INTERNATIONAL WOOL TEXTILE ORGANISATION
Technology and Standards Committee
Special Topics Group

OFDA MEASUREMENT OF WOOL FIBRE CRIMP - A PRELIMINARY REPORT

by S. Smuts*, A. Schleth** and L. Hunter*

* CSIR Division of Textile Technology, South Africa
** Zellweger Uster, Switzerland

Introduction

The complete description of a wool, in terms of objectively obtained results, is the ideal which is to be strived for since this would allow its full potential to be exploited. One shortcoming of present day Objective Measurement is the absence of a method whereby an inexpensive, rapid and relatively accurate estimate of fibre (staple) crimp can be obtained. As indicated by Brims (1), the OFDA offers a facility for measuring the curvature of fibre snippets. It is expected that this parameter, which can be obtained simultaneously (and therefore at little extra cost) with diameter distribution measurement, may be a relatively good measure of the fibre crimp (ie provided, particularly in the case of wool which has been processed, a relaxation procedure can be found which will ensure that the fibre crimp is always returned to its "natural state"). In fact, preliminary work by Edmunds (2) indicated that the OFDA system has potential for providing quantitative data on fibre crimp in terms of fibre curvature. He found, however, as may be expected, that sample pretreatment and snippet preparation procedures had important effects on the results obtained. This focuses attention on the fact that, for meaningful results to be obtained, such factors need to be taken into consideration in any test procedure which may be devised.

In order to further explore the potential of the OFDA measured snippet curvature for providing a measure of fibre crimp, a preliminary investigation was carried out to determine how well it correlates with some other measures of fibre crimp [such as staple crimp, wool bulk and bulk/diameter ratio(3, 4)].

Experimental

A selection of tops (n=25) produced from wools representing merino and allied breeds and varying widely in fibre diameter and staple crimp (see Table I) were used in this preliminary investigation, previous work having shown that top crimp and bulk compressional properties are highly correlated with fibre and staple crimp provided certain precautions are taken in terms of the relaxation of the fibres. Except for the

OFDA curvature measurements (obtained recently) all other results were the product of other earlier studies (5).

The curvature measurements were made on snippets cut from tops which were several years old (ie the tops were tested in this **"aged" state**). A "guillotine" was used to cut 2 mm snippets which were then distributed on a slide using a circular spreader. Three slides were prepared for each sample and from these 2000 snippets were measured.

The other properties referred to in this report were measured (using standard test methods) on samples which had been conditioned in a standard atmosphere. The **diameter** was measured using a conventional projection microscope, the **staple crimp** was measured on staples (placed untensioned, but straight and flat, on a velvet board) using a crimp glass and the **wool bulk** (measured in terms of the the compressed height) was obtained on *steam relaxed tops*, using a simple *cylinder and "plunger"* apparatus devised at the CSIR and briefly described elsewhere (6).

Results and Conclusion

The results (given in Table I) are illustrated graphically in Figs 1 to 3. Linear regressions were carried out between the OFDA curvature and each of the measures of crimp considered (see Table II). According to these preliminary results (see especially the correlation between the OFDA curvature values and staple crimp in Fig 1) the OFDA curvature measurement facility appears to hold sufficient potential for providing a measure of fibre and staple crimp to justify further work. It is now planned to undertake more work on a wide range of greasy wool and also scoured wool and tops and to investigate the effects of factors such as crimp form (shape), snippet length, preparation, etc.

References

1) Brims, M.A., **IWTO Tech. Cmmttee.**, Rep. No. 22, May 1993.

2) Edmunds, A.R., **IWTO Tech. Cmmttee.**, Rep. No. 19, June 1995.

3) Smuts, S. and Hunter, L., **SAWTRI Bull., 15**(1), 22 (1981).

4) Smuts, S., Hunter, L. and van Rensburg, H.L.J., **SAWTRI Tech. Rep. No. 482**, (1981).

5) Hunter, L., Turpie, D.W.F. and Gee, E., **The Papers of THE FIRST WORLD MERINO CONF.**, Melbourne, Australia, p109 (July, 1982).

6) Hunter, L. and Smuts, S., **SAWTRI Tech. Rep. No. 409**, May 1978.

the conventional comparison plot, whereas figure 2b shows the relationship between the differences and the mean of the two measurements.

Figure 2a: Verification of OFDA calibration for rapid bulk

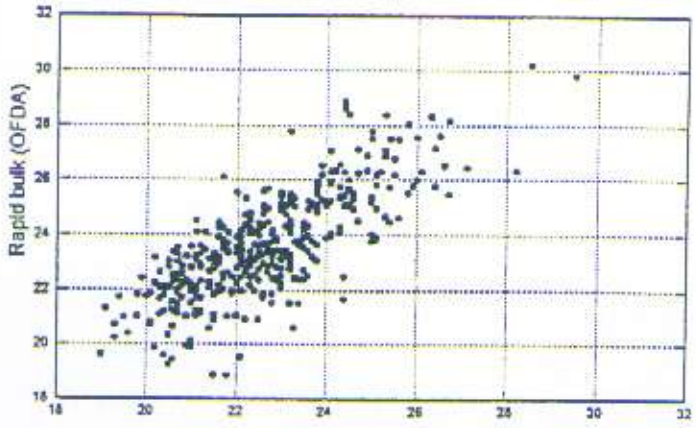
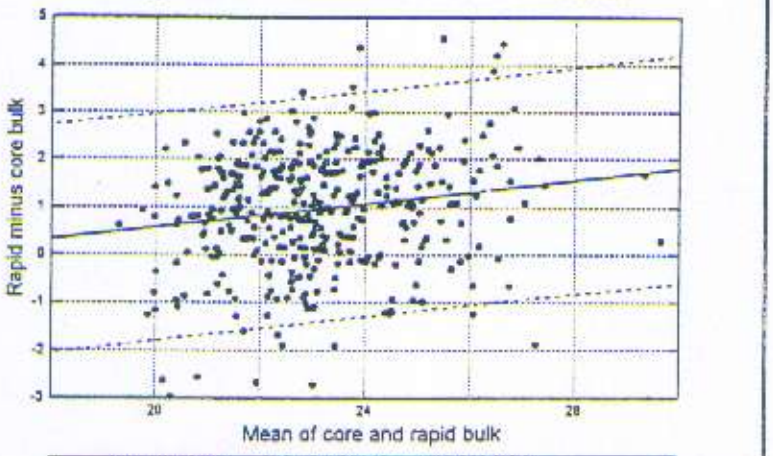


Figure 2b: Examination of verification differences



It can be seen that this attempt at verification would not satisfy normal criteria for acceptance, since both the slope and intercept of the differences plot are significantly different to zero. Nevertheless, the data is encouraging.

During the course of trying to develop a calibration, it was noted that the curvature measurements were strongly influenced by sample preparation methods (as confirmed by Edmunds), including the scouring, conditioning time and minicoring. This is not surprising, since preparation has to be tightly controlled for the core bulk test. It is clear from the work carried out to date that further standardisation is required before a viable test method can be proposed.

CONCLUSIONS

From the work carried out to date it appears feasible that a rapid bulk test could be developed using the OFDA curvature software. More work is required to standardise sample preparation.

TABLE I

SOME MEASURES OF FIBRE CRIMP

SAMPLE NUMBER	MEAN FIBRE DIAMETER (Top) (µm)	STAPLE CRIMP (per cm)	COMPRESSED HEIGHT (STEAMED TOP) * (mm)	BULK/DIAMETER RATIO (mm/µm)	CURVATURE (deg/mm)
BR02	20.7	5.8	22.9	1.105	93.1
BR07	20.9	4.6	18.6	0.890	72.3
BR08	24.3	4.1	18.8	0.774	72.1
BR11	19.5	5.3	18.4	0.944	83.6
BR12	20.2	5.2	20.0	0.990	86.5
BR13	23.8	4.8	20.6	0.874	82.4
BR16	25.4	2.5	14.7	0.579	47.5
BR23	24.7	3.0	16.6	0.672	57.4
BR27	22.3	5.2	20.6	0.924	76.1
BR29	27.1	2.9	16.0	0.590	49.8
BR30	31.7	2.1	16.7	0.527	40.4
BR33	24.1	5.9	21.1	0.876	66.8
BR36	22.6	3.7	14.9	0.659	60.2
BR37	25.1	3.3	15.3	0.610	53.0
BR38	23.2	5.6	20.8	0.897	97.3
BR39	18.2	4.6	20.2	1.110	76.6
BR42	19.6	4.1	14.0	0.714	53.2
BR44	23.2	3.0	14.8	0.638	48.5
BR45	21.3	3.6	15.0	0.704	54.9
BR48	29.5	2.6	15.0	0.508	40.5
BR49	33.1	1.9	13.6	0.411	30.4
BR50	18.1	5.8	15.2	0.840	78.6
BR53	25.4	5.1	22.6	0.856	85.8
BR55	19.5	6.5	23.8	1.221	122.7
BR57	18.5	6.0	20.3	1.097	91.1

* - Bulk

OFDA EXPT - b:\crimpcur2.wk4

TABLE II

LINEAR REGRESSION ANALYSES

OFDA CURVATURE (deg/mm) vs STAPLE CRIMP (per cm)

Regression Output:

Constant		0.066609
Std Err of Y Est		7.113375
R Squared		0.906296
No. of Observations		25
Degrees of Freedom		23
X Coefficient(s)	16.06761	
Std Err of Coef.	1.07729	

OFDA CURVATURE (deg/mm) vs COMPRESSED HEIGHT (mm)

Regression Output:

Constant		-44.9601
Std Err of Y Est		11.67671
R Squared		0.747507
No. of Observations		25
Degrees of Freedom		23
X Coefficient(s)	6.312185	
Std Err of Coef.	0.764949	

OFDA CURVATURE (deg/mm) vs BULK/DIAMETER RATIO (mm/µ)

Regression Output:

Constant		-9.7416
Std Err of Y Est		9.343551
R Squared		0.838329
No. of Observations		25
Degrees of Freedom		23
X Coefficient(s)	98.17497	
Std Err of Coef.	8.989712	

LOG-LOG REGRESSION ANALYSES

LOG OFDA CURVATURE (deg/mm) vs LOG STAPLE CRIMP (per cm)

Regression Output:

Constant		1.230441
Std Err of Y Est		0.046372
R Squared		0.912142
No. of Observations		25
Degrees of Freedom		23
X Coefficient(s)	0.959036	
Std Err of Coef.	0.062062	

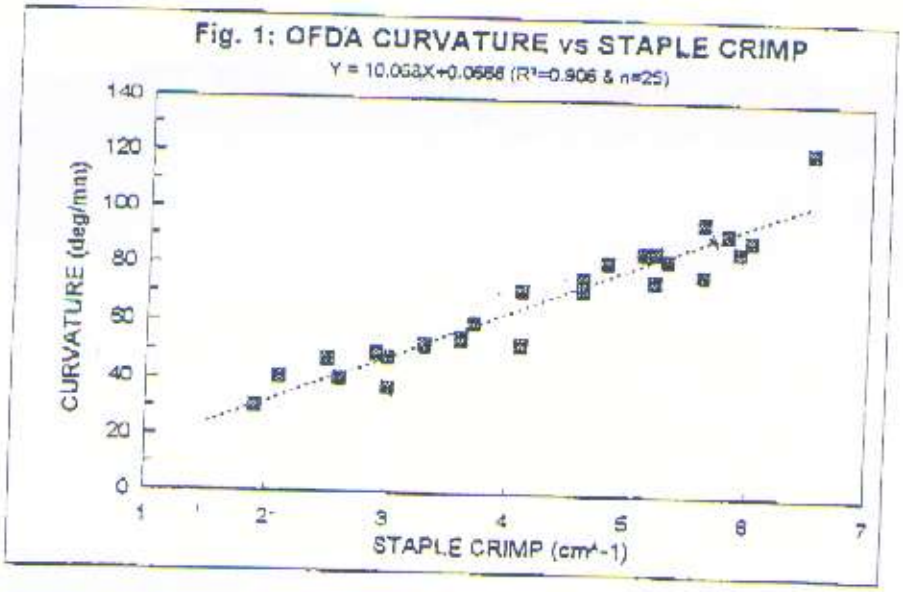


Fig. 1: OFDA CURVATURE vs STAPLE CRIMP
Y = 10.053X+0.0566 (R²=0.906 & n=25)
CURVATURE (deg/mm)
STAPLE CRIMP (cm^-1)

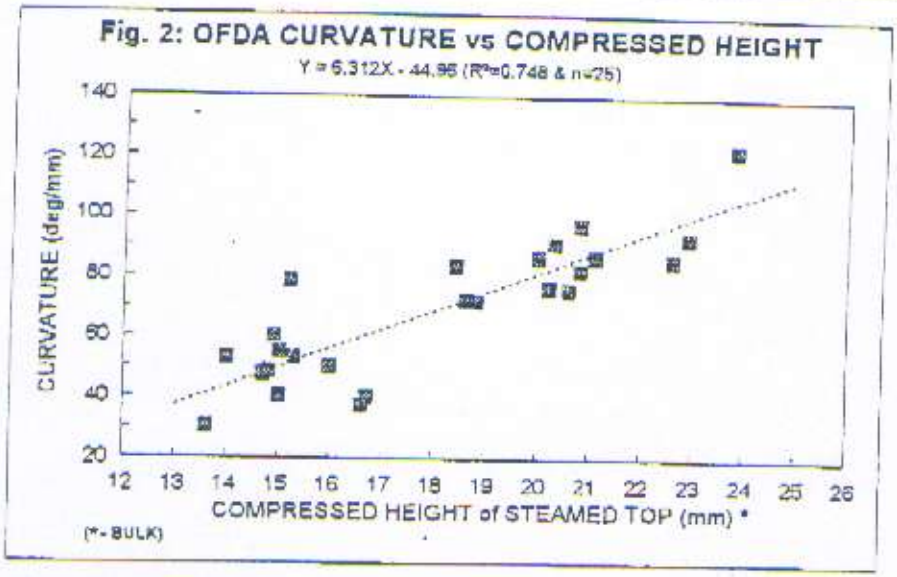


Fig. 2: OFDA CURVATURE vs COMPRESSED HEIGHT
Y = 6.312X - 44.96 (R²=0.748 & n=25)
CURVATURE (deg/mm)
COMPRESSED HEIGHT of STEAMED TOP (mm) *
(* - BULK)

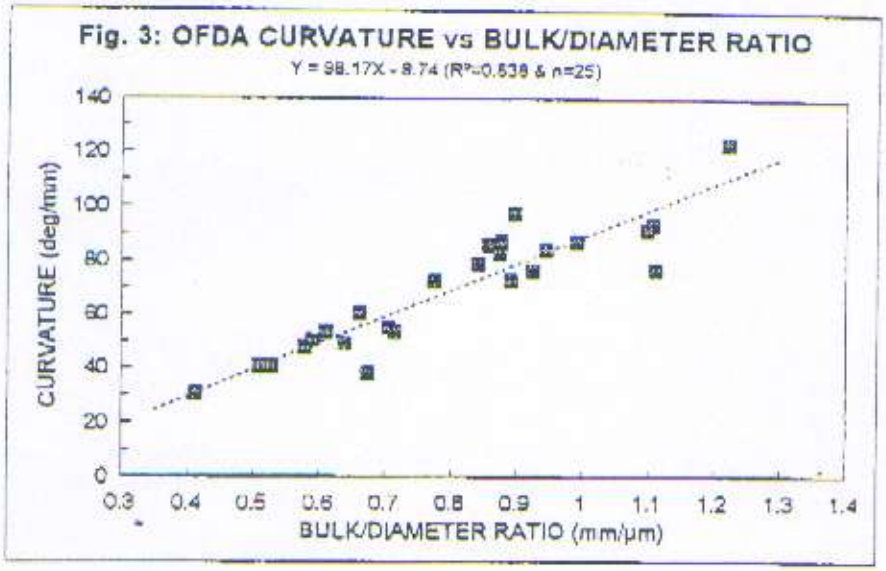


Fig. 3: OFDA CURVATURE vs BULK/DIAMETER RATIO
Y = 98.17X - 8.74 (R²=0.539 & n=25)
CURVATURE (deg/mm)
BULK/DIAMETER RATIO (mm/µm)