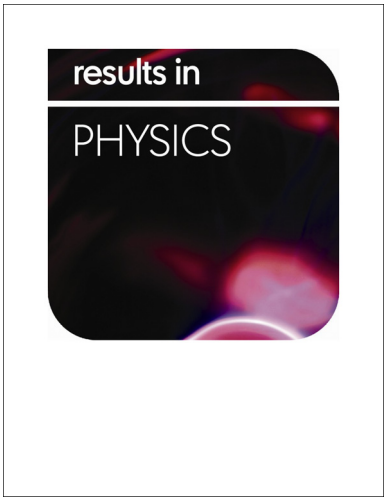

Computational modeling of unsteady third-grade fluid flow over a vertical cylinder: A study of heat transfer visualization

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Computational modeling of unsteady third-grade fluid flow over a vertical cylinder: A study of heat transfer visualization

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Abstract: The present paper aims to investigate the effect of Prandtl number for unsteady third-grade fluid flow over a uniformly heated vertical cylinder using Bejan's heat function concept. The mathematical model of this problem is given by highly time-dependent non-linear coupled equations and are resolved by an efficient unconditionally stable implicit scheme. The time histories of average values of momentum and heat transport coefficients as well as the steady-state flow variables are displayed graphically for distinct values of non-dimensional control parameters arising in the system. As the non-dimensional parameter value gets amplified, the time taken for the fluid flow variables to attain the time-independent state is decreasing. The dimensionless heat function values are closely associated with an overall rate of heat transfer. Thermal energy transfer visualization implies that the heat function contours are compact in the neighborhood of the leading edge of the hot cylindrical wall. It is noticed that the deviations of flow-field variables from the hot wall for a non-Newtonian third-grade fluid flow are significant compared to the usual Newtonian fluid flow.

Keywords: Third-grade fluid; Heat function; Boussinesq's approximation; Vertical cylinder; Implicit method; Prandtl number.