Abstract

The isochoric and isothermal flow of a viscoelastic fluid of the second-order in the annular region between two confocal ellipsoids is investigated theoretically. The study is carried out in terms of the three dimensional ellipsoidal (prolate spheroidal) coordinates (ζ,θ,φ) *where the inner and the outer ellipsoids are uniformly rotating with angular velocities* Ω_1 *and* Ω_2 *; respectively, about the axis connecting their foci.*

Up to the first-order the equation of motion had been solved .Hence a first-order velocity field $W_1(\zeta,\theta)$ *which represents the primary flow in the* φ *-direction about the z-axis is calculated.*

A second-order stream-function $\psi_2(\zeta,\theta)$ *which describes the secondary flow field superimposed onto the primary one has been properly formulated by solving the three-dimensional inhomogenious biharmonic vector equation . The particular solution of the planar second-order equation of motion is obtained via the three dimensional Green's function of the ellipsoidal coordinates .*

On the basis of the obtained velocity field, the stresses, forces and torques acting on the outer ellipsoid when it is being at rest has been calculated for viscoelastic third- order fluids. An important result for rheometry is that the resultant torques can be used to determine the coefficient of viscosity μ *and the third-order shear viscosity* $(\beta_2+\beta_3)$.