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DETECTION OF COTTON SHORT FIBERS RESULTING FROM BREAKAGE

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Abstract

A technique was developed whereby a new cotton fiber property, the broken fiber fraction (BFF) by mass of bale cotton, could be calculated from measurements of the relative shape of the fiber length distribution. This physical approach differs from existing statistical-regression tools employed in cotton quality measurement. The method is based upon the assumption that any given cotton originates with a relatively longer and more intact native length distribution, and accumulates additional short (broken) fiber by degradation due to breakage-like processes during production into bale form. Accumulation of different levels of broken fiber for that cotton is (to some extent) simply the result of varying degrees of breakage inflicted, thus lending broken fiber fraction a special significance as a damage index for cotton processing. To make the calculations required in this work, a numerical model of fiber breakage was adapted from the mechanical processing of textiles (*TRJ* **70**, 108). In the textile model, fiber breakage is deduced by measuring the length properties of fiber output from a process, and comparing them to like properties of the raw fiber being put into the system, under the assumption of conservation of fiber mass and length during each breaking event. Through this mathematical technique, observable changes in length distribution can be related to the fundamental nature of the physical breakage mechanisms inherent in the process. For bale cotton, the amount of broken fiber in a specific case was characterized by measuring the shape of the distribution of longer fibers in a particular bale sample, and then comparing it through the random-break model to the known shape of a standard reference distribution. Since cotton length distributions are believed to approximate "broken" normal distributions, the general form of the reference distribution used was Gaussian by mass. This generalized approach was applied to Suter-Webb array data for bale samples of 164 medium-staple cotton cultivars from a regional crop survey. Relationships between the broken-fiber fraction (BFF) and the short fiber content (SFC) of these cottons were analyzed. Although these commercial U.S. Upland cotton bales had a median short fiber content (SFC) of about 12%, the breakage analysis indicates that the corresponding median content by mass of broken fibers was over 54%. Because this procedure is basically a numerical calculation performed upon histogram data, it might be amenable to implementation as an automated tool for high-speed classing instruments.

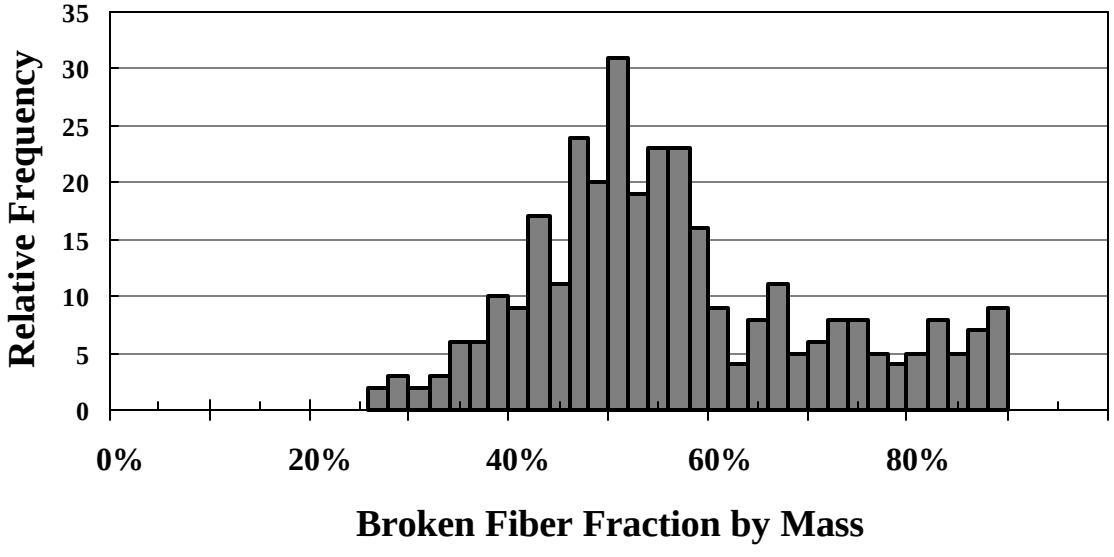

Figure 1. Frequency histogram of Broken Fiber Fraction by Mass (BFF) for 164 medium-staple commercial cotton samples by Suter-Webb Array. The median value of BFF for these cottons was 54%, corresponding to a SFC of 12%. The two reps for each cotton are plotted individually.