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A Comparison of the Airflow Measured Fineness Characteristics of Cotton Lap and Sliver Using Different Sample Preparation Techniques

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A COMPARISON OF THE AIRFLOW MEASURED FINENESS CHARACTERISTICS OF COTTON LAP AND SLIVER USING DIFFERENT SAMPLE PREPARATION TECHNIQUES

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ABSTRACT

Airflow measured micronaire, maturity and fineness values, obtained on lap and card and drawframe slivers, have been compared, the samples having been prepared for testing by opening and randomisation on either a Shirley Analyser or an Essdiel Sliver Trash Analyser. It was found that the micronaire and fineness, particularly the former, of lap and sliver samples could be measured fairly accurately by the airflow technique provided the samples had been passed through either a Shirley Analyser (lap and sliver) or an Essdiel Sliver Trash Analyser (sliver) prior to measurement.

INTRODUCTION

Sometimes it is necessary to determine the fineness and maturity characteristics of cotton when it has already been mechanically processed, e.g. into either lap or sliver. At the present time the simplest and quickest way of doing so would be by the airflow technique but questions concerning the sample preparation and the accuracy and meaning of the results arise, particularly if it is intended to relate the values to those of the lint or to use them as a measure of the latter. Although the importance of cotton sample preparation for airflow tests, particularly for fineness and maturity, is well documented[1-8] in the case of lint, very little information is available for semi-processed cotton (i.e. lap and sliver). This report deals with a study undertaken on the airflow measurement of fineness and maturity of cotton in lap and sliver form, using two different instruments, viz., a Shirley Analyser and an Essdiel Sliver Trash Analyser[9,10] for preparing the samples.

EXPERIMENTAL

Material

A range of cottons (approximately 40), was sampled at different stages of processing, viz. after lap formation (blowroom), carding, first drawframe passage and second drawframe passage, processing in all cases being carried out on full-scale commercial machines. Sub-samples from the samples drawn at the various stages were then prepared in one or more of the following ways, prior to airflow measurement of fineness and maturity:

1. One passage through Shirley Analyser

2. Two passages through Shirley Analyser
3. One passage through Essdiel Sliver Trash Analyser.

The latter instrument is designed to be used for determining the foreign matter content in slivers but it also appears to have potential for converting a sliver into a well opened randomised mass of fibres, free of foreign material and suitable for airflow testing.

Testing

All the samples were conditioned and tested under standard atmospheric conditions ($20 \pm 2\,^{\circ}C$ and $65 \pm 2\%$ RH). The micronaire, fineness and maturity of the various samples were determined by means of an IIC-Shirley Fineness/Maturity Tester according to the basic recommendations of the relevant ASTM method[11].

RESULTS AND DISCUSSION

One Passage Through Shirley Analyser vs Two Passages

The correlations between the values obtained after one and two passages through the Shirley Analyser, respectively, are shown in Table I.

TABLE I

CORRELATION BETWEEN VALUES OBTAINED AFTER ONE AND TWO SHIRLEY ANALYSER PASSAGES, RESPECTIVELY

Property	No. of Results (n)	Correlation Coefficient (r)
Micronaire	39	0,996
Maturity	39	0,986
Fineness	39	0,987

There were no consistent differences between the values obtained on samples passed once and twice, respectively, through the Shirley Analyser (see Figs 1 to 3), this applying to both lap and sliver samples. In the case of maturity (Fig 2) there was, however, a tendency for two passages through the Shirley Analyser to produce slightly higher maturity values than one passage in the case of the slivers.

In the light of these findings it can be concluded that there is little advantage to be gained by an extra passage through the Shirley Analyser and all subsequent discussion will be concerned with the results obtained on samples passed through the Shirley Analyser once.

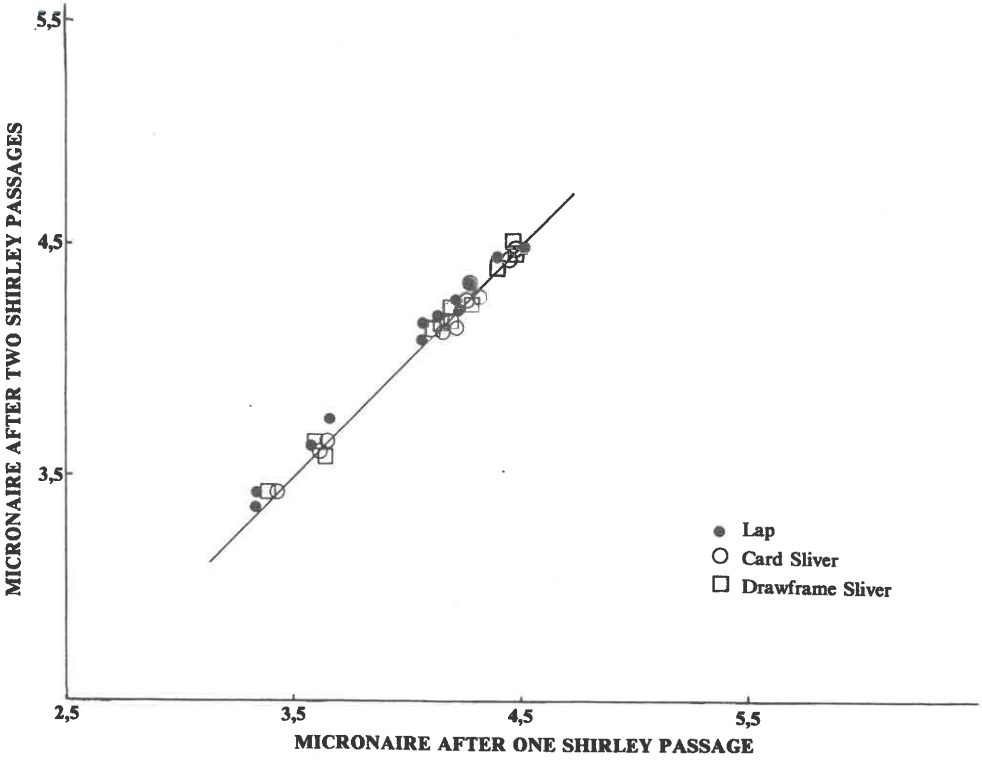

Fig. 1 – Micronaire values obtained on samples passed twice through Shirley Analyser vs those obtained on samples passed once through Shirley Analyser.

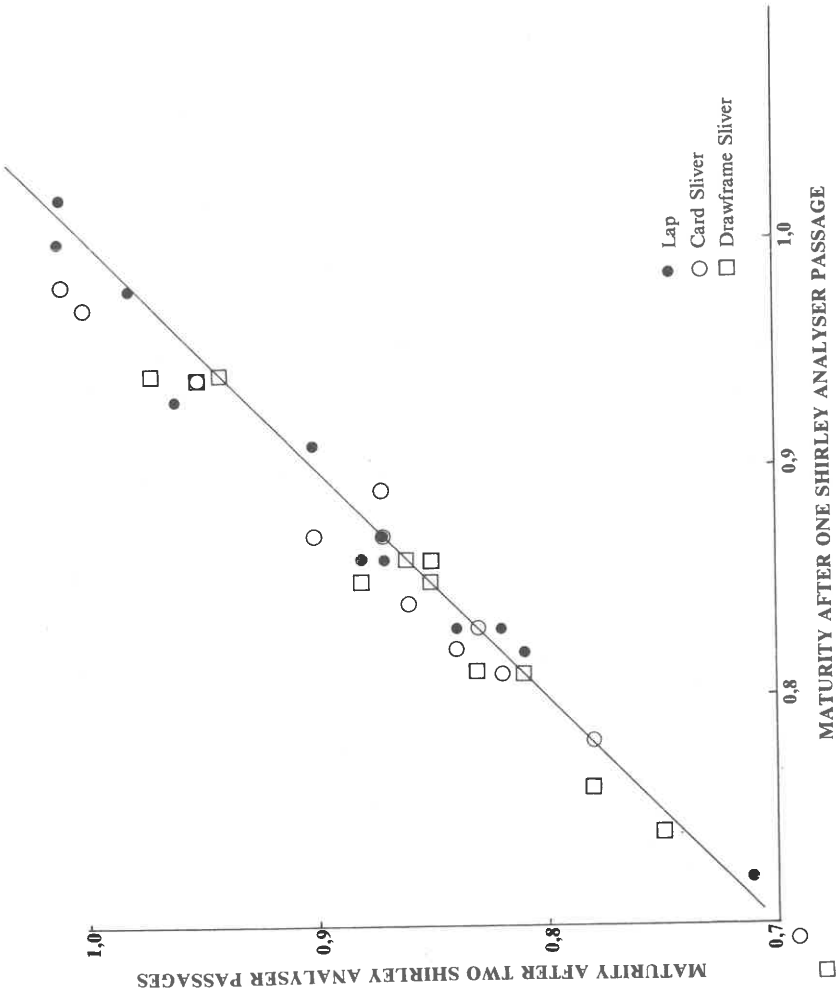

Fig. 2 – Maturity values obtained on samples passed twice through Shirley Analyser vs those obtained on samples passed once through Shirley Analyser.

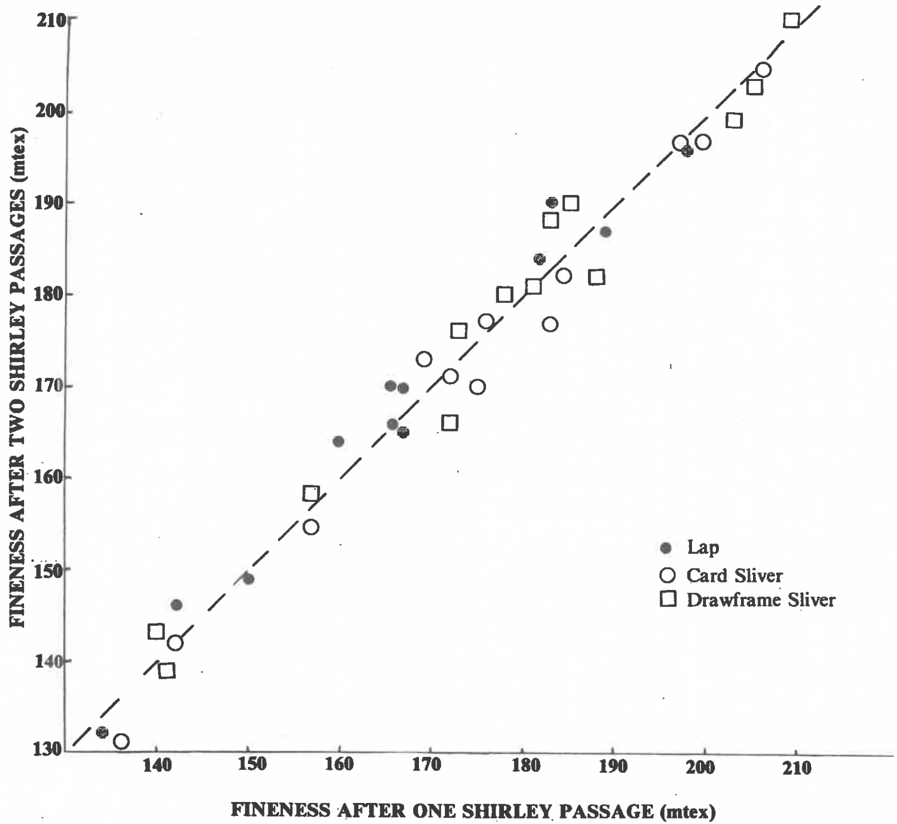

Fig. 3 – Fineness values obtained on samples passed twice through Shirley Analyser vs those obtained on samples passed once through Shirley Analyser.

According to the results plotted in Figs 1 to 3, the micronaire values as obtained here (each representing the average of four tests) are generally accurate to within 0,1 units, the maturity values are generally accurate to within about 0,03 units and the fineness values to within about 10 mtex.

One Drawframe Passage vs Two Draframe Passages

For all three of the measures of the cotton fineness characteristics, viz. micronaire, fineness and maturity, the differences between the first and second drawframe slivers were found to be small and not consistent when the samples had been passed through the Shirley analyser. Concerning the samples passed through the Essdiel Sliver Trash Analyser there were no consistent differences either, although the micronaire values obtained on the second drawframe passage sliver tended to be slightly higher (by 0,1 units on average) than those obtained on the first drawframe passage sliver. This difference, however, is considered to be small enough to be negligible for all practical purposes.

The correlation coefficients between the values obtained on first and second drawframe samples, respectively, were of the order of 0,99 for micronaire and fineness and 0,92 for maturity (approximately 20 different cottons tested in each case). In all subsequent discussions, no distinction will be made between the results obtained on samples from the first and second drawframe passages.

Correlation Between Values obtained on Samples passed through the Shirley Analyser and the Essdiel Sliver Trash Analyser, respectively.

The following regression equations and correlation coefficients were obtained between the values of sliver (card and drawframe), passed through the Shirley Analyser (S) and the Essdiel Sliver Trash Analyser (E), respectively.

$$\text{Micr.}_{(E)} = 1{,}03\ \text{Micr.}_{(S)} - 0{,}23 \quad \ldots\ldots(1)$$

$n = 73;\ r = 0{,}991$

$$\text{Mat.}_{(E)} = 0{,}53\ \text{Mat.}_{(S)} + 0{,}36 \quad \ldots\ldots(2)$$

$n = 73;\ r = 0{,}603$

$$\text{Fineness}_{(E)} = 0{,}86\ \text{Fineness}_{(S)} + 29 \quad \ldots\ldots(3)$$

$n = 73;\ r = 0{,}945$

The results have been plotted in Figs 4 to 6.

From eq. (1) and Fig 4, it can be seen that the micronaire values obtained on the card and drawframe slivers which had been passed through the Essdiel Trash Analyser were very highly correlated with those obtained in the

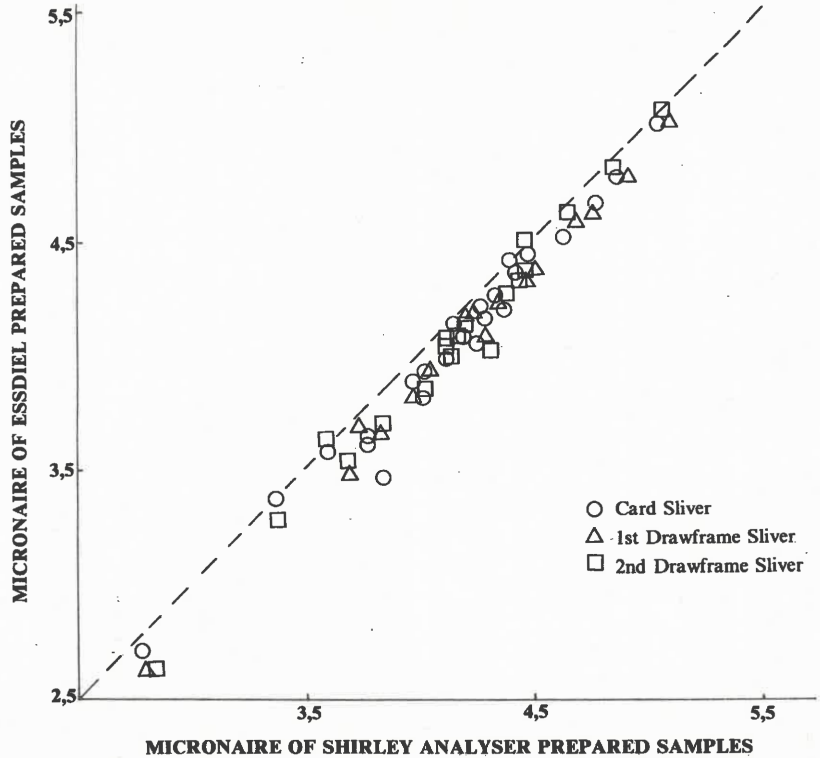

Fig. 4 – Relationship between micronaire values obtained on samples passed once through Shirley Analyser and Essdiel Trash Analyser, respectively.

corresponding samples passed through the Shirley Analyser, although the latter values were, on average, about 0,1 units higher than the former. Clearly, therefore, micronaire values can be fairly accurately determined on slivers, provided the samples are properly randomised either by passing through a Shirley Analyser or an Essdiel Sliver Trash Analyser.

According to eq. (2) and Fig 5, the maturity results obtained on the differently prepared samples were not highly correlated, confirming previous findings[3-8] that airflow measured maturity is very sensitive to the manner of sample preparation. In general, the maturity values obtained on the samples which had been passed through the Shirley Analyser were higher than those which had been passed through the Essdiel Sliver Trash Analyser (Fig 5).

From the results of the statistical analysis and Fig 6, it is apparent that the fineness values obtained on the differently prepared samples were better correlated (r = 0,945) than the maturity values (r = 0,603), but were not as highly correlated as the micronaire values (r = 0,991). If anything, the fineness values of the samples passed through the Essdiel tended to be higher than those of the samples passed through the Shirley, although the differences were not consistent.

Comparison of Lap and Sliver Values

The following regression equations and correlation coefficients were obtained:

Shirley Analysed Samples

Micr. (Lap) = 1,03 (Micr. of Card Sliver) - 0,13 .....(4)

n = 24; r = 0,986

Micr. (Lap) = 1,03 (Micr. of Drawframe Sliver) - 0,16 .....(5)

n = 24; r = 0,996

Micr. (Card Sliver) = 0,986 (Micr. Drawframe Sliver) + 0,05 .....(6)

n = 31; r = 0,993

Mat. (Lap) = 0,72 (Mat. of Card Sliver) + 0,27 .....(7)

n = 24; r = 0,865

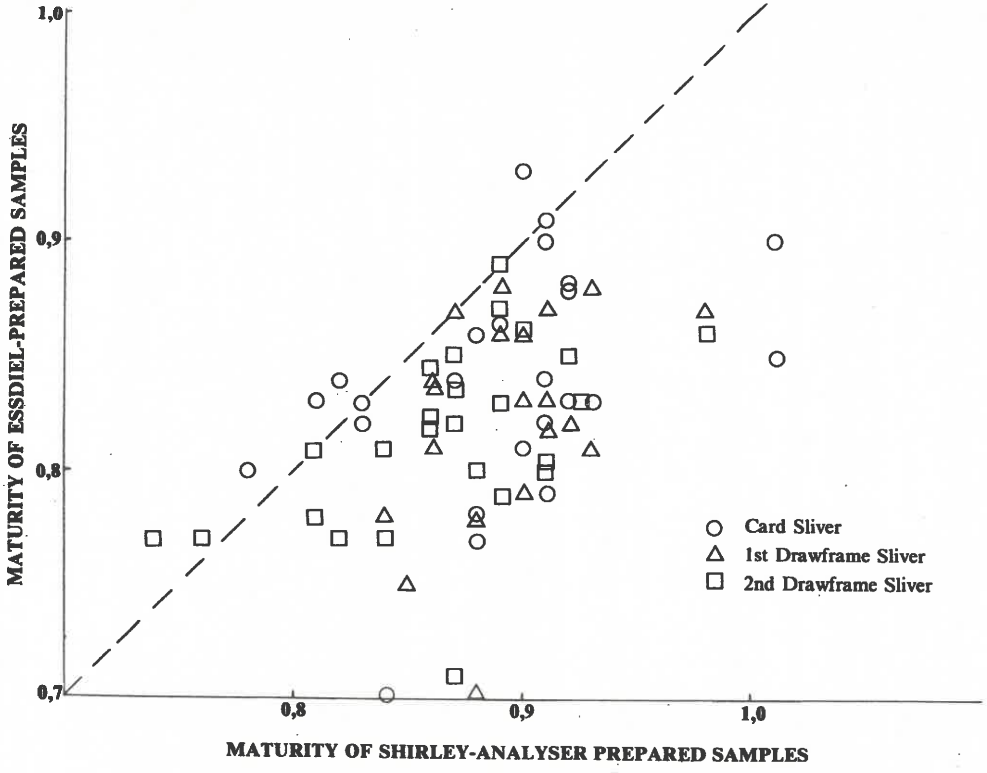

Fig. 5 – Relationship between maturity values obtained on samples passed once through Shirley Analyser and Essdiel Trash Analyser, respectively.

Mat. (Lap) = 0,80 (Mat. of Drawframe Sliver) + 0,22 .....(8)

n = 24; r = 0,864

Mat. (Card Sliver) = 1,0 (Mat. of Drawframe Sliver) + 0,02 .....(9)

n = 31; r = 0,925

Fineness (Lap) = 0,83 (Fineness of Card Sliver) + 25 .....(10)

n = 24; r = 0,912

Fineness (Lap) = 0,87 (Fineness of Drawframe Sliver) + 13 .....(11)

n = 24; r = 0,942

Fineness (Card Sliver) = 1,02 (Fineness of Drawframe Sliver) - 7 .....(12)

n = 31; r = 0,987

Samples Passed Through Essdiel Sliver Trash Analyser

Micr. (Card Sliver) = 0,97 (Micr. of Drawframe Sliver) + 0,12 .....(13)

n = 45; r = 0,991

Mat. (Card Sliver) = 1,11 (Mat. of Drawframe Sliver) - 0,07 .....(14)

n = 45; r = 0,940

Fineness (Card Sliver) = 0,85 (Fineness of Drawframe Sliver) + 22.....(15)

n = 45; r = 0,978

According to the correlations between the card and drawframe results (eq's. 6, 9 and 12 to 15), it is apparent that these two sets of results generally were very highly correlated for samples prepared on either the Shirley Analyser or the Essdiel Sliver Trash Analyser. This, together with the high correlations obtained earlier for samples passed either once or twice through the drawframe and either once or twice through the Shirley Analyser indicate that fairly accurate and consistent results can be obtained on sliver (either card or drawframe), particularly with respect to micronaire and fineness, provided the samples have been prepared properly (i.e. on either a Shirley Analyser or an Essdiel Sliver Trash Analyser). According to the results of the samples passed through the

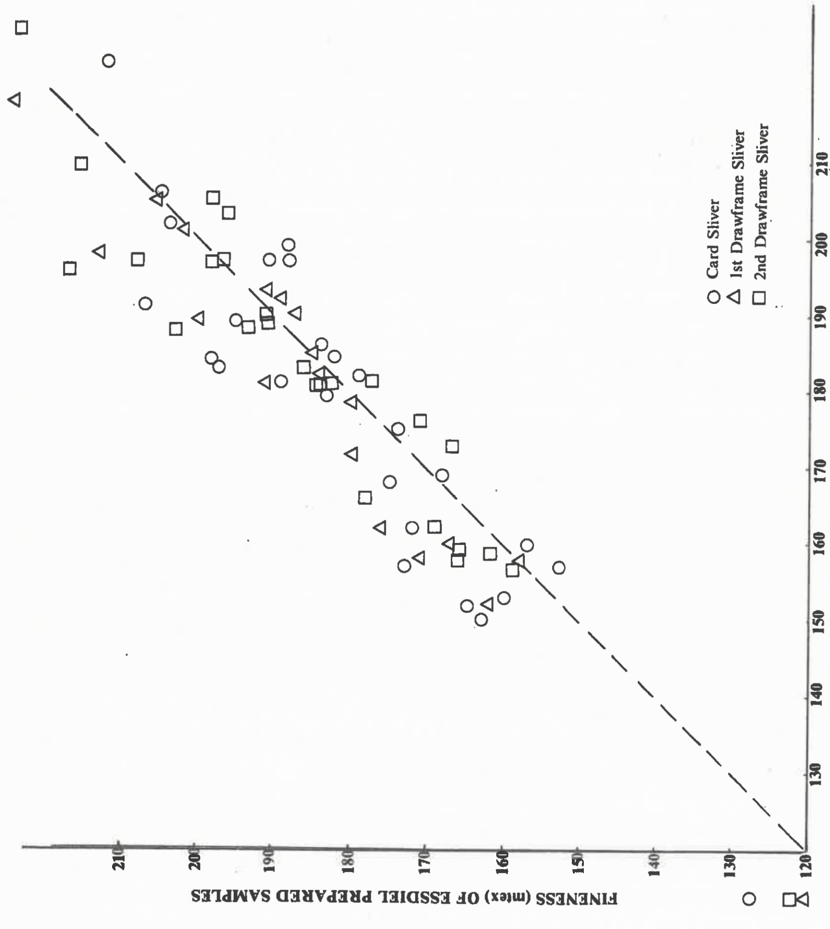

Fig. 6 – Relationship between fineness values on samples passed once through Shirley Analyser and Essdiel Trash Analyser respectively.

Shirley Analyser, the values obtained on the lap samples were also highly correlated with those obtained on the slivers, although the correlation coefficients were generally lower than those between the card and drawframe sliver samples. The correlation coefficient for maturity again was significantly lower than that for either micronaire (which was the highest) or fineness.

The micronaire values obtained on card sliver and drawframe sliver samples, which had been prepared on the Essdiel did not differ significantly, the difference generally being less than 0,1 units. The same applied to the lap, card sliver and drawframe sliver samples prepared on the Shirley Analyser.

For maturity measured on samples prepared on the Shirley Analyser, it was found that the lap tended to give higher values (0,03 on average) than the card or drawframe sliver samples. The values obtained on card and drawframe sliver samples did not differ consistently although there was a tendency for the card sliver to give higher values than the drawframe sliver. For the samples which had been passed through the Essdiel Sliver Trash Analyser there was a tendency for the card sliver samples to produce slightly higher maturity values (0,02 higher on average) than the drawframe sliver samples.

Concerning the fineness of the Shirley Analyser samples, the lap samples tended to produce higher values (6,5 on average) than the card sliver samples, the latter, in turn, generally producing higher values (3,7 on average) than the drawframe sliver samples.

The fineness values obtained on the card sliver samples, which had been passed through the Essdiel Sliver Trash Analyser, tended to be lower (by 4,6 mtex on average) than those obtained on the drawframe sliver samples which had been similarly prepared.

The correlation between the values obtained on the cotton lint and those obtained on lap and sliver is still to be investigated.

SUMMARY AND CONCLUSIONS

The airflow measurement of cotton micronaire, maturity and fineness on lap and card and drawframe sliver, has been investigated and compared. The lap samples were prepared for airflow testing by passing them either once or twice through a Shirley Analyser while the sliver samples were prepared by either one or two passages through the Shirley Analyser or by one passage through an Essdiel Sliver Trash Analyser. The cotton samples were drawn at the various stages of a full-scale processing line.

It was found that there was little difference between the values obtained on samples (lap and sliver) passed once and twice, respectively, through the Shirley Analyser, the results being very highly correlated ($r \approx 0,99$). No significant differences between the results obtained on first and second passage drawframe slivers were found provided the slivers were prepared for testing on either the Shirley Analyser or the Essdiel Analyser. The correlation between the

first and second drawframe sliver results was approximately 0,99 (20 samples) for micronaire and fineness and approximately 0,92 (20 samples) for maturity.

According to the results obtained in the experiments carried out, the reproducibility of the results was generally very good provided the same sample preparation technique and sample at the same processing stage were compared and provided at least four sub-samples had been tested. In such a case, micronaire was generally accurate to within 0,1 units, maturity to within 0,03 units and fineness to within about 10 mtex.

A high correlation was found between the micronaire ($r \approx 0,99$) and fineness ($r \approx 0,95$) values of sliver samples passed through the Shirley Analyser and Essdiel Sliver Trash Analyser, respectively. The correlation for maturity, however, was generally poor ($r \approx 0,60$). The correlation between card and drawframe sliver values, after sample preparation on either the Shirley or the Essdiel, was generally very high in the case of micronaire ($r \approx 0,99$) and fineness ($r \approx 0,98$) but lower in the case of maturity ($r \approx 0,93$). The correlation between the lap and sliver values was only slightly lower.

It can be concluded, from the results of this study, that micronaire and fineness, particularly the former, of semi-processed cotton can be measured fairly accurately by the airflow technique provided the samples are passed through either a Shirley Analyser (lap or sliver) or an Essdiel Sliver Trash Analyser (sliver) prior to measurement. Maturity can be determined less accurately, particularly when two different sample preparation techniques are used.

The correlation between values obtained on lint, lap and sliver remains to be investigated.

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