

A one-dimensional method based on Cosserat theory for a generalized unsteady viscoelastic fluid of third-grade

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Abstract

In this talk, we study the unsteady motion of a generalized viscoelastic fluid of third-grade where specific normal stress coefficient depends on the shear rate by using a power-law model. For that, we use the Cosserat theory approach which reduces the exact three-dimensional equations to a system depending only on time and on a single spatial variable. This one-dimensional system is obtained by integrating the linear momentum equation over the cross-section of the tube, taking a velocity field approximation provided by the Cosserat theory. The velocity field approximation satisfies exactly both the incompressibility condition and the kinematic boundary condition. From this reduced system, we obtain unsteady equations for the wall shear stress and mean pressure gradient depending on the volume flow rate, Womersley number, viscoelastic coefficients and flow index over a finite section of the tube geometry with constant circular cross-section. Attention is focused on some numerical simulations and on the analysis of perturbed flows.

Keywords

One-dimensional model, Cosserat theory, volume flow rate, generalized third grade fluid, axisymmetric motion, pressure gradient.

References

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