BRUSHING EFFECTS ON COTTON BUNDLE STRENGTH

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Abstract

Bundle strength experiments were carried out on different types of cotton, using an HVI-system and an electromechanical tensile tester. The specimen preparations were varied systematically using a specially developed brushing station. By increasing brushing force and brushing time, increased tenacity values were recorded according to the different specimen types. It was established, through parallel investigations, that the measured increase in tenacity was due to intensifying the brushing process in the improved bundle geometry, which led to a homogenization of individual fibre stress in the bundles. As far as the minimalization of the type-specific differences is concerned, we recommend that brushing force in common HVI-systems be controlled exactly, selected as high as possible and brushing time lengthened if necessary. Consideration should be given to alternative clamping techniques.

Introduction

World-wide, there are almost 1,000 HVI-systems which are used for the quality control of raw cotton. The systems work quickly, offer a high level of user comfort, are mainly automized and consist of varying indirect measuring procedures which must be calibrated with standard materials, mainly of raw cotton or carded cotton. In most of the testing systems, with the exception of the latest versions, there have not only been inevitable apparatus failures, but also operator influences which have effected the accuracy and precision of the measurements. Specimen preparation is especially problematic (1,2).

While most measuring systems for technical requirements function satisfactorily, there are, despite extensive improvement efforts, some inadequacies in measuring tenacity and elongation within individual and between different laboratories. Ranges in individual tenacity values from 4-8 g/tex in a laboratory and Tom 6-7 g/tex in laboratory mean values, ea. in the Bremen Cotton Round Trial, are to be considered normal (3). The mean variation in repeat measuring on a testing system is partly determined naturally and can be governed statistically. In contrast, the differences between different testing stations are problematic, especially when these are operated by different technicians in separate laboratories. It is known that the causes are to found in varying adjustments to machinery and types of software. More serious influences, however, are caused by the manner in which specimens due for testing are prepared.

Investigations into tenacity and elongation are carried out on a tapered beard, using an air stream for positioning the fibres between the clamping device. When the beard is being clamped an undefined state of motion is blocked. As the fibres are neither optimally decrimped nor parallelized, loading to the individual fibres of the bundle, therefore is mechanically undetermined. Light-optical intensity measurement to determine mass is taken whilst the fibres are moving in the air stream, which can lead to incorrect determination.

In order to minimize unwanted influences which occur when measuring on HVI-systems in this way, and to eliminate further influences, the beard is combed and brushed before testing, which serves as a parallelization of the fibres. It is common knowledge that when the pressing force is increased and the time lengthened during brushing procedures, the measured bundle strength increases (4). Both these parameters, however, are not normally monitored and can therefore exert uncontrolled influences on the test results. The underlying reasons for increased measurement values is not known.

Whether, apart from the pure parallelization of the fibres in the bundles, a removal of weak fibres, a decrease in crimping, a decrease in fibre convolutions or even fibre strengthening through molecular extension can have a serious influence, is still to be investigated.

In spite of the calibration can be assumed that varying provenances react differently to the brushing process in specimen preparation. Therefore, systematic investigations into this problem were carried out.

Materials and Methods

Tensile tests were undertaken on ten different types of cotton using a conventional HVI-system (Spinlab 910). The beards produced with the Fibro Sampler were not prepared in the conventional brushing station, but in a specially developed brusher (Fig.l). By lowering the brushes onto the base plate mechanically in stages of 0.2mm, brushing forces of between 0 and 10N could be produced (Fig.2). The rotation of the brushes was kept at a constant (n=30 1/min). The brushing force as well as brushing time could be varied. Testing took place immediately after brushing. An electromechanical tensile tester (Instron) was also used. Fibre bundles in Pressley clamps were tested after the brushing process using a method developed at the Faserinsfitut Bremen, whereby the fibres are loaded in such a way that they are parallelized optimally, decrimped and burdened with a defined prestress. One length category was tested at a time. The tester measured force and elongation while the bundle mass was determined by scales. In a special series of experiments the clamping conditions in the

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:511-512 (1997)
National Cotton Council, Memphis TN

HVI-system were simulated by applying a Pressley clamp with an air stream to the bundle.

Results and Discussion

The materials used in the experiments were selected from samples from different Bremen Cotton Round Trials as well as International Calibration Cotton Standards and HVI-Calibration Cotton Standards. The measured increase in tenacity (normed to known mean values) due to brushing force is shown exemplary in Fig.3. The differences in level are probably due to the apparatus, the differences in slope though, show varying sensitivity of the specimens to brushing. The CV value is 4% in average. A trend dependent on tenacity is not discemible. The influence of brushing time is shown in Fig. 4. Short brushing times record strong differences; longer brushing times lead to a saturation value. HVI and Instron results are compared in Fig.5. Bundle experiments were carried out by means of applying Pressley clamps with an air stream to the fibres and thus producing HVI-similar clamping conditions.. Length categories analyzed showed similar tendencies towards dependency on brushing force as in the HVI beards. After nominal bundle preparation with optimal decrimping, parallelizat on and prestressing of the fibres, the measurement values showed no influences due to the brushing process (Fig.6).

Experiments have shown that measurement values of bundle tenacity during HVI testing increase when brushing force and brushing time are increased. The same is true if bundles, similar to those in the HVI-system, are provided with an air stream in the Pressley clamps. The increase in tenacity is type-dependent. It can be assumed that longer, firmer and more mature fibres are less influenceable. The effects are not measurable if, after brushing, bundles with equal fibre lengths which have been decrimped optimally, parallelized and prestressed in Pressley clamps are tested. This would appear to indicate that the essential effect of brushing is the geometrical alignment of the fibre. On the one hand, a more even force-distribution is attained in the bundles which leads to a higher maximal force in more confined elongation distribution, and on the other hand a smaller fibre mass is determined in fibres which are better aligned. Fibres vibrating strongly or weakly in the air stream have an additional influence on the optimal determination of mass. According to previous results, possible effects on individual fibre tenacity through brushing can be disregarded just as much as the effect of brushing on weaker fibres. More recent test results by Chr. K. Shower confirm these findings with reference to individual fibre tenacity (5).

In conclusion, it can be stated that the brushing process must be given the greatest attention.. HVI-system calibration standards may only react a little to varying brushing forces. Measurement error can also be minimalized in types of cotton which react sensitively when calibrating as well as measuring, if the brushing force is set high and the time is long. In every case, brushing conditions are to be monitored exactly. However, a distinct system improvement can probably only be attained by changing the beard clamping technique.

Summary

In HVI-testing, the bundle strength of different types of cotton is subject to varying influence by the brushing process. The measurable increase in tenacity with increased brushing intensity is a result of an improvement in bundle geometry, leading to a homogenous distribution of force within the bundle. Through this, the elongation of the bundle is reduced and the maximum force in the force-elongation-curve increased. Mass determination is also improved. The results confirm the importance of brushing process control. They also indicate the necessity for considering alternative fibre clamping techniques.

Acknowledgments

The authors would like to thank Mrs. Hannelore Gerardi for her professional performance of the strength tests.

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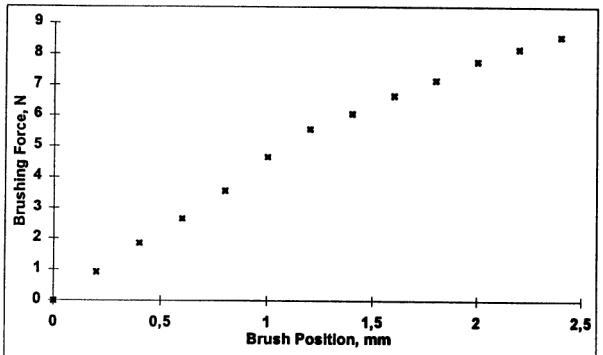

Figure 2. Range of Brushing Force

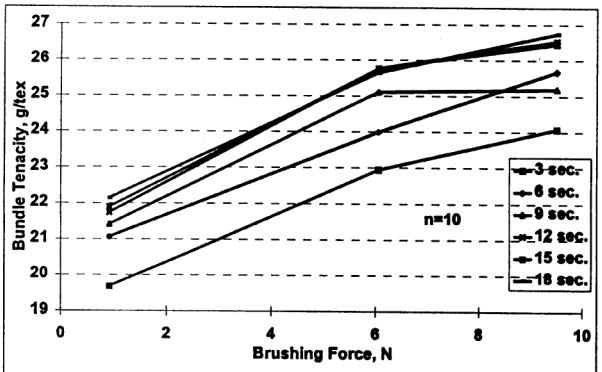

Figure 4. Influence of Brushing Time

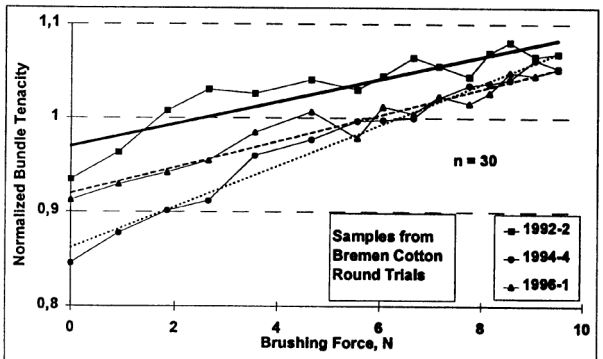

Figure 3. Tenacity Depending on Specimen Brushing

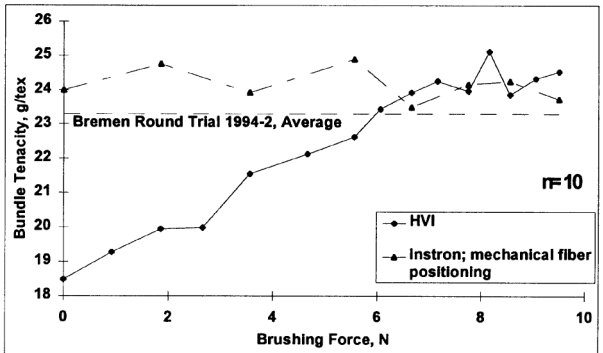

Figure 6. HVI Results and Results from a Tensile Tester