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Modeling Non-Isothermal wire-coating from a bath using Giesekus fluid

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In this paper we extend the recent analysis of Giesekus isothermal viscoelastic fluid model by inclusion of temperature in the uni-axial flow which occurs in the wire-coating process. The wire-coating flow of incompressible non-Newtonian fluid is described by the boundary value problem in terms of the equation of continuity, momentum, and energy with Giesekus constitutive equation. The equations of the uni-axial flow are written in the cylindrical coordinates and the analytical solution for the velocity is obtained. The energy equation which takes into account the viscous dissipation term is then solved to understand the temperature distribution in the flow region. The influences of non-Newtonian rheological parameters like Deborah number, Giesekus parameter and Brinkman number on velocity and temperature distributions are discussed. A comparison of the approximated solutions and the numerical solutions of the exact model equation for the velocity field is given to verify the validity of the approximated solutions. It is observed that the Giesekus parameter influences the temperature profile in the entire fluid domain.

Keywords: Giesekus fluid, Non-isothermal, Wire-coating