EFFECTS OF CHEMICAL REACTION AND HEAT GENERATION ON DOUBLE-DIFFUSIVE NATURAL CONVECTION ALONG A NON-ISOTHERMAL VERTICAL CONE IN NON-NEWTONIAN FLUID SATURATED POROUS MEDIUM WITH VARIABLE VISCOSITY AND THERMAL RADIATION

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***Abstract*— In this work, we studied of variable viscosity, Dufour and Soret effects on free convection heat and mass transfer of a non-Newtonian power-law fluid over a vertical full cone in a saturated porous medium in the presence of chemical reaction, non uniform heat generation and thermal radiation. The transformed nonlinear ordinary differential equations are solved numerically using the fourth-order Runge-Kutta method coupled with the shooting method. The influences of various parameters on the local Nusselt number and the local Sherwood number are presented and discussed.**

***Keywords*— Dufour and Soret effects; Non-Newtonian power-law fluids; Variable viscosity; Thermal radiation; Porous medium; Chemical reaction; Heat generation.**

I. INTRODUCTION

Considerable attention by many authors on the problem of combined heat and mass transfer convection in a fluid saturated porous medium has been made because of its practical applications such as heat exchangers devices, petroleum reservoirs, underground spreading of chemical contaminants through water saturated soil, nuclear waste disposal, chemical catalytic reactors and moisture migration in fibrous insulation. The boundary layer analysis about variable viscosity effects on the double-diffusive convection near a vertical truncated cone in a fluid-saturated porous medium with constant wall temperature and concentration was investigated by Cheng (2009a). Yih (1999) studied heat and mass transfer driven by natural convection from a truncated cone immersed in a porous medium with variable heat and mass flux or with constant wall temperature and concentration. Natural convection heat transfer of a Darcian fluid about a cone was investigated by Cheng *et al.* (1985). Free convection boundary layer over a vertical surface immersed in a porous medium with constant heat and mass fluxes taking into account the effect of wall injection was analyzed by Lai and Kulacki (1991).

The above studies were restricted to Newtonian fluids, while many fluids involved in a number of processes that occur in chemical industry display non-Newtonian fluid behavior. Relationship between shear stress and shear rate for non-Newtonian fluids is different from that Newtonian fluids. Many of non-Newtonian fluids used in chemical engineering follow the Ostwald- de Waele power-law model for the shear stress. Buoyancy-induced flow of non-Newtonian fluids in a porous medium over a vertical plate with non-uniform surface heat flux was investigated by Mehta and Rao (1994). Kumari and Jayanthi (2005) investigated the influence of a uniform lateral mass flux on the natural convection flow past a vertical cone embedded in a porous medium saturated with non-Newtonian fluid. The influence of uniform lateral mass flux on the natural convection of non-Newtonian power-law fluids on an isothermal or isoflux vertical cone in a porous medium was studied by Yih (1998). The problem of steady free convection boundary layer over a vertical cone embedded in a porous medium filled with a non-Newtonian fluid in the presence of internal heat generation was investigated by Groşan *et al.* (2004). Cheng (2009b) investigated the problem of the steady natural convection boundary layer flow over a downward pointing vertical cone in porous media saturated with non-Newtonian power-law fluids under mixed thermal boundary conditions.

In the above mentioned works, Soret (thermal-diffusion) and Dufour (diffusion-thermo) effects are not taken into consideration. Such effects are significant when density differences exist in the flow regime. For example when species are introduced at a surface