

ABSTRACT

The study of linear stability of flows in porous media gained interest by researchers working in various branches of engineering and science during the last century because of its wide spread applications. To model the heat and mass transfer in porous media, three equations, namely, mass conservation, momentum balance and energy equation are considered. In most of the existing literatures, the viscous dissipation term in the energy equation is neglected. Of late, it is seen that viscous dissipation alone may play an important role in the onset of convection. Keeping this fact in mind, in this thesis, the linear stability of thermal convection and double-diffusive convection is investigated with significant viscous dissipation effect in the medium. Also how some other influential effects, such as variable gravity, Soret effect etc, act in presence of viscous dissipation is analyzed.

In the first part of the thesis, the thermal convection is studied in both Darcy and non-Darcy regime. Also a variable gravity field is taken into account. The convection induced by inclined temperature gradient in a Brinkman regime is considered with horizontal throughflow and non-negligible viscous dissipation. The governing equations are reduced to an eigen value problem. The resulting equations are solved using Runge-Kutta accompanied by the Shooting technique. The numerical solutions are obtained using the software Mathematica 9.0. Various ranges of the governing parameters are considered to find the onset criterion for the instability. In the second part of the thesis, double-diffusive convection is dealt with. The dissipation induced stability and also the presence of external horizontal temperature gradient is considered in separate problems. The cross coupling between thermal and solutal gradients, namely the solutal flux generated due to temperature gradient, known as the Soret effect, is considered significant in the medium. In one problem the horizontal porous layer is bounded by two impermeable planes whereas for the other problem an open upper boundary is considered. It is seen that the influence of viscous dissipation is more significant in the presence of Soret parameter. The presence of open top boundary advances the onset of convection. However, the horizontal temperature gradient shows a stabilizing effect when the upper boundary is open.

Keywords: Porous Medium; Viscous dissipation; Variable gravity; Inclined gradients; Soret effect; Open boundary; Linear Stability; Thermo-solutal Convection.