Chem. Eng. Comm., 199:925–942, 2012

ISSN: 0098-6445 print/1563-5201 online
DOI: 10.1080/00986445.2011.626380

Taylor & Francis
Taylor & Francis Group

MHD Flow and Heat Transfer in a Viscous Fluid over a Non-Isothermal Stretching Surface with Thermal Radiation in Slip-Flow Regime

MOSTAFA A. A. MAHMOUD

Department of Mathematics, Faculty of Science, Benha University, Egypt

The present work is concerned with the effects of surface slip conditions and thermal radiation on an electrically conducting fluid over a non-isothermal stretching surface in the presence of a uniform transverse magnetic field. Similarity transformation is used to transform the partial differential equations describing the problem into a system of nonlinear ordinary differential equations, which is solved analytically. The effects of various parameters on the velocity and temperature profiles as well as on the local skin-friction and the local Nusselt number are discussed in detail and displayed through graphs.

Keywords Heat transfer; MHD; Non-isothermal stretching surface; Slip flow regime; Thermal radiation

Introduction

The problem of flow and heat transfer in the boundary layer induced by a stretching surface in an otherwise ambient fluid is important in many industrial applications, such as the extrusion of plastic sheets, electronic chips, glass blowing, continuous casting, and spinning of fibers. Crane (1970) was the first to investigate analytically the problem of boundary layer flow of an incompressible viscous fluid over a linearly stretching surface. This problem was then extended by many authors. Gupta and Gupta (1977) studied the effect of suction/blowing on heat and mass transfer over a stretching surface. Grubka and Bobba (1985) analyzed heat transfer characteristics of a continuous stretching surface with variable temperature. Dutta et al. (1985) studied the temperature field in the flow over a stretching sheet with uniform heat flux. Cortell (2005) studied the effects of heat generation/absorption and suction/blowing on the flow and heat transfer of a fluid through a porous medium over a stretching surface.

In the above investigations, the authors dealt with hydrodynamic flow and heat transfer. Due to the importance of hydromagnetic flow and heat transfer problems in many engineering and industrial applications such as magnetohydrodynamic (MHD) power generators, polymer processes, and electro-chemistry they have attracted the attention of several researchers. In many metallurgical processes, such as drawing, annealing, and tinning of copper wires, that involve the cooling of continuous strips or filaments by drawing such strips in an electrically conducting fluid

Address correspondence to Mostafa A. A. Mahmoud, Department of Mathematics, Faculty of Science, Benha University (13518), Egypt. E-mail: mostafabdelhameed@yahoo.com