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RADIATION EFFECT ON FREE CONVECTION OF A NON-NEWTONIAN FLUID OVER A VERTICAL CONE EMBEDDED IN A POROUS MEDIUM WITH HEAT GENERATION

M. A. A. Mahmoud

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Abstract: The effects of thermal radiation on free convection in a non-Newtonian fluid over a vertical cone embedded in a porous medium in the presence of heat generation are studied. By using similarity transformations, the governing equations describing the problem are transformed to a system of nonlinear ordinary differential equations, which are solved numerically. The results are presented in the graphical form. The effects of various physical parameters and of the local Nusselt number on the velocity and the temperature profiles are discussed.

Keywords: vertical cone, non-Newtonian fluid, heat generation, thermal radiation, porous medium.

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INTRODUCTION

Heat transfer by natural convection in a fluid-saturated porous medium has received a great deal of attention due to numerous geophysical applications, such as geothermal extraction, ground water flows, and oil recovery processes, as well as many engineering applications, such as storage of nuclear waste material, thermal insulation engineering, cooling of electronic components, casting and welding of manufacturing processes, ceramic processing, and various processes in chemical industry.

A steady free convection flow over a vertical flat plate in fluid-saturated porous media was investigated by Cheng and Minkowycz [1], Johnson and Cheng [2], Hung et al. [3], Mahmood and Merkin [4], Ress and Pop [5], and Bejan and Khair [6]. Steady free convection around a vertical cylinder embedded in a porous medium was analyzed by Minkowycz and Cheng [7]. Cheng et al. [8] investigated free convection heat transfer from a vertical cone pointing downwards in a fluid-saturated porous medium.

Laminar natural convection of Newtonian fluids over a frustum of a cone was studied by Na and Chiou [9]. Cheng [10] discussed combined heat and mass transfer by natural convection from truncated cones in saturated porous media with variable wall temperature and concentration. The problem of free convection heat and mass transfer near a wavy cone with a constant wall temperature and concentration in a porous medium was examined by Cheng [11]. Chamkha and Quadri [12] investigated the problem of combined heat and mass transfer by natural convection over a permeable cone embedded in a porous medium in the presence of an external magnetic field and heat generation or absorption.

Benha University, Benha, 13518, Egypt; mostafabdelhameed@yahoo.com. Translated from Prikladnaya Mekhanika i Tekhnicheskaya Fizika, Vol. 53, No. 5, pp. 127–135, September–October, 2012. Original article submitted October 11, 2011.