ABSTRACT

This thesis mainly deals with the design and development of a personal computer based torsional rigidity analyser meant for textile fibres and yarns. The thesis describes a 'state of the art' equipment developed using digital technology and two different techniques. The two techniques are

i) Torsion Pendulum technique:

In this method a textile fibre or filament is taken and a suitable mass of known moment of inertia is suspended from it. The top end of the textile material is attached to a stepper motor. Through a suitable software command to the motor, the mass is subject to torsional oscillations and the period of oscillation is recorded with the help of an infrared sensor interfaced to the computer. From the period of oscillation, the torsional rigidity is easily calculated by the computer. The computer also gives a statistical output for a number of experiments.

ii) Torsion Balance technique:

This method is suitable for spun or twisted yarns. In this method a torsion wire of known torsional property is taken. One end of the same is attached to a stepper motor placed at the top end of the equipment. The other end is attached to the yarn under test through a pointer-pin chuck combination. The bottom end of the yarn is tensioned by a weight, and the yarn with the tensioning weight can be given a predetermined twist by a bottom stepper motor. When the yarn is twisted by the bottom stepper motor, it gives the torsional wire a small angular movement causing the pointer which is sensed by suitable sensors to shift. When this happens, the computer causes the top motor to step, bringing the pointer back to the original position. The number of steps moved by the
top motor is proportional to the torque developed. Thus the
interrelationship between twist versus torque can be determined.
Suitable programs were made to obtain torque vs. twist curve, hysteresis
curve, residual torque in yarn and also breaking twist angle.

The equipment developed is the only one of its kind based on
the personal computer, using digital signals which combines both the
torsion pendulum technique and the torsion balance technique.

A novel method for determining the residual torque of cotton
yarns using polyester monofilament as the standard is discussed.

The torsional properties of the relatively new fibre, namely
Lyocell were determined including its breaking twist angle for the first time.

Excessive snarling tendency or the residual torque present in
yarns can create problems in textile production. This tendency in the
case of cotton yarns, is sometimes reduced by adopting a process,
'Steam Setting' in which the cotton yarn is taken to an auto clave and
subject to steam under pressure. A pilot scale 'insitu steam setting
arrangement' was developed to do this during yarn manufacture itself at
the Ring Frame ----- thus attempting to eliminate a separate
process\machine.

Singeing is a process where in a yarn is taken to a Singeing
Machine where the protruding fibres in the yarn are burnt away. A pilot
scale insitu singeing arrangement was developed to do this during yarn
manufacture itself at the Ring Frame. It was observed that insitu singeing
also resulted in 'setting of the snarling tendency\ residual torque. The
results of insitu singeing cum setting are described for the first time.

A survey of 30s count, 100% cotton yarn meant for the
Tirupur (South India) Knitting industry was undertaken. The residual
torque which in excess causes the defect 'spirality' in a knitted fabric was
determined for several yarns produced by different manufacturers. It is
hoped that this study will ultimately lead to further research and the
formulation of new standards for residual torque that can exist in a hosiery yarn.

The industrial implications of the study are fully discussed.