Alharbi, Ozwah S.; Abdullah, Abdullah A. 
A revised model for the effect of nanoparticle mass flux on the thermal instability of a nanofluid layer. (English) Zbl 1484.76026

The authors present the Rayleigh-Bénard problem for a horizontal layer of nanofluid heated from below. The motion of nanoparticles is characterized by the effects of thermophoresis and Brownian diffusion. The nanofluid layer is confined between two rigid boundaries. Both boundaries are assumed to be impenetrable to nanoparticles with their distribution being determined from a conservation condition. The material properties of the nanofluid are allowed to depend on the local volume fraction of nanoparticles and are modelled by non-constant constitutive expressions developed by K. Khanafer and K. Vafai [Int. J. Heat Mass Transfer 54, No. 19-20, 4410-4428 (2011; Zbl 1227.80022)] based on experimental data. The results show that the profile of the nanoparticle volume fraction is of exponential type in the steady-state solution. The resulting equations of the problem constitute an eigenvalue problem which is solved using the Chebyshev tau method. The critical values of the thermal Rayleigh number are calculated for several values of the parameters of the problem. Moreover, the obtained critical eigenvalues were real-valued, which indicates that the mode of instability is via a stationary mode.

Reviewer is of the opinion that this is a well written paper and will be of some importance to researchers working in the area of nanofluids.

Reviewer: Ioan Pop (Cluj-Napoca)

MSC:
76E06 Convection in hydrodynamic stability
76T20 Suspensions
76R50 Diffusion
76M99 Basic methods in fluid mechanics
80A19 Diffusive and convective heat and mass transfer, heat flow

Keywords:
linear stability analysis; Rayleigh-Bénard convection; critical Rayleigh number; Brownian diffusion; thermophoresis; Chebyshev tau method

Full Text: DOI

References:

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