World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:10, No:07, 2016

Limitation of Parallel Flow in Three-Dimensional Elongated Porous Domain Subjected to Cross Heat and Mass Flux

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Abstract : In the present work 2D and 3D numerical simulations of double diffusion natural convection in an elongated enclosure filled with a binary fluid saturating a porous medium are carried out. In the formulation of the problem, the Boussinesq approximation is considered and cross Neumann boundary conditions are specified for heat and mass walls conditions. The numerical method is based on the control volume approach with the third order QUICK scheme. Full approximation storage (FAS) with full multigrid (FMG) method is used to solve the problem. For the explored large range of the controlling parameters, we clearly evidenced that the increase in the depth of the cavity i.e. the lateral aspect ratio has an important effect on the flow patterns. The 2D perfect parallel flows obtained for a small lateral aspect ratio are drastically destabilized by increasing the cavity lateral dimension. This yields a 3D fluid motion with a much more complicated flow pattern and the classically studied 2D parallel flows are impossible.

Keywords : bifurcation, natural convection, heat and mass transfer, parallel flow, porous media
Conference Title : ICFMFA 2016 : International Conference on Fluid Mechanics and Flow Analysis
Conference Location : Paris, France
Conference Dates : July 25-26, 2016