Linear Stability of Convection in a Viscoelastic Nanofluid Layer

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Abstract

Abstract—This paper presents a linear stability analysis of natural convection in a horizontal layer of a viscoelastic nanofluid. The Oldroyd B model was utilized to describe the rheological behavior of a viscoelastic nanofluid. The model used for the nanofluid incorporated the effects of Brownian motion and thermophoresis. The onset criterion for stationary and oscillatory convection was derived analytically. The effects of the Deborah number, retardation parameters, concentration Rayleigh number, Prandtl number, and Lewis number on the stability of the system were investigated. Results indicated that there was competition among the processes of thermophoresis, Brownian diffusion, and viscoelasticity which caused oscillatory rather than stationary convection to occur. Oscillatory instability is possible with both bottom- and top-heavy nanoparticle distributions. Regimes of stationary and oscillatory convection for various parameters were derived and are discussed in detail.

Keyword：Keywords—instability, viscoelastic, nanofluids, oscillatory,