

THE ADVANTAGE OF LOWER HALF MEAN LENGTH IN CHARACTERIZING SHORT FIBERS

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Abstract

Short fibers reduce textile processing efficiencies and product quality. The industry has been studying cotton short fiber properties and their measurements for a long time. There have been increasing interests in this area in recent years internationally. Currently a common parameter for characterizing short fibers is Short Fiber Content (SFC). We developed a new statistical parameter, Lower Half Mean Length (LHML), as an alternative to SFC. In this paper we report the advantages of LHML over SFC. We also discuss the approaches for obtaining LHML from HVI measurements.

SFC is defined as the percentage of fibers shorter than ½ inch in the U.S. However, 16 mm is used in a few countries, such as China. Questions have been raised that which length should be used to define SFC. The major problem with SFC is its high variation. Several prominent researchers, including K. Hertel, criticized the SFC for its capability of properly characterizing short fibers. In those earlier efforts in searching SFC alternatives, other parameters have been proposed, such as Relative Short Fiber Index, Floating Fiber Percentage, and Floating Fiber Index. We developed a new statistical parameter, Lower Half Mean Length (LHML), which is defined as the mean length of the fibers that are in the shorter half by weight of the fiber sample.

Criteria for selecting alternative parameters to SFC include (1) Having less variation than SFC, (2) Characterizing short fibers well (having high correlation with SFC), (3) Being able to predict spinning performance and yarn quality as SFC does, (4) Being easy to understand and therefore easier to be accepted.

We have carried out experimental and theoretical work to compare LHML and SFC, as well as other short fiber parameters, based on the above criteria. We used AFIS to test 21 samples of Upland cotton of different varieties and growth locations and established their length distributions. We used these distributions to compute SFC and LHML. These cotton samples were also converted to open-end, ring, and vortex spun yarns.

Our results show that, (1) the CV (Coefficient of Variation) of LHML is approximately 1/3 of the SFC CV; (2) The Correlation Coefficient between LHML and SFC is very strong (-0.987), and a linear model fits their relationship very well with a R^2 of 0.975; (3) In a series of stepwise regression models, LHML has better capability in predicting yarn properties than SFC does by comparing the models' goodness of fit.

Consequently, we can summarize the advantages of LHML compared to SFC: it has much lower variation, has high correlation coefficient with SFC, and predicts yarn quality similarly as SFC does. Moreover, LHML contains information on fibers of the lower half, and hence characterize shorter fibers better than SFC which summaries only fibers shorter than 0.5 inch. Since LHML is a complement of UHML (Upper Half Mean Length), it is easier to be understood and accepted by the industries. For these reasons, we consider LHML as the most promising candidate for replacing SFC.

Calculating LHML requires the knowledge of the entire length distribution. Currently, HVI does not report the length distribution. We are working on algorithms to obtain LHML directly from HVI fibrogram since the HVI is widely used for classing cotton. In the meantime, we developed a semi-empirical equation to calculate LHML from HVI reported parameters (Uniformity Index and UHML). These preliminary results show high correlation between calculated LHML and HVI SFI (Short Fiber Index).