A NEW DESIGN IN A REFERENCE TENSILE TESTER

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Abstract

Calibration of HVIs for measuring tenacity is generally accomplished through the use of calibration cottons. There is, however, the desire to have available a more direct reference measurement using a modified version of standardized tensile testing techniques. The development of this instrument is a step toward this standardization, as well as for laboratory use.

Introduction

It is recognized that the ability of HVI to provide tenacity has led to general acceptance and spread of HVI testing. Nevertheless, of all the present HVI tests, strength correlates the least with traditional tests (1). It is not necessarily surprising in view of the fact that the traditional methods of Stelometer and Pressley tests are fundamentally different tests from those made on the HVI. Factors contributing to differences and variations in tenacity can be attributed to rate of extension, tapered versus parallel beard, tensioning and crimp removal, estimation of sample mass and sample preparation.

There already has been attention directed to standardized instrumentation for tensile calibration purposes and the importance has been addressed (2). Development of a mechanized strength testing instrument with improved precision, accuracy, and reproducibility is underway at Clemson (3). Test samples consist of parallel arrays prepared in Pressley clamps and the rate of extension during break is set to the HVI rate of extension. The mass of the test specimen is determined gravimetrically.

Our instrumentation design incorporates a similar technique where Pressley clamp specimens are used. Both constant rate of extension and constant rate of loading can be established over a wide range for the purpose of observing stress-strain response behavior differences. The purpose is to allow studies beyond those for HVI calibration which may be useful to either the mill or for more basic research on fiber loading response behavior. The work presented here is only an initial step in the process.

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Description and Preliminary Results

The sample loading component of the tensile tester is machined from three pieces of flat stock aluminum and measures 18"long x 8" wide x 5" high. Two of the three pieces of flat stock comprise ends mounted to a base. Into the top of one end is machined a grove to accept one section of a Pressley clamp. Into the opposite end piece is machined a hole to accept a BNC connector for making connection to the computer.

In between the two end plates are placed all mechanical components and electronics associated with sample testing. The moving components include a stepping motor with screw drive which, in combination, provides linear movement to a flat plate. On this plate are mounted a strain gage (Interface) rated at 100 pounds. One end of the strain gage is secured to the plate of the drive unit and the other end is secured to a machined block with a slot for accepting one face of the Pressley clamp. This slotted block is aligned with the slotted end plate on the main base of the unit so that a Pressley clamp with specimen can be easily mounted for testing. Extension of the sample is made through motion of the stepping motor and loading is obtained through the strain gage and associated signal conditioning electronics (Analog Devices). The load and the extension (stress-strain) of the sample are monitored in parallel. Extension is obtained from the count of pulses driving the stepper motor. Each pulse or step of the stepping motor corresponds to 0.00061-inches displacement.

The software used for data acquisition and for graphical analysis is LabVIEW. LabVIEW, as a graphical programming system, offers an innovative programming methodology in which one graphically assembles software modules called virtual instruments (VIs). The VIs are assembled to acquire data from plug-in boards to which, in our case, connects our PC to the tensile tester. Writing of each software program step is not necessary. Blocks of already existing sub-programs are simply assembled. The assembling of VIs allows one to create front panel user interfaces, giving the operator interactive control of the operation of the instrument. VIs are pictorial representations and are combined easily with line connections.

After the data acquisition components of the instrument are completed and operational, we plan to use Analysis VI Libraries to convert the raw data into meaningful results. This allows us to further introduce useful algorithms for combining the data with additional fiber properties. An example would be fiber fineness if we are using optical measurements to determine the sample mass, rather than obtaining the mass by cut-and-weigh methods.

Because the instrument is in its earliest stages of development, only some preliminary results are available.

But they are sufficient to show the direction and progress that have occurred. LabView allows one to operate the instrument from the front panel of a computer when we are operating in a windows format. All of the programming of software are hidden from view and the initiation of loading of fiber samples and the selection of rates of extension are acted upon with the use of a mouse and a keyboard.

A front panel and graphics display are illustrated in the accompanying figure (Fig.1). On the left side of the front panel are placed several sub-panels for selecting operational parameters such as scan rates, data number limitation, time between repeated runs, and signal range. Direction of motion of the clamp holder motion can even be selected of mechanical control, as will as electronic response control. All of this is made available up front. Viewing the data is much like looking at the signal - time response on an oscilloscope where signal strength is obtained from distorting the balanced strain gage bridge circuitry and displayed along the ordinate axis. The displacement associated with the strain of the fiber bundle would be displayed along the abscissa. The stress-strain of an arbitrarily selected sample is displayed on the front panel of the figure. The ordinate axis actually in given in volts and the abscissa is numbered as a position step associated with displacement from an initial starting point. The actual displacement would be determined by multiplying the step position number by 0.00061-inch. The exact position at break can be determined and is, in this example, approximately 55. Hence, the strain is 55 x 0.00061-inch or 0.034-inch. Elongation, based on 1/8-inch gage, is 26 percent. This is higher than expected and suggests that the beginning of the break is not yet established. Tenacity is calculated at approximately 90 mN/tex. This value is lower than expected.

Some of the problems that need to be corrected to reduce the elongation and raise the tenacity are to realign the holding jaws for the Pressley clamp. The fibers are not elongating relative to the direction of extension - a result of relative side shift of the end plate of the instrument which incorporates one of the Pressley clamps. There is also a slight misalignment in the clamp holders that does not allow for fibers to receive uniform force across the array of fibers. Both of the above factors will raise the load-at-break and reduce the elongation-at-break.

At his time, only constant rate of extension has been established over a range of extension rates. Those rates range between 48 and 450 percent elongation per second. Programming for load-extension curves at constant rates of loading is yet to be done. That programming feature and the necessary geometrical alignments referred to above are next items toward operational development.

Acknowledgements

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References

1. Hunter, L. 1990. HVI Testing of Cotton - Applications, Developments and Problem Areas. Proceedings of the International Cotton Conference, Bremen 1990, 37-44.

2. Taylor, R. A., Godbey, L. C., Howle, D. S. and May, O. L. 1995. Why We Need a Standard Strength Test for Cotton Variety Selection. Proc. 1995 Beltwide Cotton Conferences, National Cotton Council, Memphis TN, 1175-11178.

3. Taylor, R. A. and Godbey, L. C. 1993. A Reference Method for HVI Strength. Proc. 1993 Beltwide Cotton Conferences, National Cotton Council, Memphis TN, 1076-1079.

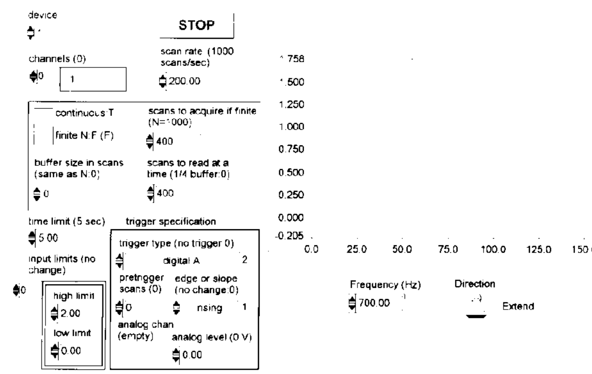

Figure 1.LabVIEW front panel displaying the setting and operational switches, along with the display screen showing a load-extension response.