Title: **Numerical and Experimental Investigation of Buoyancy Induced Convection in High Porosity Media**

Student: **Tupakula Rama Krishna** (12ME92R08)

Abstract

The thesis reports the results of numerical modeling and experimental investigation of buoyancy induced (natural) convection in high porosity media. The first half focuses on numerical modeling of natural convection inside a differentially heated inclined rectangular enclosure filled with high porosity medium. Steady state numerical solution of the non-dimensional governing equations, considering Brinkman-Forchheimer-extended Darcy model and the Local Thermal Equilibrium (LTE) energy model, is obtained using a finite volume method. The angle of inclination of the cavity as well as its aspect ratio is varied in the different sets of simulations. The results show that the Nusselt number has a strong dependence on the Rayleigh and Darcy numbers as well as the angle of inclination and aspect ratio. Contrary to conventional wisdom, the optimum angle of inclination is not necessarily the vertical orientation of the cavity, but instead depends on the Rayleigh and Darcy numbers as well as the aspect ratio. Depending on the Rayleigh and Darcy numbers, the contribution of the non-Darcy terms in determining the Nusselt number can be significant.

The experimental investigation deals with buoyancy induced external natural convection of air in an open cell aluminium foam with porosity of 93% with pore densities of 2, 4, 8 and 16 pores per cm (PPC) under different heights and orientations. The average heat transfer coefficient is found to depend on the pore density, the thickness of the foam, the orientation of the base plate and the Rayleigh number. For a given angle of inclination and foam thickness, the thermal performance of samples with lower pore density is found to be superior. Two empirical correlations are proposed for estimation of the Nusselt number as a function of the independent variables and are found to match with the experimental results within ±5%.

Keywords: Natural convection, Porous Media, Non-Darcy, Differentially heated cavity, Heat sink.