On axisymmetrical boundary problem of unsteady motion of micropolar fluid in the half-space

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The Newtonian relationships cannot be characterized to explain the behaviour of materials in shear. Eringen [1] proposed the basics of the theory of micropolar fluids display the effects of couple stresses, body couples and local rotary inertia. This theory might serve as a satisfactory model for describing the flow properties of polymeric fluids, liquid crystals which are made up of dumbbell molecules, animal blood and fluids containing certain additives.

El-Sirafy [2] generalized the results of the solution of the homogeneous Navier-Stokes equations in the half-plane for the slow motion of viscous incompressible fluids to the class of the micropolar fluids for the case of the given shear stresses on the boundary.

The aim of this paper is developing an exact solution for the problem of axisymmetrical flow of unsteady micropolar fluid in the upper half-space $y \geq 0 | t > 0$ when the shear stresses are given while each of normal velocity and microrotation vanishes on the boundary. We assume that the components of the vector of velocity and microrotation vanish initially and also at large distance from the boundary of the upper half-space. The Laplace-Hankel transform technique is used to solve this problem. Some physical quantities such as velocities , microrotation and pressure are obtained in a closed form and illustrated numerically as a function of y at different values of time t. This problem could be met in the study of the flow near a boundary which is not wet by the given fluid.

References

[1] A.C. Eringen, Theory of micropolar fluids, J. Math. Mech. 16 (1966) 1-18.

[2] I. H. Elsirafy, Two –dimensional flow of nonstationary micropolar fluid in the half-plane for which the shear stresses are given on the boundary. Journal of Computational and Applied Mathematics 12(13)(1985), 271-276