Torsional Properties

The behaviors shown by textile fibre, when it is subjected to twisting is known as torsional properties.

a) Torsional rigidity:

Torsional rigidity is the resistance of a textile fibre against twisting. It can also be defined as the torque applied to insert unit twist per unit length of fibre. The unit of torsional rigidity is N-mm^2, N-m^2 etc.

Mathematically, $Rt = \frac{\eta E T^2}{\rho}$

Where, η = Shape factor
E = Specific shear modulus (in N/tex)
T = Linear density (in tex)
ρ = Density (in gram/cm^3)

Specific torsional rigidity:

The specific torsional rigidity is the torsional rigidity of a textile fibre of unit linear density. Specific torsional rigidity is usually expressed as N-mm^2/tex, N-m^2/tex etc.

Mathematically, Specific torsional rigidity = $\frac{\eta E (1)^2}{\rho} = \frac{\eta E}{\rho}$

Where, η = Shape factor
E = Specific shear modulus (in N/tex)
T = Linear density (in tex)
ρ = Density (in gram/cm^3)

Specific torsional rigidity of different fibres:

Fibre	Specific torsional rigidity (mN-mm^2/tex)
Cotton	0.16
Wool	0.12
Silk	0.16
Viscose	0.085
Nylon-6.6	0.06
Polyester	0.067

b) Breaking twist:

Breaking twist is the twist for which a textile fibre will break. Breaking twist can also be defined as the number of turns or twists required to break a fibre. Breaking twist depends upon the diameter of fibre and is inversely proportional to the diameter.

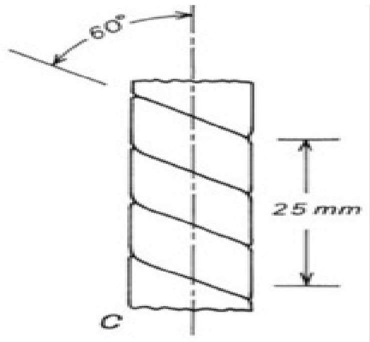
So, Breaking twist, $Tb \propto 1/d$ [d = fibre diameter]

Breaking twist angle:

The angle through which the outer layers of fibres are sheared at breaking is known as breaking twist angle. Breaking twist angle is usually expressed as α.

Mathematically, Breaking twist angle, $\alpha = \tan^{-1} (\prod d\ Tb)$

Where, d = Fibre diameter & Tb = Breaking twist per unit length of fibre



Breaking twist angle of different fibres:

Fibre	Breaking twist angle (α)	Fibre	Breaking twist angle (α)
Cotton	35^0	Wool	40^0
Viscose	33^0	Silk	39^0
Polyester	50^0	Glass	4^0

C) Shear modulus:

Shear modulus can be defined as the ratio between shear stress and shear strain.

So, Shear modulus = $\frac{\text{Shear stress}}{\text{Shear strain}}$

Shear strain is usually measured in radian. Shear modulus of a fibre is expressed as kN/mm^2. For example, shear modulus of wool is 1.3 kN/mm^2.