HEAT AND MASS TRANSFER IN ELASTICO-VISCOUS FLUID PAST AN IMPULSIVELY STARTED INFINITE VERTICAL PLATE WITH HALL EFFECT

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***Abstract*— An unsteady hydromagnetic free convection flow of elastico-viscous fluid past an infinite vertical plate is investigated when the temperature and concentration are assumed to be oscillating with time and also the Hall effects are taken into account. Assuming constant suction at the plate, closed form solutions have been obtained for velocity, temperature and concentration distributions and presented graphically, for various values of the elastic parameter (α), Schmidt number (Sc), Magnetic parameter (M) and Hall parameter (m).**

***Keywords*— Hall effect, elastico-viscous, Heat-mass transfer.**

I. INTRODUCTION

The phenomenon of heat and mass transfer has been the object of extensive research due to its applications in science and technology. Such phenomenon is observed in buoyancy induced motions in the atmosphere, in bodies of water, quasi-solid bodies such as earth and so on. In nature and industrial applications many transport processes exist where the heat and mass transfer takes place simultaneously as a result of combined effects of thermal diffusion and diffusion of chemical species. In addition, the phenomenon of heat mass transfer is also encountered in chemical processes industries such as food processing and polymer production. Soundalgekar and Warve (1977) have analyzed two dimensional unsteady free convection flows, past an infinite vertical plate with oscillating wall temperature and constant suction. The effects of suction, which oscillates in time about a constant mean, have also been studied by them. An extensive contribution on heat and mass transfer flows has been made by Khair and Bejan (1985). Lin and Wu (1995) have analyzed the problem of simultaneous heat and mass transfer with entire range of buoyancy ratio for most practical chemical species in dilute and aqueous solutions. Muthukumarswamy *et al.* (2001) studied the heat and mass transfer effects on flow past an impulsively started infinite vertical plate. The solution was derived using the Laplace transform technique, and the effects of Grashof number, Prandtl number and Schmidt number were discussed.

Magnetohydrodynamics (MHD) is currently undergoing a period of great enlargement and differentiation of subject matter. The interest in these new problems originates from their importance in liquid metals, electrolytes and ionized gases. The MHD heat and mass transfer processes are of interest in power engineering, metallurgy, astrophysics, and geophysics. *Singh et al.* (2003) studied the MHD heat and mass transfer in a flow of viscous incompressible fluid past an infinite vertical plate. Assuming oscillatory suction normal to the plate, they solved the problem analytically. The problem of combined heat and mass transfer of an electrically conducting fluid in MHD natural convection adjacent to vertical surface was analyzed by Chen (2004). The strength of the magnetic field was found to have an appreciable effect on skin friction coefficient, the Nusselt number and the Sherwood number. In the above investigations, the effects of Hall current are not considered. Therefore, the results in these investigations cannot be applied to the flow of ionized gases. This is because in an ionized gas where the density is low and (or) the applied magnetic field is strong, the effect of Hall current may be significant. Katagiri (1969) has studied the effects of Hall current on the magnetohydrodynamic boundary layer flow past a semi-infinite plate. Pop and Soundalgekar (1974) and Gupta (1975) have investigated the effects of Hall current on the steady hydromagnetic flow in an incompressible viscous fluid. Hossain and Rashid (1987) discussed the effects of Hall current on unsteady free convection flow along a porous plate in the presence of foreign gases such as H_2, CO_2, and NH_3 subjected to a transpiration velocity inversely proportional to square root of time. Pop and Wattanable (1994) considered the Hall effect on magneto-hydrodynamic free convection about a semi infinite vertical plate and solved the problem numerically by employing difference-differential method in combination with Simpson's rule. Acharya *et al.* (1995, 2001) analyzed Hall effect with simultaneous thermal and mass diffusion on unsteady hydromagnetic flow past an vertical plate. Assuming constant suction/injection normal to the plate, they solved the problem analytically. The results are discussed with respect to hydromagnetic parameter, Hall parameter, suction parameter, and Schmidt number. Aboeldahab and Elbarbary (2001) discussed heat and mass transfer along a vertical plate under the combined buoyancy force effects of thermal and species diffusion in the presence of transversely applied magnetic field and taking Hall effect into account. The system of non-linear equations is solved by using Runge-Kutta methods. Recently Sharma and Chaudhary (2005) studied the MHD heat and mass transfer along a vertical plate immersed in porous me-