

Stability of Marangoni convection in a composite porous-fluid with a boundary slab of finite conductivity

ABSTRACT

A linear stability analysis is used to investigate the onset of Marangoni convection in a three-layer system comprising an incompressible fluid saturated porous layer over which lies a layer of the same fluid and below which lies a solid layer. The lower boundary is subjected to a fixed heat flux, while the upper free surface of the fluid is non-deformable. At the interface between the fluid and the porous layer, the Beavers-Joseph slip condition is used and the Darcy law is employed to describe the flow in the porous medium. The asymptotic analysis of the long-wavelength is performed and the results are compared with those for the case of porous-fluid layer system. The effects of the thermal conductivity and the thickness of the solid plate on the onset of convective instability are studied. It is found that the solid plate with a higher relative thermal conductivity or higher thickness ratio tends to stabilize the system.

Keyword: Linear stability, Marangoni convection, Porous medium, Regular perturbation method