NUMERICAL SIMULATION OF DOUBLE DIFFUSIVE NATURAL CONVECTION IN A POROUS CAVITY WITH A PARTIAL HEATING AND SALTING SOURCE

A. Abaiebaghri[1], S. Tavassolpour[*2], A.R. Noghrehabadi[2] & Gh. Rashed[3]

1. Department of Mechanical Engineering, Behbahan Branch, Islamic Azad University, Behbahan, Iran
2. Department of Mechanical engineering, Shahid Chamran university of Ahvaz, Ahvaz, Iran
3. Department of Mechanical Engineering, Petroleum University of Technology, Abadan, Iran

*(Number. 49, Shahid Gohary Alley, Ayatollah Vahid Behbahani Boulevard, Behbahan, Iran; P.O. Box: 63618-65778)

*Correspondence author: Fax: +98 67 1333 0234 Email: S.tavassolpour@yahoo.com

Keywords: *Natural convection, mass transfer, porous enclosure, finite volume method, Brinkman -Darcy-Forchheimer extended model*

ABSTRACT

In this article, double diffusive natural convection in a two-dimensional porous cavity is investigated numerically. Problem has been analyzed using the finite volume method. The grid layout was arranged by utilizing Quick scheme were adopted for the convection-diffusion terms for calculation in the fluid domain. The combine continuity, momentum and energy equations have been solved using the SIMPLEC algorithm. In this simulation, it is assumed that the vertical walls are at the constant temperature and uniform concentration. Bottom wall is party adiabatic and party with constant heat flux. At the top wall, a salting segment of constant length is subjected to higher concentration, while the rest of it is insulated. Non-slip boundary conditions are imposed over the walls of the enclosure. The Brinkman-Darcy-Forchheimer extended model was used as momentum equations in the porous medium. The physical properties are assumed to be constant except the density in the buoyancy term. The temperature and concentration influence on the density are incorporated through the Boussinesq approximation. In the actual computations, Prandtl number is fixed at 0.71, thermal and solutal Rayleigh numbers are varying from 10^4 to 10^7, the Lewis number from 10^{-3} to 10^2 and the Darcy Number from 10^{-1} to 10^{-5}. Average Nusselt and Sherwood numbers at the walls and velocity at mid-width of the cavity have been calculated for different values of above parameters to predict the flow effect and diffuse transport of heat and mass in the enclosure. The isotherms, streamlines and iso-concentrations for different solutal Rayleigh numbers, Lewis numbers have been studied. With an increase in the *Le* number, raise the value of average Sherwood number. Since when *Le* number augments, thermal buoyancy forces are principally to compel the flow motion. The thickness of the concentration boundary layer turns into thinner and the average Sherwood number along the salting element enhances. Also, When Darcy number is too small, the porous medium resistance becomes large and it behaves like a solid. In this situation, the conduction heat transfer is dominating mechanism in the porous medium.