International Journal of
Science and Engineering Investigations
vol. 4, issue 40, May 2015
ISSN: 2251-8843

An Analysis of Steady Convective MHD Fluid Flow in Parallel Vertical Semi-Infinite Plates with Constant Magnetic Field

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Abstract- An investigation of MHD stokes free convection of an incompressible electrically conducting fluid between two vertical parallel semi-infinite plates subjected to a homogenous magnetic field has been done. The effect of a uniform magnetic field directed perpendicularly to the plates on the dynamic behavior of the fluid is studied. One plate is rigid, porous and fixed along the y axis while the other plate is placed at a distance h from the y axis and impulsively started in the flow direction. Further, a study on how Prandtl number and Hartman Number affect velocity and temperature profiles is carried out. The velocity profiles and temperature distribution are governed by a coupled set of continuity, momentum and energy equations. The generated equations have been solved numerically by the central finite difference approximations. The results obtained are discussed and presented both in tabular and graphical form. An increase in Hartmann is found to cause a decrease in velocity profile while an increase in Prandtl leads to a fall in temperature distribution. These results are found to merge with the physical situation of the flow.

Keywords- *porous plate, incompressible, magneto hydrodynamics*

I. INTRODUCTION

A fluid is a substance that can flow in an enclosure, in a pipe, in a channel or over a plate. Heat is transferred from one point to another as fluids flow. Heat transfer in fluids is called convection. In engineering devices, fluid flows occur in the presence of magnetic field. Fluid flow in the presence a magnetic field is called hydro magnetic flow and the study of hydro magnetic flows is called magneto hydro dynamics (MHD).A steady flow of an incompressible, viscous and electrically conducting fluid is very significant due to its application in MHD generators, pumps and flow meters. Further, this flow in a porous media is used to study the migration of underground water, movement of oil, gas and water through the reservoir, water purification, ceramic engineering and powder metallurgy.

II. LITERATURE REVIEW

The history of MHD flow traces back to 1930's.Since then a lot of research has been done on this area and considerable progress made. Some of the recent investigations include the influence of lateral mass flux on the free convection flow past a vertical flat plate embedded in a saturated porous medium done by [1] u nsteady heat transfer to pulsatile flow of a dusty viscous incompressible fluid in a channel was investigated by[2] . [3] Solved magneto hydrodynamics stokes problem of convection flow for a vertical infinite plate in a dissipative rotating fluid with Hall current. This is an analysis of the effects of various parameters on the concentration velocity and temperature profiles. [4]conducted a study on Radiation and free convection flow past a moving plate while[5] presented their work on MHD free convection heat and mass transfer of a heat generating fluid past an impulsively started infinite vertical plate with Hall current and radiation absorption a solution to hydro magnetic flow of dusty visco- elastic fluid between two infinite parallel plates was done by[6].Further,[7] presented their work on MHD stokes free convection past an infinite vertical porous plate subjected to a constant heat flux with ion-slip and radiation absorption. They discussed their tabulated results on concentration, velocity profiles and temperature distributions both theoretically and graphically whilst [8] studied a steady MHD flow of an electrically conducting fluid between two parallel infinite plates when the upper plate is made to move with constant velocity while the lower plate is stationary. [9] Investigated Radiation effects on MHD couette flow with heat transfer between two parallel plates whereas [10] carried out an investigation on Free Convection MHD Flow with Thermal Radiation from an Impulsively Started Vertical Plate. They established that velocity increases with a decrease in magnetic field parameter. In addition they realized that dimensionless temperature decreases with an increase in thermal radiation. [11] Carried out an investigation on hydro magnetic free convectional currents effects on boundary layer thickness while [12] carried out an investigation on the effects of Hall current and Rotational Parameter on dissipative fluid past a vertical semi-infinite plate. They found that an increase in Hall parameter for both cooling and heating of the plate by free convection currents has no effect on temperature profiles but leads to an increase in velocity profiles.[13] Conducted an investigation on unsteady transient free convection MHD flow between two long vertical parallel plates with constant temperature and variable mass diffusion. They established that velocity and skin friction of the fluid increase with increase