ABSTRACT

The velocity and stress fields of a fluid of grade two moving in the annular region between two rotating eccentric spheres is investigated . The bispherical system of coordinates delivers the most proper frame for solvig the present problem .Hence ,this system is employed for the solution of this boundary value problem .

The distribution of surface traction , forces and torque per unit area at the outer stationary sphere are calculated and discussed . The obtained results reveal that , in principle, a rheometer can be constructed on the basis of this boundary value problem to evaluate the material constants μ and the first normal stress difference coefficient ($\alpha_2 + 2\alpha_1$) .The measurement of the torque about the symmetry axis is used to determine the coefficient of viscosity μ .On the other hand ,the force along the symmetry axis which , if left without counterpart , would shift the spheres from the eccentric to the concentric state is used to determine the first normal stress difference .Since this system is less associated with the problem of end effects which appears in the case of the eccentric cylinder rheometer [1] ,it is expected that its construction should be more simple and its measurements more accurate .

The second -order approximation reveals that superimposed on the primary flow a secondary flow takes place . The secondary flow has components in the direction of α axis and β axis but it has no components in the ϕ direction which is the direction of the primary flow .