ABSTRACT

The influence of various second order effects like thermal stratification, thermal and solutal dispersion, melting, thermo-diffusion, variable viscosity and radiation on the free and mixed convection heat transfer or coupled heat and mass transfer in a non-Newtonian fluid saturated non-Darcy porous medium is analyzed. The Ostwald-de Waele power law model is used to characterize the non-Newtonian fluid behavior. In Chapter 1, an introduction to various flow models that are used in porous media and a brief survey of literature on Newtonian and non-Newtonian flows through porous media is presented. Effect of thermal dispersion on free convective heat transfer from a vertical flat plate in a non-Newtonian fluid saturated thermally stratified non-Darcy porous medium is presented in Chapter 2. Main focus in Chapter 3 is to examine the combined effects of viscous dissipation and radiation on natural convection in a non-Darcy porous medium saturated with non-Newtonian fluid of variable viscosity. The influence of melting and thermo-diffusion effect on natural and mixed convection heat and mass transfer from vertical flat plate in a non-Newtonian fluid saturated non-Darcy porous medium is presented in Chapter 4 and Chapter 5, respectively. The effect of power law index parameter on free convection heat and mass transfer from a vertical wall is analyzed by considering double dispersion in a non-Darcy porous medium with constant wall temperature and concentration conditions is presented in Chapter 6 while the same for the mixed convection is presented in Chapter 7. In Chapter 8 we present the influence of viscous dissipation and Soret effect on natural convection heat and mass transfer from vertical cone/flat plate in a non-Darcy porous medium. In each case, the non-dimensional governing equations are solved numerically by similarity and local non-similarity methods wherever applicable. It is concluded that for a suitable choice of power law fluid these second order effects can control / alter both heat and mass transfer rates.

KEY WORDS: Natural convection, Mixed convection, Heat transfer, Mass transfer, Viscous dissipation, Radiation, Non-Darcy porous medium, Power-Law fluids, Pseudoplastics, Dilatants, Thermal dispersion, Solutal dispersion, Melting, Thermal stratification.