THE PERFORMANCE OF AN UPGRADED COTTONSCAN FOR RAPID MEASUREMENT OF FIBER FINENESS

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Abstract

Previous Beltwide papers have demonstrated the principle of measuring average fibre fineness and maturity using the Cottonscan instrument developed in Australia by CSIRO. Recently the Cottonscan technology has been upgraded resulting in a significant reduction in the measurement time. This paper presents the results of inter-machine trials comparing the performance of three upgraded instruments.

Introduction

Cotton fiber fineness, and maturity are two important fiber quality parameters that are currently not routinely evaluated or used by the industry. Both fiber fineness and maturity have separate effects during textile processing. The commonly used micronaire value is related to both fiber fineness and fiber maturity however it is not possible to accurately 'de-convolute' the micronaire value into separate fiber linear density and fiber maturity.

CSIRO has been developing the Cottonscan instrument for measuring the average fiber fineness of a cotton lint sample (Naylor and Sambell, 1999; Naylor, 2001; Gordon and Naylor, 2004; Naylor and Purmalis, 2005; Naylor and Purmalis, 2006). The approach illustrated in Figure 1 is based on the direct method of measuring the total length of a known mass of fibre snippets to calculate directly mass per unit length. As shown in the Figure the snippets are suspended in an aqueous medium within the instrument and then the suspension passes through the measurement cell. The suspended snippets are then imaged as shown and the total snippet length within the image is extracted.

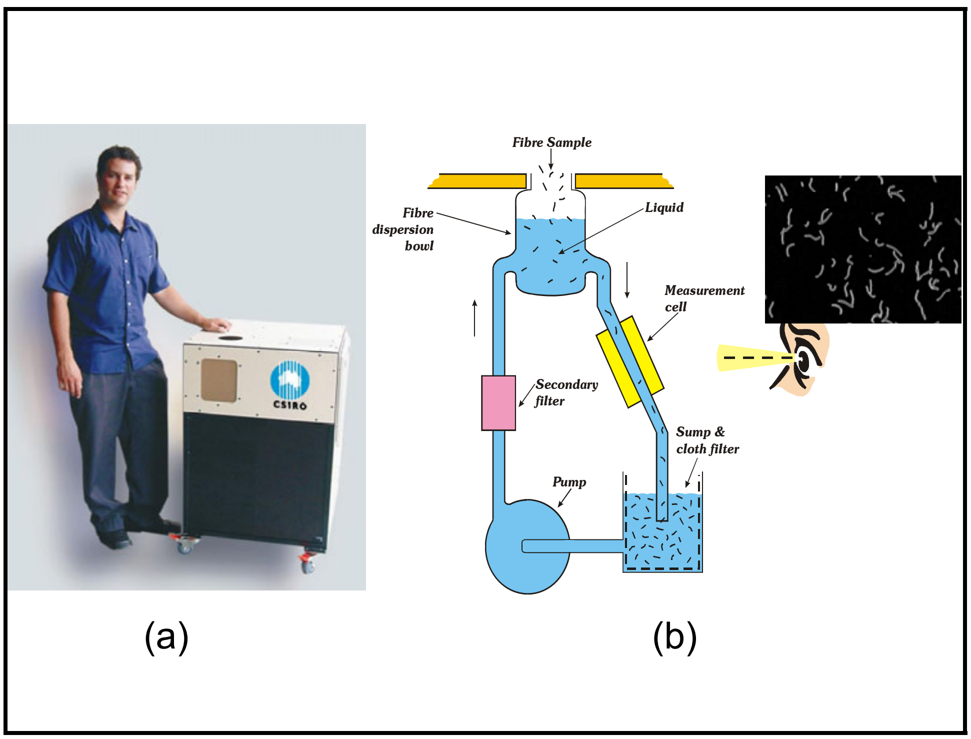

Figure 1. The 'Cottonscan' instrument.

An easy to use module for preparing snippets was developed and has been described by Higgerson et al (2007). This paper also reported the outcomes of an inter-laboratory trial which demonstrated the robustness and precision of the technology.

More recently the instrument has been upgraded to reduce the cycle time of the instrument to approximately one minute. The principle of operation has not been modified. The significant decrease in measurement time has been largely achieved by reengineering the liquid suspension module in the instrument. This paper reports the results of comparative trials comparing the performance of three upgraded instruments.

Results

As described previously (Higgerson et al 2007) a ‘reference’ cotton with an assigned average fiber fineness value of 168 mtex was initially used to harmonise the output of the three upgraded instruments, by applying a single parameter scaling factor.

For this trial six different well blended cottons were chosen covering a broad range of average fibre fineness values. Ten replicate determinations of the average fiber fineness of each sample were obtained from each instrument as summarised in Figure 2. Figure 3 shows the partial residuals after removing the global averages for each sample. The scatter in the individual measurements is similar in magnitude to that observed previously (eg Higgerson et al, 2007).

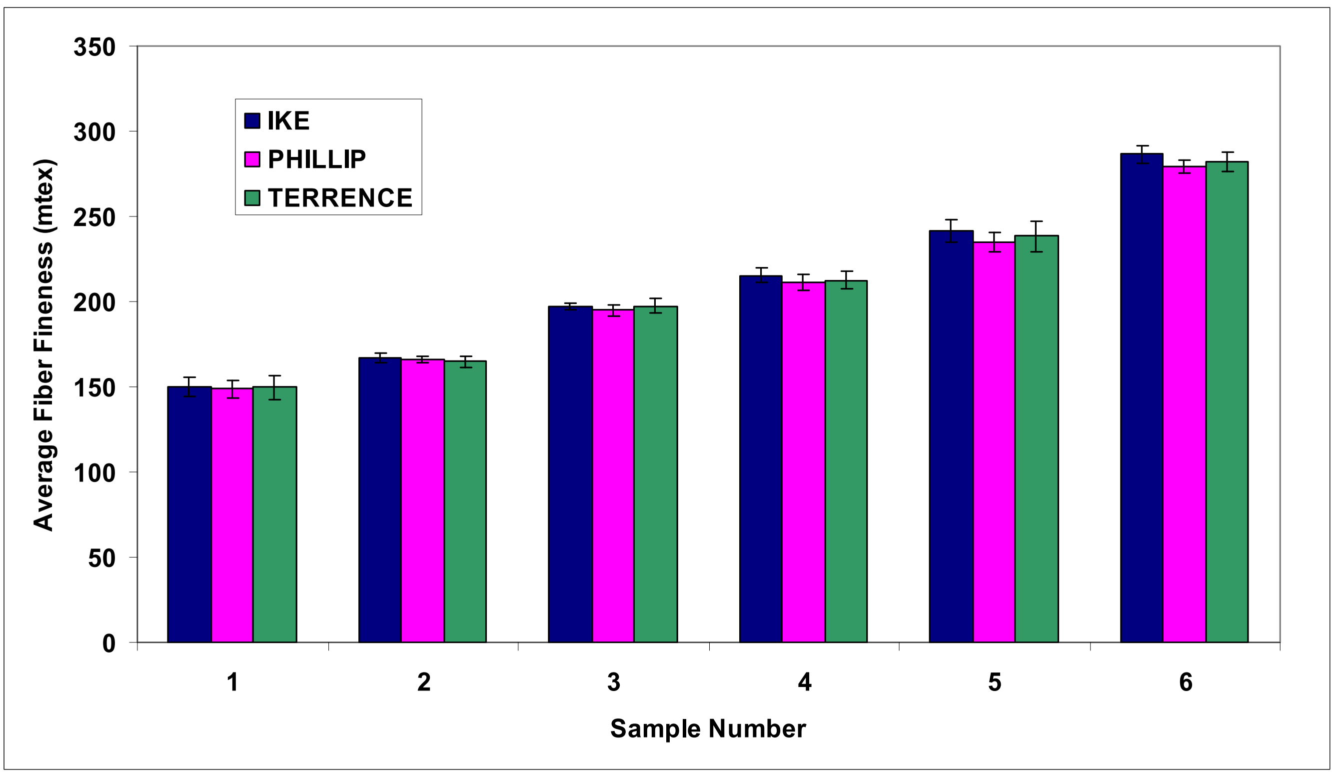

Figure 2. Summary of the results of the inter-instrument trial comparing three Cottonscan™ systems. (The error bars represent the standard deviation of the ten replicate measurements per sample.)

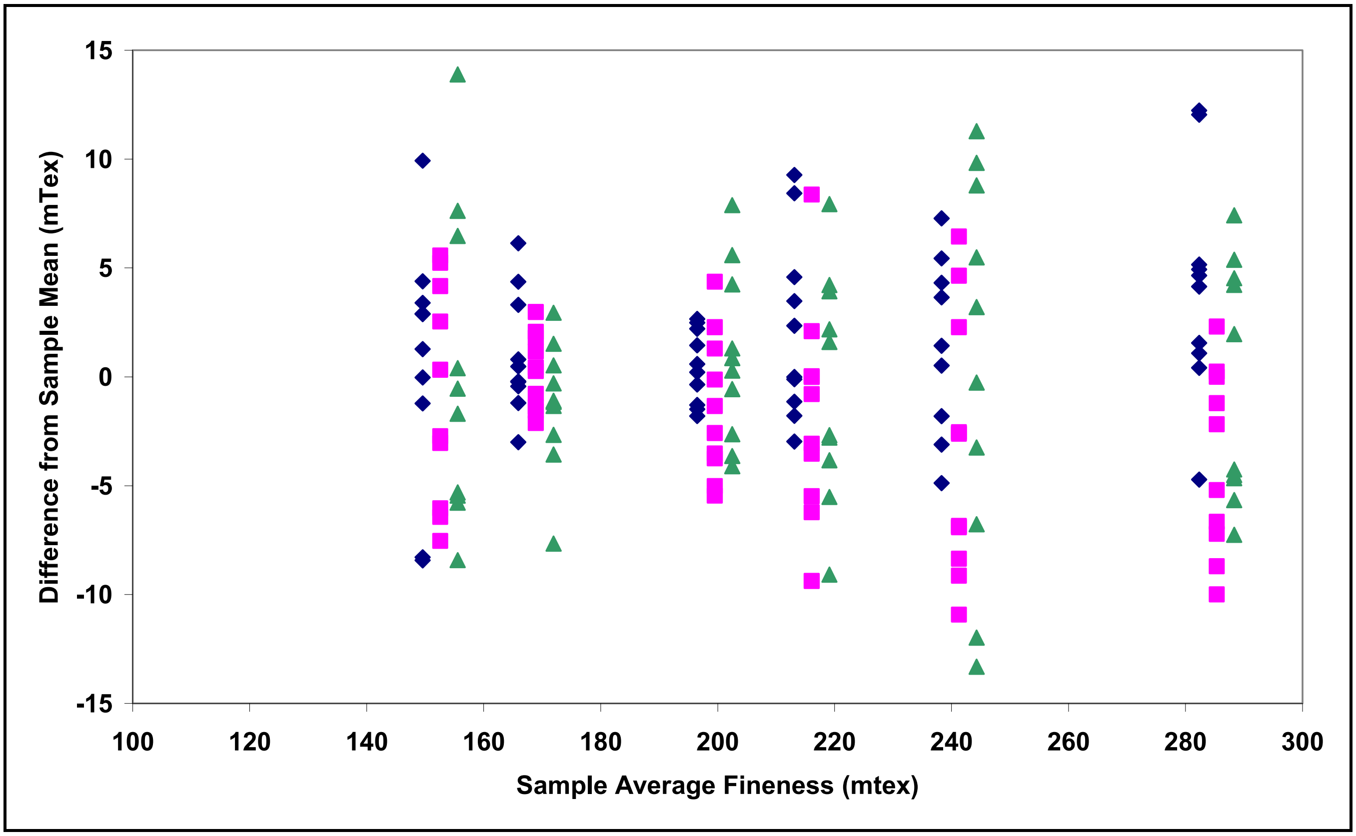

Figure 3. Partial residuals of the individual data points taking account of the between sample variation (the different symbols represent the three different instruments)

Figures 4 and 5 directly compare the results from each instrument against the average value for instrument "TERRENCE". For both of these relationships, general linear regressions confirmed that that the intercept for is not statistically significantly different from zero and so the best fit straight lines in each figure have been constrained to pass through the origin. The excellent straight line fit the over the whole, relatively wide, range of average fiber fineness values is indeed encouraging. The differences in the slope values relative to a perfect 'one to one' relationship are approximately one percent which is within the tolerance of the between instrument harmonisation procedure. This is indeed also very encouraging.

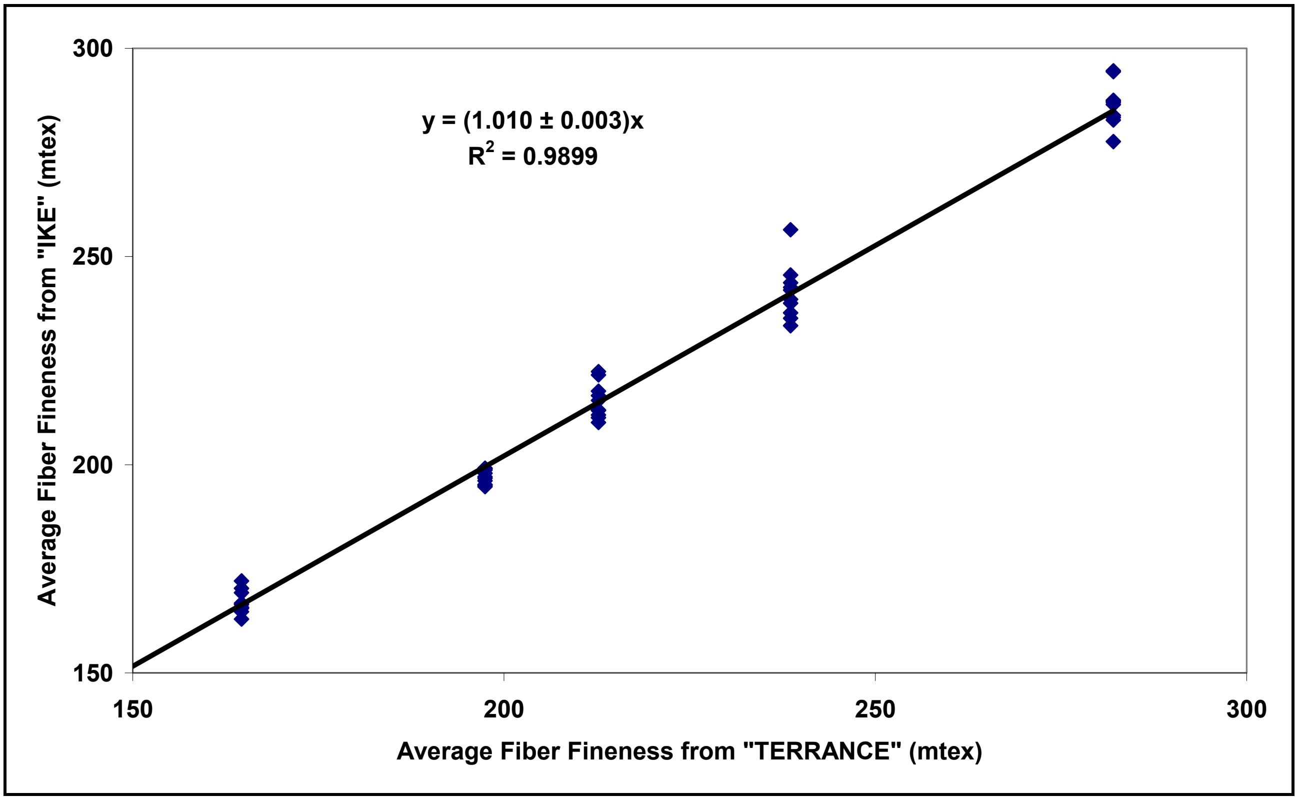

Figure 4. A comparison of the average fiber fineness values determined by the two instruments IKE and TERRANCE. The values plotted on the horizontal axis are the average of the 10 replicate measurements on TERRENCE for each sample. The illustrated best fit straight line has been constrained to pass through the origin.

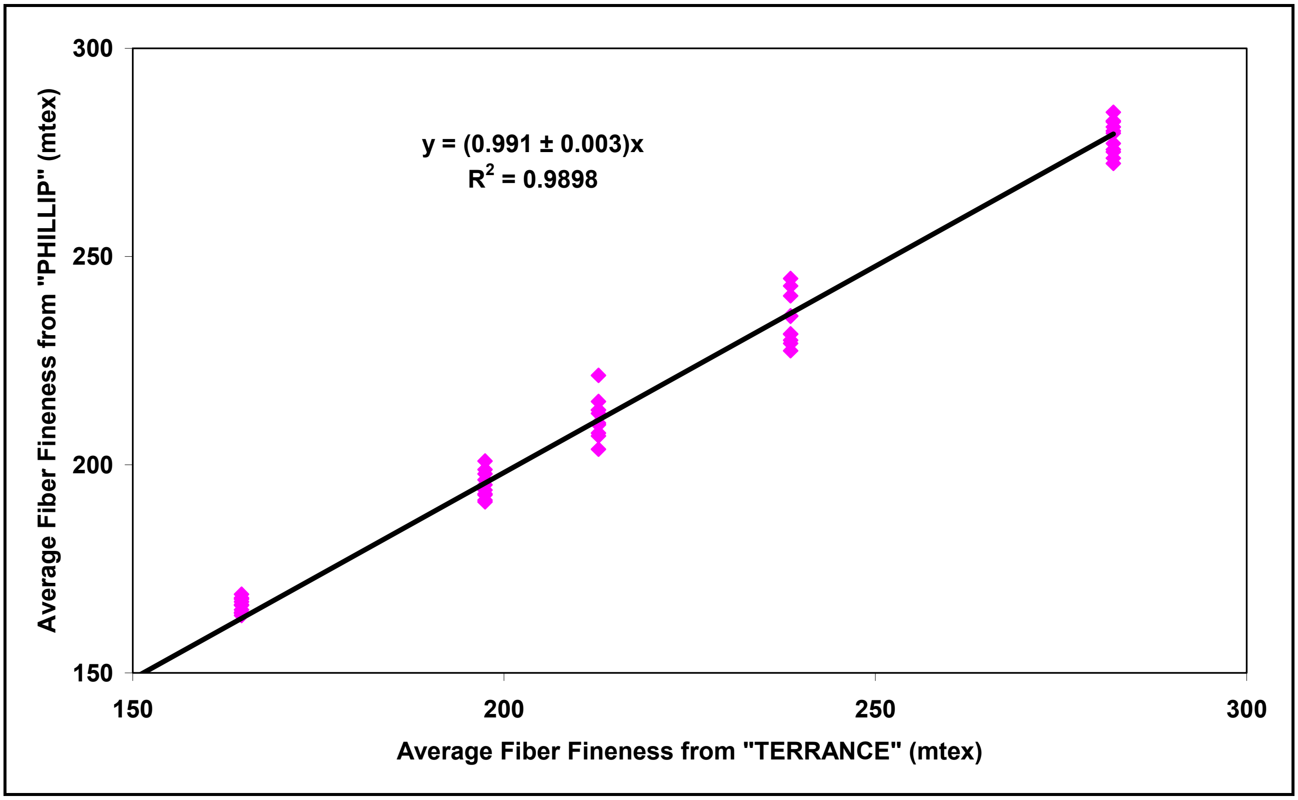

Figure 5. A comparison of the average fiber fineness values determined by the two instruments PHILLIP and TERRANCE. The values plotted on the horizontal axis are the average of the 10 replicate measurements on TERRENCE for each sample. The illustrated best fit straight line has been constrained to pass through the origin.

Conclusion

The Cottonscan instrument for the rapid measurement of average fiber fineness has been successfully upgraded to increase its speed of operation without compromising its technical performance.

Acknowledgements

The authors would like to acknowledge the financial support of the Australian Cotton Research and Development Corporation and CSIRO. They would also like to acknowledge the expert technical assistance of Liz Coles.

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