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Stability of the boundary layer on a rotating disk for power-law fluids PAUL GRIFFITHS, School of Mathematics, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK, STEPHEN GARRETT, Department of Engineering, University of Leicester, University Road, Leicester LE1 7RH, UK — The stability of the flow due to a rotating disk is considered for shear-thinning fluids that satisfy the power-law relationship. In this case the basic flow is not an exact solution of the Navier-Stokes equations, however, in the limit of large Reynolds number the flow inside the three-dimensional boundary layer can be determined via a similarity solution. An asymptotic analysis is presented in the limit of large Reynolds number. It is shown that the stationary spiral instabilities observed experimentally in the Newtonian case can be described for shear-thinning fluids by a linear stability analysis. Predictions for the wavenumber and wave angle of the disturbances suggest that shear-thinning fluids may have a stabilizing effect on the flow. The hypotheses of the asymptotic study are confirmed via a numerical investigation. The neutral curves are computed using a sixth-order system of linear stability equations which include the effects of streamline curvature, Coriolis force and the non-Newtonian viscosity model. It is found that the neutral curves have two minima; these are associated with the type I (cross-flow) and type II (streamline curvature) modes. Results indicate that an increase in shear-thinning has a stabilizing effect on both the type I and II modes.

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