Yin, Chen; Wang, Chunwu; Wang, Shaowei
Thermal instability of a viscoelastic fluid in a fluid-porous system with a plane Poiseuille flow. (English) Zbl 1457.76038

Summary: The thermal convection of a Jeffreys fluid subjected to a plane Poiseuille flow in a fluid-porous system composed of a fluid layer and a porous layer is studied in the paper. A linear stability analysis and a Chebyshev $\tau$-QZ algorithm are employed to solve the thermal mixed convection. Unlike the case in a single layer, the neutral curves of the two-layer system may be bi-modal in the proper depth ratio of the two layers. We find that the longitudinal rolls (LRs) only depend on the depth ratio. With the existence of the shear flow, the effects of the depth ratio, the Reynolds number, the Prandtl number, the stress relaxation, and strain retardation times on the transverse rolls (TRs) are also studied. Additionally, the thermal instability of the viscoelastic fluid is found to be more unstable than that of the Newtonian fluid in a two-layer system. In contrast to the case for Newtonian fluids, the TRs rather than the LRs may be the preferred mode for the viscoelastic fluids in some cases.

MSC:
76A10 Viscoelastic fluids
76S05 Flows in porous media; filtration; seepage
80A19 Diffusive and convective heat and mass transfer, heat flow

Keywords:
viscoelastic fluid; thermal convection; Poiseuille flow; fluid-porous system

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