D'ETATS

Les désignations suivantes sont faites conformément à la règle 4.9.a) (*cocher les cases appropriées: une au moins doit l'être*):
Brevet régional

- EP Brevet européen : AT Autriche, BE Belgique, CH et LI Suisse et Liechtenstein, DE Allemagne, DK Danemark, ES Espagne, FR France, GB Royaume-Uni, GR Grèce, IT Italie, LU Luxembourg, MC Monaco, NL Pays-Bas, SE Suède et tout autre Etat qui est un Etat contractant de la Convention sur le brevet européen et du PCT
- OA Brevet OAPI : Bénin, Burkina Faso, Cameroun, Congo, Côte d'Ivoire, Gabon, Guinée, Mali, Mauritanie, République centrafricaine, Sénégal, Tchad, Togo et tout autre Etat qui est un Etat membre de l'OAPI et un Etat contractant du PCT (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*)

Brevet national (*si une autre forme de protection ou de traitement est souhaitée, le préciser sur la ligne pointillée*):

- | | |
|--|--|
| <input type="checkbox"/> AT Autriche | <input type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> AU Australie | <input type="checkbox"/> MN Mongolie |
| <input type="checkbox"/> BB Barbade | <input type="checkbox"/> MW Malawi |
| <input type="checkbox"/> BG Bulgarie | <input type="checkbox"/> NL Pays-Bas |
| <input type="checkbox"/> BR Brésil | <input type="checkbox"/> NO Norvège |
| <input checked="" type="checkbox"/> CA Canada | <input type="checkbox"/> PL Pologne |
| <input type="checkbox"/> CH et LI Suisse et Liechtenstein | <input type="checkbox"/> RO Roumanie |
| <input type="checkbox"/> CS Tchécoslovaquie | <input checked="" type="checkbox"/> RU Fédération de Russie |
| <input type="checkbox"/> DE Allemagne | <input type="checkbox"/> SD Soudan |
| <input type="checkbox"/> DK Danemark | <input type="checkbox"/> SE Suède |
| <input type="checkbox"/> ES Espagne | <input checked="" type="checkbox"/> US Etats-Unis d'Amérique |
| <input type="checkbox"/> FI Finlande ..... | ..... |
| <input type="checkbox"/> GB Royaume-Uni ..... | ..... |
| <input type="checkbox"/> HU Hongrie ..... | ..... |
| <input checked="" type="checkbox"/> JP Japon ..... | ..... |
| <input type="checkbox"/> KP République populaire démocratique de Corée ..... | ..... |
| <input type="checkbox"/> KR République de Corée ..... | ..... |
| <input type="checkbox"/> LK Sri Lanka ..... | ..... |
| <input type="checkbox"/> LU Luxembourg ..... | ..... |

Cases réservées pour la désignation (aux fins d'un brevet national) d'Etats qui sont devenus parties au PCT après la publication de la présente feuille :

- | | |
|--------------------------|-------|
| <input type="checkbox"/> | |

Outre les désignations faites ci-dessus, le déposant fait aussi conformément à la règle 4.9.b) toutes les désignations qui seraient autorisées en vertu du PCT, sauf la désignation de _____

Le déposant déclare que ces désignations additionnelles sont faites sous réserve de confirmation et que toute désignation qui n'est pas confirmée avant l'expiration d'un délai de 15 mois à compter de la date de priorité doit être considérée comme retirée par le déposant à l'expiration de ce délai. (*Pour confirmer une désignation, il faut déposer une déclaration contenant la désignation en question et payer les taxes de désignation et de confirmation. La confirmation doit parvenir à l'office receleur dans le délai de 15 mois.*)

Cadre n° VI REVENDICATION DE PRIORITE			D'autres revendications de priorité sont indiquées dans le cadre supplémentaire <input type="checkbox"/>
La priorité de la ou des demandes antérieures suivantes est revendiquée :			
Pays (dans lequel ou pour lequel la demande a été déposée)	Date de dépôt (jour/mois/année)	Demande n°	Office de dépôt (seulement s'il s'agit d'une demande régionale ou internationale)
(1) FRANCE	20 MAI 1992	92 06142	
(2)			
(3)			

Cocher la case ci-dessous si la copie certifiée conforme de la demande antérieure doit être délivrée par l'office qui, aux fins de la présente demande internationale, est l'office récepteur (une taxe peut être exigée) :

L'office récepteur est prié de transmettre au Bureau international une copie certifiée conforme de la ou des demandes antérieures indiquées ci-dessus au(x) point(s) : (1)

Cadre n° VII RECHERCHE ANTERIEURE

Remplir si une recherche (internationale, de type international ou autre) a déjà été effectuée par l'administration chargée de la recherche internationale ou demandée à cette administration et si cette administration est maintenant priée de fonder la recherche internationale, dans la mesure du possible, sur les résultats de cette recherche antérieure. Pour permettre d'identifier cette recherche ou cette demande de recherche, donner les renseignements demandés ci-après pour la demande de brevet pertinente (ou sa traduction) ou pour la demande de recherche :

Pays (ou office régional) : Date (jour/mois/année) : Numéro :
FRANCE 20 MAI 1992 92 06142

Cadre n° VIII BORDEREAU

La présente demande internationale comprend le nombre de feuillets suivant :

1. requête	:	3	feuilles
2. description	:	8	feuilles
3. revendications	:	2	feuilles
4. abrégé	:	1	feuilles
5. dessins	:	1	feuilles
Total	:	15	feuilles

Le ou les éléments cochés ci-après sont joints à la présente demande internationale :

1. <input checked="" type="checkbox"/> pouvoir distinct signé SUIVRONT	5. <input type="checkbox"/> feuille de calcul des taxes
2. <input type="checkbox"/> copie du pouvoir général	6. <input type="checkbox"/> indications séparées concernant des micro-organismes déposés
3. <input type="checkbox"/> explication de l'absence d'une signature	7. <input type="checkbox"/> listage de séquence de nucléotides ou d'acides aminés
4. <input checked="" type="checkbox"/> document(s) de priorité SUIVRA	8. <input checked="" type="checkbox"/> autres élément Recherche (préciser) : antérieure

La figure n° 1 des dessins (le cas échéant) est proposée pour publication avec l'abrégé.

Cadre n° IX SIGNATURE DU DEPOSANT OU DU MANDATAIRE

A côté de chaque signature, indiquer le nom du signataire et, si cela n'apparaît pas clairement à la lecture de la requête, à quel titre l'intéressé signe.

LERNER & BRULLE S.C.P.
François LERNER

Réserve à l'office récepteur

1. Date effective de réception des pièces supposées constituer la demande internationale :	2. Dessins : <input type="checkbox"/> reçus : <input type="checkbox"/> non reçus :
3. Date effective de réception, rectifiée en raison de la réception ultérieure, mais dans les délais, de documents ou de dessins complétant ce qui est supposé constituer la demande internationale :	
4. Date de réception, dans les délais, des corrections demandées selon l'article 11.2) du PCT :	
5. Administration chargée de la recherche internationale indiquée par le déposant : ISA /	6. <input type="checkbox"/> Transmission de la copie de recherche différée jusqu'au paiement de la taxe de recherche

Réserve au Bureau international

Date de réception de l'exemplaire original par le Bureau international :

Cette feuille ne fait pas partie de la demande internationale ni ne compte comme une feuille à celle ci.

PCT

FEUILLE DE CALCUL DES TAXES Annexe de la requête

Réservé à l'office récepteur

Demande internationale n°

Timbre à date de l'office récepteur

Référence du dossier du déposant ou du mandataire B.Et.3580

Déposant : CENTRE INTERNATIONAL DE RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT (C.I.R.A.D.)

CALCUL DES TAXES PRESCRITES

1. TAXE DE TRANSMISSION	400	T
2. TAXE DE RECHERCHE	823 0	S

Recherche internationale à effectuer par _____

(Si plusieurs administrations chargées de la recherche internationale sont compétentes en ce qui concerne la demande internationale, inscrire le nom de celle qui est choisie pour la recherche internationale.)

3. TAXE INTERNATIONALE

Taxe de base

La demande internationale contient 15 feuillets.

30 premières feuillets	3010	b ₁
feuilles suivantes montant additionnel		b ₂

Additionner les montants portés dans les cadres b₁ et b₂ et inscrire le total dans le cadre B

3010 B

Taxe de désignation

6 x 730 =	4 380	D
nombre de désignations montant de la taxe de désignation		

(Si ce produit dépasse le montant correspondant à dix fois la taxe de désignation, porter ce dernier montant dans le cadre D.)

Additionner les montants portés dans les cadres B et D, et inscrire le total dans le cadre I

7390 I

100 P

4. TAXE AFFERENTE AU DOCUMENT DE PRIORITE

5. TOTAL DES TAXES DUES

Additionner les montants portés dans les cadres

T, S, I et P, et inscrire le résultat dans le cadre TOTAL

16 120

TOTAL

La taxe de désignation sera payée ultérieurement.

MODE DE PAIEMENT

autorisation de débiter un compte de dépôt (voir ci-dessous)

traite bancaire

coupons

chèque

espèces

autres (préciser):

mandat postal

timbres fiscaux

AUTORISATION CONCERNANT UN COMPTE DE DEPOT

L'office récepteur/ est autorisé à débiter mon compte de dépôt du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt de tout montant manquant – ou à le créditer de tout excédent – dans le paiement du total des taxes indiqué ci-dessus.

est autorisé à débiter mon compte de dépôt du montant de la taxe afférante à l'établissement du document de priorité et à sa transmission au Bureau international de l'OMPI.

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11 mai 1993

François LERNER

Numéro du compte de dépôt

Date (jour/mois/année)

Signature

L'invention a pour objet un procédé et une installation pour l'évaluation du caractère collant de matières fibreuses végétales telles que des cotons ; l'invention vise en outre l'utilisation de ce procédé et de cette installation pour la conduite dans les meilleures conditions d'opérations successives de traitement des matières fibreuses ainsi polluées.

Depuis quelques années, les matières fibreuses végétales et en particulier les cotons de diverses provenances provoquent un phénomène de collage en filature, ce qui induit de fortes pertes de productivité.

Le collage est lié principalement à des déjections d'insectes appelées "miellats" composées essentiellement de sucre et qui confèrent au coton un pouvoir collant.

Pour solutionner ce problème, plusieurs procédés ont été proposés pour déterminer et éliminer les miellats ou leur action de collage.

En particulier, la demanderesse a mis au point une machine qui permet, par examen d'un échantillon maintenu à un degré hygrométrique précis et qui est pressé entre deux feuilles d'aluminium convenablement chauffées de déterminer le potentiel de collage de l'échantillon examiné.

Cette machine présente l'inconvénient que la procédure est relativement délicate à mettre en oeuvre, longue, coûteuse et qu'en outre, la détermination du degré de collage de l'échantillon reste finalement très subjective et peut varier considérablement d'un opérateur à l'autre.

L'invention a pour objet de résoudre ces difficultés en permettant une évaluation précise rapide et économique du caractère collant de la matière fibreuse en perfectionnant notamment le procédé et la machine dont il

vient d'être question.

Le procédé conforme à l'invention se caractérise par les étapes successives suivantes :

- on prépare un échantillon de la matière fibreuse de façon qu'il présente une large surface par rapport à son poids,

- on applique au moyen d'un organe pressant et chauffant l'échantillon ainsi déployé sur une plaque d'aluminium ou analogue pendant quelques secondes,

- on applique ensuite une pression à froid du même échantillon sur la même plaque pendant quelques secondes,

- si nécessaire, on effectue un séchage superficiel à l'air chaud de la plaque,

- on enlève les fibres de l'échantillon adhérant à la plaque,

- et on compte le nombre des points de miellats adhérant à la plaque, lequel nombre détermine le caractère collant de l'échantillon ramené à sa surface déployée.

On partira avantageusement d'un échantillon de quelques grammes, par exemple d'un poids compris entre 2 et 5 grammes que l'on ouvrira sur une surface de quelques centaines de cm^2 , par exemple de l'ordre de 200 cm^2 .

Lorsqu'on procède de cette façon on constate que toutes choses égales par ailleurs, le nombre des points de miellat décompté est indépendant du poids de l'échantillon qui n'a donc pas besoin d'être pesé de façon précise, tandis qu'il est aisé de l'ouvrir sur une surface donnée par exemple de $17 \times 12 \text{ cm}$ soit environ 200 cm^2 .

Avantageusement, le chauffage s'effectue à une température comprise entre 33 et 140° C , de préférence entre 50 et 90° C .

La pression à chaud peut être maintenue pendant quelques secondes et sera de l'ordre d'au moins 40 g/cm^2 , des résultats très satisfaisants étant obtenus avec une pression comprise entre 80 g/cm^2 et 500 g/cm^2 .

Plus la température est basse, plus la pression et la durée de maintien de cette pression seront élevées.

Par exemple d'excellents résultats sont obtenus avec les paramètres suivants :

5 a) température : 53°C, pression : 500 g/cm²,
durée de maintien de la pression : 30 secondes,

b) température : 85°C, pression : 80 g/cm²,
durée de maintien de la pression : 5 secondes.

La pression à froid pourra être maintenue
10 pendant 15 à 30 secondes environ, la pression étant du même ordre de grandeur que celle utilisée pour la pression à chaud.

Le procédé de l'invention permet ainsi en un laps de temps très court, inférieur à 2 minutes, de
15 déterminer de façon précise le caractère collant d'un coton pollué par des miellats ; la connaissance quasi instantanée du pouvoir collant du coton permet alors de déterminer sans retard et d'adapter immédiatement les opérations de traitement les plus appropriées à ce coton.

20 En particulier, il est possible, à partir de la connaissance de ce pouvoir collant du coton, de piloter une installation de traitement de dépollution du même coton.

De la même façon, il est possible, à partir de la connaissance du pouvoir collant du coton, de déterminer
25 quel type de filature peut éventuellement être mis en oeuvre sans inconvénient majeur.

30 L'invention vise en outre des installations permettant l'automatisation ou la semi-automatisation du procédé, comme il va résulter plus clairement de la description qui va suivre faite en référence aux dessins annexés dans lesquels :

la figure 1 montre schématiquement une installation pour la mise en oeuvre du procédé de l'invention selon un premier mode de réalisation,

35 la figure 2 montre de façon similaire à la figure 1 une variante de ce procédé,

la figure 3 est un schéma relatif à une troisième variante.

En se référant tout d'abord à la figure 1, on a repéré en 1 un système d'identification des échantillons, correspondant par exemple à des balles de coton déterminées, lesquels échantillons peuvent être repérés par un système de lecteur à codes barres par exemple.

En 2, on a représenté schématiquement un système de préparation de l'échantillon, par exemple du type à rotor permettant d'ouvrir un échantillon de coton pouvant peser entre 1 et 5 grammes, et généralement entre 2 et 3 grammes et qui une fois ouvert, va occuper une surface d'environ 17 X 12 centimètres (de l'ordre de 200 cm²).

L'échantillon est alorsposé, comme indiqué en 3, sur une bande métallique, avantageusement d'aluminium 4, déroulée à partir d'un rouleau 5 approvisionneur et enroulée à la sortie de la machine sur un rouleau de reprise 6.

La feuille 4 se déroule au-dessus d'un support neutre 7 par exemple en matériau plastique ou en bois.

Un plateau chauffant 8 est chauffé à la température choisie entre 33° C et 140° C, préférentiellement entre 50° C et 90° C.

Lorsque l'échantillon 3 est en place, sous le plateau chauffant 8, celui-ci est commandé en abaissement et vient presser l'échantillon contre la feuille d'aluminium 4.

La pression est maintenue pendant une durée plus ou moins longue selon la température choisie et qui peut être de l'ordre de 5 à 30 secondes par exemple, pour des températures de l'ordre de 85° C à 53° C.

La pression est avantageusement comprise entre 40 g/cm² et 1 000 g/cm², des résultats tout à fait satisfaisants étant obtenus avec une pression comprise entre 80 g/cm² et 500 g/cm², des pressions plus élevées étant avantageusement utilisées en relation avec des

températures moins élevées.

L'action conjuguée de la pression et de la chaleur exercée sur l'échantillon 3 fait s'évaporer une partie de l'humidité contenue dans le coton, créant une fine couche de vapeur sur le support d'aluminium et permettant à ce niveau le ramollissement des billes de sucre ou de miellats contenues dans le coton et qui viennent se fixer au support d'aluminium 4. A ce sujet, on notera que l'action indiquée suppose l'existence d'une certaine humidité du coton ; en l'occurrence, un degré d'humidité de l'échantillon compris entre 40 % et 85 % permet d'obtenir sans problème le résultat recherché, la mesure étant en pratique généralement conduite pour un taux d'humidité proche de 60-65 %. On notera que c'est l'effet conjugué d'une certaine épaisseur, ni trop faible, ni trop importante de l'échantillon, et d'un cheminement de vapeur à travers l'épaisseur de l'échantillon qui paraît donner à la mesure du caractère collant du coton son indépendance par rapport au poids testé de l'échantillon.

L'opération de pressage à chaud étant terminé, par exemple au bout de 5 secondes, le plateau 8 est relevé, la bande 4 est avancée d'un pas et vient se présenter sous le plateau 9 qui s'abaissera alors et qui va assurer une pression à froid de l'échantillon 3 qui s'est déplacé en 3'.

La pression à froid peut être maintenue pendant environ 15 à 30 secondes ; elle a pour objet d'assurer une meilleure fixation des points collants sur le support d'aluminium 4.

La pression du plateau froid 9 est avantageusement du même ordre de grandeur que celle exercée par le plateau chauffant 8.

A la fin de cette opération, le plateau 9 est relevé et une brosse ou un balai 10 placé après le poste 9 élimine la plupart des fibres de l'échantillon 3' lorsque la bande 4 est avancée d'un pas jusqu'au poste référencé 11

qui est un poste de séchage.

A cet endroit, l'échantillon, si nécessaire, est séché par de l'air chaud de façon à éliminer l'humidité résiduelle et à fixer correctement à la feuille d'aluminium 4 les points de sucre et de miellat qui se sont déposés sur elle. On a constaté que généralement le séchage n'est pas requis si l'on a utilisé une température de pression à chaud relativement basse, exemplairement comprise entre 50° C et 55° C et un maintien de la pression suffisamment long, exemplairement de l'ordre de 30 secondes.

L'échantillon est ensuite avancé jusqu'à une brosse 12, éventuellement doublée d'un système d'aspirateur nettoyeur 13, qui éliminent les fibres restantes adhérent à la plaque.

En 14, il ne reste plus qu'à lire, par exemple au moyen d'une caméra appropriée, le nombre de points laissés par l'échantillon sur la feuille 4.

Ce nombre de points, ramené à la surface de l'échantillon préparé, permet de déterminer de façon précise et automatique le degré ou pouvoir collant du coton ainsi traité.

Bien entendu, de nombreuses variantes peuvent être apportées au mode de réalisation décrit.

Ainsi, dans le mode de réalisation illustré à la figure 2 et dans laquelle les mêmes repères indiquent les éléments semblables se retrouvant dans ces deux réalisations et qui ne seront pas redécrits, la feuille d'aluminium 4 a été remplacée par une bande métallique continue 15, par exemple d'aluminium d'épaisseur convenable et qui circule en continu en étant entraînée sous tension entre les deux rouleaux 16, 17 dont l'un au moins est moteur.

La bande 15, à la sortie du poste 14 est débarassée comme indiqué en 18, par exemple par un racleur de la plupart des matières qui y adhèrent, après quoi elle est convenablement nettoyée par un rouleau ou une brosse 19

éventuellement imprégné d'un solvant, puis séchée en 20, avant réutilisation au poste de départ 8.

Dans la variante illustrée à la figure 3, au lieu d'une bande métallique qui se déplace sous différents postes successifs, on trouve des plaques individuelles se déplaçant successivement sous des postes : 22 d'application du miellat sur la plaque 21 ; 23 de nettoyage/chauffage de l'échantillon pour le débarrasser des fibres ; 24 de comptage des points de miellat ; et 25 de nettoyage avant réutilisation au poste 22.

Le poste 22 peut comprendre une plaque de pressage à chaud 26 et une plaque de pressage à froid 27 qui viennent successivement en action (après retournement de 180° de l'ensemble) et qui sont séparées par un isolant 28.

Le poste de nettoyage/enlèvement des fibres, peut comprendre une zone d'aspiration/brossage 29 et une zone de séchage 30 ainsi qu'une brosse 31 pour enlever les dernières fibres.

Le poste de nettoyage 25 peut comprendre une raclette 32 avec élimination des déchets en 33 et une brosse de nettoyage/séchage 34.

Bien entendu, de nombreuses variantes peuvent être imaginées aux modes de réalisation schématiquement décrits uniquement à titre d'illustration. En particulier, on peut bien entendu travailler sur des échantillons plus ou moins importants, l'essentiel étant de respecter une proportion dans laquelle le poids de l'échantillon utilisé reste faible par rapport à sa surface, soit préférentiellement de l'ordre de 2 à 5 g pour 200 cm² dans les exemples donnés, une fourchette satisfaisante pouvant être par exemple de 0,5 à 5 g pour 100 cm².

De la description qui précède, on comprend que le procédé et l'installation d'évaluation conformes à l'invention peuvent être entièrement automatisés et que les paramètres acquis par cette installation peuvent être

utilisés pour piloter de la manière appropriée toute installation de traitement prévue en aval.

En particulier, une installation du type ci-dessus décrit peut être utilisé pour piloter une installation d'élimination des miellats notamment par dissolution/modification par vapeur d'eau chauffée, en adaptant le degré du traitement au degré de pollution du coton.

REVENDICATIONS

1 - Procédé d'évaluation du caractère collant de matières fibreuses végétales telles que des cotons, 5 caractérisé en ce que :

- on prépare un échantillon (3) de la matière fibreuse de façon qu'il présente une large surface par rapport à son poids,

10 - on applique au moyen d'un organe pressant et chauffant (8) l'échantillon ainsi déployé sur une plaque d'aluminium ou analogue (4, 15, 21) pendant quelques secondes,

15 - on applique ensuite une pression à froid du même échantillon sur la même plaque pendant quelques secondes,

- on effectue éventuellement un séchage superficiel à l'air chaud de la plaque,

- on enlève les fibres de l'échantillon qui adhèrent à la plaque,

20 - et on compte le nombre des points de miellats adhérant à la plaque, lequel nombre détermine le caractère collant de l'échantillon ramené à sa surface déployée.

25 2 - Procédé selon la revendication 1 caractérisé en ce qu'on utilise en tant qu'échantillon une masse de coton de quelques grammes, avantageusement de 2 à 5 g, que l'on ouvre sur une surface de quelques centaines de cm^2 , avantageusement de l'ordre de 200 cm^2 .

30 3 - Procédé selon la revendication 1 ou 2 caractérisé en ce qu'on effectue le chauffage entre 33 et 140° C, de préférence entre 50° C et 90° C.

4 - Procédé selon l'une des revendications précédentes caractérisé en ce qu'on maintient la pression à chaud pendant une durée comprise entre 5 secondes et 30 secondes environ.

35 5 - Procédé selon l'une des revendications précédentes caractérisé en ce que la pression à chaud est

supérieure à 40 g/cm² et de préférence comprise entre 80 g/cm² et 500 g/cm².

6 - Procédé selon les revendications 3, 4 et 5, caractérisé en ce que la valeur de la pression utilisée pour la pression à chaud et la durée du maintien de cette pression sont d'autant plus élevées dans les fourchettes indiquées que la température est plus basse.

7 - Procédé selon l'une des revendications précédentes caractérisé en ce qu'on maintient la pression à froid pendant une durée d'environ 15 à 30 secondes.

8 - Installation pour la mise en oeuvre du procédé selon l'une des revendications précédentes caractérisée en ce qu'on utilise en tant que plaque sur laquelle est pressé l'échantillon une feuille continue d'aluminium (4) déroulée entre un rouleau d'approvisionnement (5) et un rouleau de reprise (6).

9 - Installation pour la mise en oeuvre du procédé selon l'une quelconque des revendications 1 à 7 caractérisée en ce qu'on utilise en tant que plaque sur laquelle est pressé l'échantillon une bande continue (15) nettoyée après le processus d'évaluation du collage.

10 - Installation pour la mise en oeuvre du procédé selon l'une quelconque des revendications 1 à 7 caractérisée en ce qu'on utilise en tant que plaque sur laquelle est pressé l'échantillon, une plaque (21) qui est déplacée devant des postes successifs de pressage (22) à chaud et à froid de l'échantillon, de brossage-séchage (23), de comptage (24) puis de nettoyage (25).

11 - Utilisation du procédé selon l'une quelconque des revendications 1 à 7 et/ou d'une installation selon l'une quelconque des revendications 8 à 10 pour le traitement de matières fibreuses telles que des coton, caractérisée en ce que l'installation de traitement est gérée en fonction des paramètres d'analyse recueillis sur les échantillons dont le caractère collant est précédemment évalué.

PROCEDE ET INSTALLATION POUR L'EVALUATION DU CARACTERE
COLLANT DE MATIERES FIBREUSES VEGETALES TELLES QUE DES
COTONS ET UTILISATION DE CE PROCEDE ET DE CETTE
INSTALLATION

AU NOM DU CENTRE INTERNATIONAL DE RECHERCHE AGRONOMIQUE
POUR LE DEVELOPPEMENT CIRAD

ABREGE DESCRIPTIF

Conformément à l'invention, on prépare un échantillon (3) de la matière fibreuse que l'on applique au moyen d'un organe pressant et chauffant (8) sur une plaque d'aluminium et après enlèvement des fibres et séchage des points de miellat sur la plaque, on effectue un comptage automatique devant un poste (14).

L'invention s'applique notamment à l'automatisation des installations de traitement des cotons pollués.

Figure 1.

1 / 1

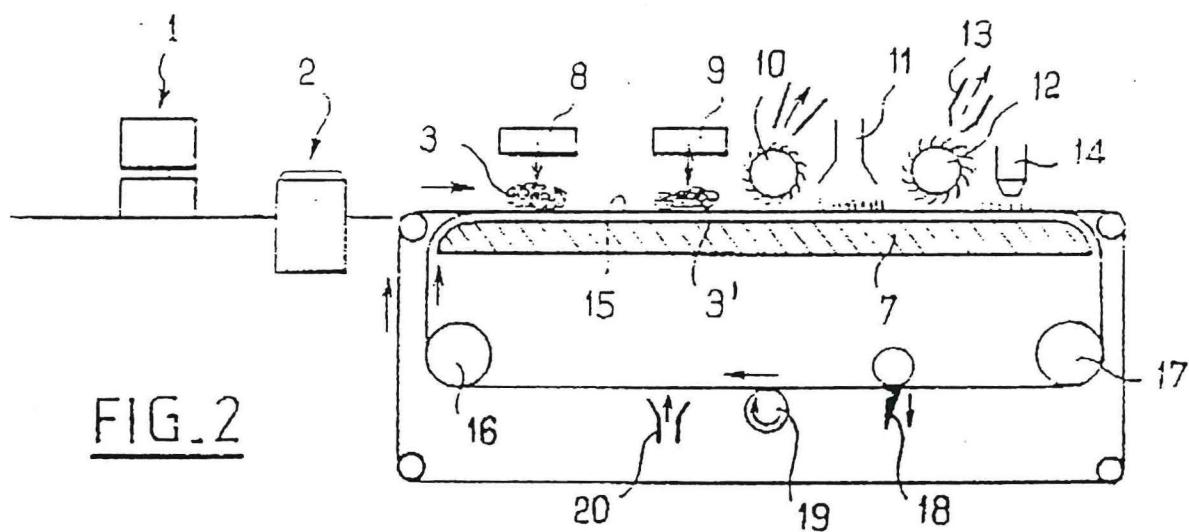
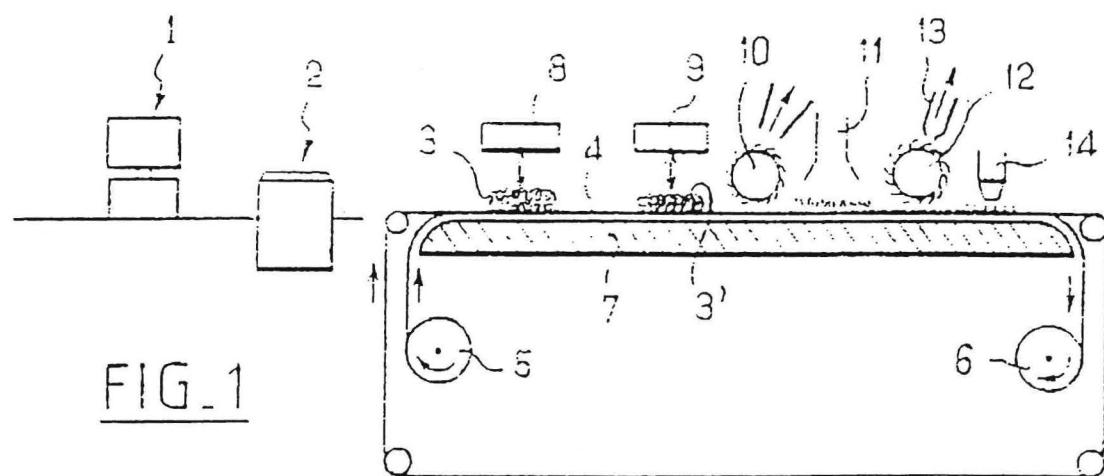


FIG. 2

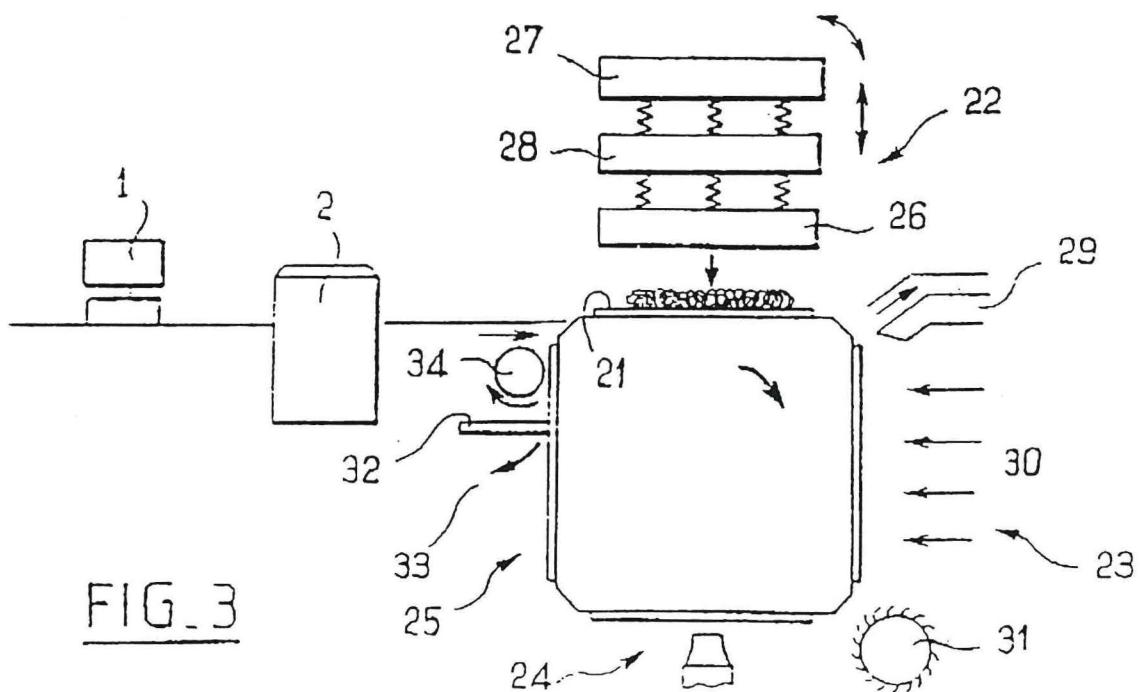


FIG. 3

NORMES

NORMES

Ces deux normes sont à l'enquête publique et ne sont donc pas définitives

[N1] - Themodétecteur SCT : en cours de normalisation CEN TC 248 WG19 « Stickiness of cotton fibers »

[N2] - Automatic thermodetection plate device : en cours de normalisation CEN TC 248 WG19 « Stickiness of cotton fibers »

**NORME EUROPÉENNE
EUROPÄISCHE NORM
EUROPEAN STANDARD**

**PROJET
prEN 14278-1**

Octobre 2001

ICS

Version Française

**Textiles - Determination du collage des fibres de coton -
Méthode utilisant un dispositif manuel de thermodétection**

Textilien - Bewertung der Klebrigkeit von Baumwolle - Teil
1:Verfahren mit dem manuellen Thermodetektionsgerät

Textiles - Determination of cotton fibre stickiness - Part 1:
Method using a manual thermodetection device

Le présent projet de Norme européenne est soumis aux membres du CEN pour enquête. Il a été établi par le Comité Technique CEN/TC 248.

Si ce projet devient une Norme européenne, les membres du CEN sont tenus de se soumettre au Règlement Intérieur du CEN/CENELEC, qui définit les conditions dans lesquelles doit être attribué, sans modification, le statut de norme nationale à la Norme européenne.

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**COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG
EUROPEAN COMMITTEE FOR STANDARDIZATION**

Centre de Gestion: rue de Stassart, 36 B-1050 Bruxelles

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Avant-propos

Le présent document a été préparé par le CEN /TC 248 "Textiles et produits textiles".

Le présent document est actuellement soumis à l'Enquête CEN.

Introduction

La présente méthode a pour but de déterminer le potentiel de collage des fibres de coton en simulant les effets négatifs de cette caractéristique au cours du procédé de filature. Les raisons du collage ne sont pas étudiées.

Les résultats obtenus à l'aide de la présente méthode ne sont pas directement liés à la détermination de la teneur en sucre.

La présente norme se compose des méthodes suivantes, présentées sous le tire général « Détermination du collage des fibres de coton » :

- *Partie 1 : Méthode utilisant un dispositif manuel de thermodétection ;*
- *Partie 2 : Méthode utilisant un dispositif automatique de thermodétection à plateau ;*
- *Partie 3 : Méthode utilisant un dispositif automatique à tambour rotatif.*

1 Domaine d'application

La présente norme décrit une technique manuelle permettant de simuler la tendance des fibres de coton à coller aux surfaces de travail textile.

Les éprouvettes peuvent être constituées de fibres brutes de coton (fibres échantillonnées à partir d'une balle, par exemple), ou de fibres ouvertes, de rubans etc.

2 Références normatives

Cette Norme européenne comporte par référence datée ou non datée des dispositions d'autres publications. Ces références normatives sont citées aux endroits appropriés dans le texte et les publications sont énumérées ci-après. Pour les références datées, les amendements ou révisions ultérieurs de l'une quelconque de ces publications ne s'appliquent à cette Norme européenne que s'ils y ont été incorporés par amendement ou révision. Pour les références non datées, la dernière édition de la publication à laquelle il est fait référence s'applique.

EN 20139, *Textiles — Atmosphères normales de conditionnement et d'essai*.

3 Termes et définitions

Pour les besoins de la présente partie de l'EN 14278, les termes et définitions suivants s'appliquent.

3.1

niveau de collage

nombre de points collants indiquant l'incidence du collage de la fibre de coton

3.2

thermodétection

processus visant à révéler les points collants par l'application combinée de chaleur et de pression

3.3

points collants

entrelacement de fibres ou fibres isolées, attaché(es) à une surface de travail en raison du collage propre au coton

3.4

ensemble

feuilles supérieure et inférieure en aluminium renfermant un échantillon de fibres

3.5

dispositif d'élimination

dispositif utilisé pour éliminer les fibres non collantes de la surface de comptage

4 Principe

Un voile de fibres, de superficie et de masse déterminées, est placé entre deux feuilles d'aluminium et comprimé à deux niveaux de pression appliqués successivement à différents réglages de la température pour révéler les points collants.

Ces points collants sont ensuite dénombrés pour évaluer le niveau de collage.

5 Appareillage

5.1 Dispositif manuel de thermodétection

Un dispositif manuel de thermodétection comprend :

NOTE 1 La méthode d'essai a été élaborée en se basant sur l'expérience, ce qui a permis de fixer la valeur des principaux paramètres (à savoir, les forces appliquées, la superficie, la température et le temps). Tout écart par rapport à ces valeurs est susceptible d'influer sur les résultats.

- a) un panneau rectangulaire inférieur (par exemple, en bois ou en tout autre matériau possédant des caractéristiques similaires d'isolant thermique), recouvert d'un plateau d'aluminium revêtu de cuivre de superficie au moins égale à (640 x 220) mm ;
- b) une plaque chauffante rectangulaire de dimensions ~~(720 ± 5) x (250 ± 5)~~ mm permettant d'exercer un effort de (780 ± 50) N de préférence uniformément réparti sur l'ensemble. La température est réglée à (84 ± 4)°C par un régulateur électronique.
- c) un panneau rectangulaire supérieur (en bois, par exemple) de dimensions ((640 ± 5) x (220 ± 5)) mm permettant d'exercer un effort de (590 ± 50) N susceptible d'être uniformément réparti sur la préparation.
- d) les dispositifs de mise en œuvre des forces et de la température peuvent être positionnés en toute sécurité et garantir une répartition uniforme de la pression sur l'éprouvette.

640 220

780

5.2 Feuille d'aluminium

Feuille d'aluminium ayant une épaisseur de (15 ± 5) microns - ou (40,5 ± 13,5) g/m² - comportant au moins une face mate dépourvue de traces d'oxydation, d'une largeur d'au moins 250 mm.

5.3 Ouvreuse électromécanique et accessoires

Comprenant :

- a) un cylindre rotatif recouvert d'une garniture souple de cardes : fils d'acier ayant une densité de 8 dents par cm² (souvent exprimée sous la forme de « 50 dents par pouce carré »), d'une longueur de 11 mm avec des angles de 12°/30° (Figure 1) et de 0,5 mm de diamètre, une plaque d'alimentation et un cylindre d'alimentation.

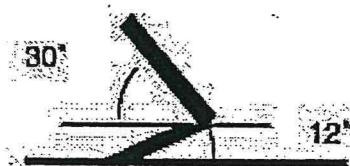


Figure 1

- b) la largeur et le diamètre du cylindre rotatif sont calculés de manière à obtenir un voile de fibres de dimensions égales à (540 ± 20) mm x (160 ± 20) mm.
- c) le diamètre du cylindre d'alimentation est de (35 ± 1) mm.
- d) la vitesse de rotation du cylindre est de (150 ± 25) min⁻¹.
- e) le rapport d'engrenage entre le cylindre rotatif et le cylindre d'alimentation est de 40/1 à 41/1.

NOTE 2 L'emploi d'un cylindre rotatif (sans garniture de cardes) ayant un diamètre de (155 ± 1) mm et une largeur de (200 ± 1) mm a été jugé approprié.

La largeur de la table d'alimentation est de (164 ± 1) mm.

5.4 Accessoires

- a) une aiguille permettant d'extraire le voile de fibres / longueur d'au moins 200 mm ;
- b) une brosse pour nettoyer la garniture souple de cardes de l'ouvreuse électromécanique.

5.5 Dispositif d'élimination

La largeur du dispositif d'élimination est de (230 ± 10) mm. La masse du dispositif de nettoyage est de (400 ± 20) g. Le dispositif d'élimination est recouvert d'un non-tissé imprégné d'huile minérale (environ 10 %) pour entraîner le retrait des fibres non collantes.

Le dispositif d'élimination doit être choisi de manière à ce que sa forme et sa géométrie n'induisent l'application sur lui-même d'aucune force ni pression pendant le nettoyage (voir paragraphe 8.6).

5.6 Source de lumière

Source de lumière blanche ayant une puissance nominale de (110 ± 10) W, ayant une géométrie de 30° , de telle sorte qu'un faisceau lumineux oblique éclaire toute la surface de la feuille d'aluminium.

5.7 Ventilateur

Dispositif produisant un courant d'air balayant la surface de la feuille d'aluminium de façon à faire vibrer les fibres collantes.

6 Atmosphère de conditionnement et d'essai

Utiliser l'atmosphère de conditionnement et d'essai définie dans la norme EN 20139.

7 Préparation des éprouvettes

7.1 Généralités

Conditionner les échantillons de fibres de coton pendant au moins 24 heures dans l'atmosphère définie dans l'article 6.

Préparer trois éprouvettes en prélevant au hasard des touffes de fibres dans l'échantillon de laboratoire.

La masse de l'éprouvette de fibre est de $(2,5 \pm 0,05)$ g.

7.2 Ouvreuse électromécanique

Nettoyer la garniture métallique de carte au moyen de la brosse.

Ouvrir et mélanger manuellement un échantillon de fibre conditionnée de façon à obtenir un pavé homogène. Le déposer sur la largeur de la plaque d'alimentation de l'ouvreuse électromécanique.

Mettre l'ouvreuse en fonctionnement pour obtenir un voile homogène de fibres de coton sur le cylindre rotatif.

Une fois le cylindre à l'arrêt, utiliser l'aiguille pour extraire le voile de fibres. Prendre une extrémité du voile avec une main (ou un morceau de papier plié) et le retirer soigneusement de la garniture métallique en exerçant une traction tout en faisant tourner le cylindre rotatif avec la poignée pour éviter toute déformation du voile de fibres.

Il est recommandé de poser directement le voile à plat sur la feuille d'aluminium.

Il convient que l'éprouvette de voile obtenue mesure (540 ± 20) mm x (160 ± 20) mm.

Si l'éprouvette est préparée selon une autre méthode (par exemple, échantillonnage à partir d'un voile de cardes), il convient que sa masse soit de $(29,5 \pm 4) \text{ g/m}^2$.

8 Mode opératoire

8.1 Montage du thermodétecteur

Chauder la plaque chauffante jusqu'à l'obtention d'une température de $(84 \pm 4)^\circ\text{C}$ sur toute sa surface. Pendant la montée en température, placer la plaque chauffante au-dessus du plateau d'aluminium revêtu de cuivre sans toutefois la fixer.

8.2 Positionnement de l'éprouvette sur le plateau d'aluminium revêtu de cuivre

Découper une feuille d'aluminium de longueur appropriée pour recouvrir le plateau d'aluminium revêtu de cuivre. La placer sur le plateau de façon à ce que sa face mate soit orientée vers le haut.

Poser l'éprouvette de voile de fibres sur la feuille d'aluminium.

Recouvrir l'éprouvette avec la deuxième feuille d'aluminium de longueur appropriée, la face mate de cette dernière étant tournée vers l'éprouvette (éviter de poser le bout des doigts sur les faces mates des feuilles d'aluminium).

8.3 Phase « chaude »

Positionner la plaque chauffante au-dessus de l'ensemble et la bloquer. Appliquer une pression de $(780 \pm 50) \text{ N}$ et maintenir une température de $(84 \pm 4)^\circ\text{C}$. Maintenir ainsi pendant $(12 \pm 2) \text{ s}$.

8.4 Phase « froide »

Débloquer la plaque chauffante et la retirer de l'ensemble.

Immédiatement appliquer et fixer le panneau supérieur (en bois, par exemple) et appliquer une pression de $(590 \pm 50) \text{ N}$ à l'ensemble pendant $(120 \pm 10) \text{ s}$.

8.5 Retrait de l'ensemble

Débloquer le panneau supérieur (en bois, par exemple).

Retirer l'ensemble et laisser reposer pendant au moins $(60 \pm 5) \text{ min}$.

8.6 Comptage des points collants

Retirer avec soin la feuille supérieure d'aluminium. La poser de façon à ce que sa face mate soit orientée vers le haut.

Sans exercer aucune pression, passer le dispositif d'élimination sur la feuille inférieure d'aluminium dans le sens de la longueur, suivant un mouvement de va-et-vient.

Eclairer la feuille inférieure d'aluminium avec la source de lumière oblique. La lumière peut être appliquée depuis n'importe quel côté. Faire vibrer les fibres collantes au moyen du ventilateur. Compter les points collants et enregistrer le résultat.

Répéter l'opération avec la feuille supérieure d'aluminium après avoir passé le dispositif d'élimination dans un seul sens.

Il est recommandé de marquer les points collants déjà comptés au moyen d'un stylo adéquat. Cela permet d'éviter les comptages doubles ou les omissions et autorise une vérification ultérieure sans source de lumière, ni ventilateur.

8.7 Répétition

Répéter le mode opératoire complet du 8.1 à 8.6 avec deux autres éprouvettes provenant du même échantillon.

9 Calcul et expression des résultats

Additionner le nombre de points collants enregistrés à partir des feuilles supérieures ou inférieures pour chaque éprouvette.

Calculer la moyenne des résultats des trois éprouvettes.

10 Rapport d'essai

Le rapport d'essai doit comprendre les informations suivantes :

10.1 Informations générales

- a) une référence à la présente Norme Européenne ;
- b) l'identification de l'échantillon pour essai et le mode d'échantillonnage, si nécessaire ;
- c) tout écart par rapport à la méthode indiquée.

10.2 Résultats d'essai

- a) le nombre total de points collants pour chaque éprouvette ;
- b) le résultat moyen des trois éprouvettes.

Annexe A (informative)

A.1 Analyse statistique

Pour les besoins de la recherche, des traitements statistiques des résultats sont généralement nécessaires pour déterminer les éventuelles différences entre deux groupes de résultats. L'analyse statistique du nombre de points collants montre que leur distribution n'est pas normale / gaussienne mais qu'elle suit la loi de Poisson ou une loi binomiale négative. Ainsi, la variance augmente avec le nombre de points collants et sa stabilisation est nécessaire avant toute analyse statistique à l'aide d'un modèle linéaire tel que la régression ou l'analyse de la variance unidirectionnelle. La transformation « racine carrée » du nombre de points collants peut être utilisée pour l'analyse de la variance à un seul facteur. Il convient d'analyser les expériences à deux facteurs ou davantage en utilisant un modèle log-linéaire avec l'aide d'un statisticien.

A.2 Répétabilité et reproductibilité

La présente méthode d'essai est connue à l'échelle internationale car des dispositifs de thermodétection ont été distribués dans le monde entier. La normalisation de la présente méthode d'essai est entreprise pour éviter toute différence d'utilisation de ce dispositif.

La répétabilité et la reproductibilité de la présente méthode d'essai peuvent être déterminées lors d'essais interlaboratoires fondés sur la méthode d'essai normalisée.



CEN TC 248 WG19 doc. N 12 Rev. 6
"Stickiness of cotton fibres"

CEN TC 248

Date: 2002-03

prEN 14278.6

CEN TC 248

Secretariat: BSI

Textiles — Determination of cotton fibre stickiness — Method using an automatic thermodetection plate device

Textile — Bewertung der Klebrigkeit von Baumwolle — Methode mit dem automatischen Plattenthermodetectionverfahren

Textiles — Détermination du collage des fibres de coton — Méthode utilisant un dispositif automatique plan de thermodétection

ICS:

Descriptors: Cotton, Fibre, Textile, Stickiness, Thermodetection

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Foreword

This document has been prepared by CEN /TC 248, "Textiles and textile products".

This document is a working document.

Introduction

The aim of this method is to provide an indication of the stickiness potential of a sample of cotton fibres by simulating the tendency of "contaminated" cotton to stick to working surface during the spinning process. This test method does not distinguish between the various type of the contamination which make causes of stickiness.

Results of this method are not directly related to the determination of sugar content.

This standard consists of the following methods, under the general title "Determination of cotton fibre stickiness" :

- Part 1 : Method using a manual thermodetection device
- Part 2 : Method using an automatic thermodetection plate device
- Part 3 : Method using an automatic thermodetection rotating drum device

1 Scope

The standard describes an automatic technique to simulate the tendency of "contaminated" cotton fibres to stick to working surfaces of textile machines (e.g. card clothing, drafting rollers, crush rolls, etc.).

Test specimens can be raw cotton fibre (fibre sampled e.g. from a bale), or opened fibre, slivers, etc....

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 20139

Textiles : Standard atmospheres for conditioning and testing.

3 Definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.3

sticky points

entanglement of one or more fibres that become attached to a working surface as a result of contamination of the cotton by sticky substance .

3.2

thermodetection

action of revealing sticky points through the combined application of heat and pressure.

3.1

stickiness level

number of sticky points indicating the severity of cotton fibre stickiness.

3.4**pad**

a thick homogeneous web of fibres formed by a special fibre opening and condensing device.

3.5**remover**

a device for removing the non sticking fibres from the aluminium foil.

4 Principle

A weighed fibre sample is processed through an opener to obtain a pad. This pad is placed on an aluminium foil and subjected to pressure by two separate pressure plates, one after the other. The first pressure plate is maintained at a temperature significantly higher than ambient. The second pressure plate is maintained at ambient temperature. The pad is removed from the foil and all loose fibres are cleaned away. Any fibre entanglements left sticking to the foil are noted and counted as sticky points. All the operations and result analysis are computer controlled.

5 Apparatus

5.1 Automatic system

The Automatic system comprises five devices stationed along a conveyor belt and the means for unrolling a roll of aluminium foil onto the conveyor. Test specimens are transported, on the aluminium foil, by the conveyor to each of the five stations in turn in less than 5 s.

The sequence of the 5 devices in the automatic system is as follows.

5.1.1 Pad preparation device

The device comprises :

- a rotating opener roller covered with metallic card clothing suitable for processing all types of cotton (saw or roller ginning) into a homogenous fibre pad. The type, dimensions and density of the card clothing are selected so as to be resistant to prevent contamination by sticking fibres from consecutive test specimens.
- an air stream and a chamber to collect the opened fibres and form a pad with a surface area of (222 ± 30) cm².
- a means to deliver the pad onto the aluminium foil.

5.1.2 Higher Temperature Pressure Device

The device comprises a heated pressure plate which can be moved vertically so as to apply a specified pressure for a specified time on a pad positioned below it.

Device has is set so as to apply a force of (1700 ± 150) N to the pad for (25 ± 2) s. The underside of the pressure plate, which comes into contact with the pad, has an area of (192 ± 1) cm² and is provided with a non-adhesive surface.

The heated surface, in contact with the pad, is maintained at a temperature of (53 ± 2) °C .

5.1.3 ambient temperature pressure plate device

The device comprises a pressure plate which can be moved vertically so as to apply a specified pressure for a specified time on a pad positioned below it.

The device is set so as to apply a force of (1700 ± 150) N to the pad for (25 ± 2) s in order to fix the sticky points to the aluminium foil. The underside of the pressure plate, which comes into contact with the pad, has an area of (192 ± 1) cm² and is provided with a "non-adhesive" surface.

The surface of the plate must remain clean without adhering fibres after applying and removing the pressure.

5.1.4 Pad Removal device

The removal device provides a means for removing the pad from the foil and cleaning away all loose fibres.

The pad is removed by suction. Any remaining loose fibres are cleaned from the aluminium foil by a rotating cylinder covered with a suitable type of cleaning fabric. The cleaning fabric is cleaned by suction.

NOTE A loop pile carpet made with polyamide loops, mass of pile per unit area above the substrate of 360 g/m² and loop height of 2.3 mm has been found suitable as cleaning fabric. Follow the supplier's recommendation for the frequency of renewal of the cleaning fabric.

5.1.5 Image analysis device

The image analysis device comprises :

- Light sources sufficient to assure even illumination of the field of view, so as to maintain a uniform grey scale level over the full detection area of the camera.
- Video camera, having a CCD sensor with a sensitivity of at least 3 lux (for camera resolution, see the note below), to provide an image of any sticky points within the area of measurement of (192 ± 1) cm².

NOTE At the moment of the redaction of the present method, video camera with a resolution of 581 x 756 pixels is suitable. Camera with improved resolution could be used.

- Linear polarisation filters, to block that portion of the light which emanates from the light sources and is reflected directly from the flat surface of the foil in order to assure the detection of the light reflected from the sticky points.

NOTE Computer provided with an appropriate video card and image analysis software to capture and analyse the camera image in terms of the number and sizes of sticky points..

Means for shielding the field of view and the camera assembly from the influence of external light sources.

NOTE As each station works independently, it is not necessary to wait until one specimen is fully processed before the next is inserted. Therefore, up to four specimens may be being processed at the same time, which means that a result is obtained almost every 30 seconds.

5.2 Balance

Balance able to weigh between 2 and 5 g with an accuracy of at least 0.1 g .

5.3 Aluminium foil

A roll of aluminium foil, whose thickness is between 10 and 30 microns - or whose weight per unit area is between 27 and 81 g/m² - having at least one bright surface, exhibiting no traces of oxidation and of a width between 200 mm and 300 mm.

6 Atmosphere for conditioning and testing

The atmosphere for conditioning and testing as defined in standard EN 20139 shall be used.

7 Preparation of test specimens

Condition the cotton fibre sample (laboratory sample) during at least 24 hours in standard conditions.

NOTE If the cotton fibre sample has a high moisture content, sample pre-drying could be required, because the equilibrium in moisture must be reached from the dried state.

Prepare three test specimens picking fibre tufts randomly from the laboratory sample.

Weigh each fibre test specimen to be between 3.0 and 3.5 g.

8 Procedure

8.1 Automatic device set-up

Follow the recommendations of the supplier : cleaning, stabilisation of the instrument, calibration, use of the software...

8.2 Operate the equipment

Place the aluminium foil onto the conveyor belt with the bright face upwards, taking care not to introduce wrinkles.

Introduce a fibre test specimen into the feeding zone of the opener and run the test.

The automatic device processes the test specimen as follows.

- a) preparation of the pad, with the device described in § 5.1.1
- b) application of heat and pressure to the pad, with the device described in § 5.1.2
- c) application of pressure at ambient temperature to the pad, with the device described in § 5.1.3
- d) removal of the pad, and any loose fibres from the aluminium foil, with the device described in § 5.1.4
- e) counting, measuring and reporting the sticky points, with the device described in § 5.1.5

An image of the sticky points (if any) is registered by the video camera as it scans the aluminium foil surface. The image is then captured by the computer and the software is used to detect, measure and count the number of sticky points contained in the image. The software can produce an histogram of frequency of sticky points as a function of their size

Repeat the procedure with the 2 other test specimens.

9 Calculation and expression of results

Express the total number of sticky points by calculating the arithmetic mean of the results of the three test specimens.

NOTE The sticky points may be classified in 3 size categories : small, medium and large.

10 Test report

The report shall contain the following information :

10.1 General information

- a) Reference to this European standard ;

- b) Identification of test sample, and sampling procedure if required ;
- c) Any deviation from given procedure ;

10.2 Test results

- d) Number of sticky points for each specimen ;
- e) The mean value result of the 3 test specimens

Annex A (normative)

Checking

Use 3 cotton standards¹⁾ *in relation to ITMF, CIRAD etc. resolutions- See Convenor*

Results should be in the confidence intervals of the referenced data, given by the supplier.

If not, go to Automatic device set-up according to the supplier recommendations.

1) ** could provide the Cotton standards.

Annex B (informative)

Statistical information

B.1 Statistical analysis

The statistical analysis of the number of sticky points shows that their distribution is not Normal / Gaussian and is more like a Poisson or a negative binomial distribution. Thus, variance increases with the number of sticky points, and its stabilisation is necessary prior to any statistical analysis with linear model as regression or one way analysis variance. 'Square root' transformation of the number of sticky points can be used for variance analysis with one factor. Experiments with 2 factors or more should be analysed using a log-linear model, and require a statistician.

B.2 Repeatability and reproducibility

This test method is expected at international levels because thermodetection devices have been distributed through the world. Standardisation of this test method is develop in order to avoid any difference in using this device.

Based on this standardised test method, interlaboratory trial should be organised in order to determinate repeatability and reproducibility of this test method.

