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J.C. Umavathi, M.A. Sheremet, Syed Mohiuddin

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Combined effect of variable viscosity and thermal conductivity on mixed convection flow of a viscous fluid in a vertical channel in the presence of first order chemical reaction

J.C. Umavathi[1,2], M.A. Sheremet[3,4*] and Syed Mohiuddin[1]

[1]Department of Mathematics, Gulbarga University, Gulbarga, Karnataka, India
[2]Department of Engineering, University of Sannio, Piazza Roma 21, 82100 Benevento, Italy
[3]Department of Theoretical Mechanics, Tomsk State University, 634050 Tomsk, Russia
[4]Department of Nuclear and Thermal Power Plants, Tomsk Polytechnic University, 634050 Tomsk, Russia

*Corresponding author, telephone/fax number: +73822529740, e-mail address: michael-sher@yandex.ru (Mikhail A. Sheremet)

Abstract

An analysis has been carried out to obtain the flow, heat and mass transfer characteristics of a viscous fluid having temperature dependent viscosity and thermal conductivity in a vertical channel. The energy equation accounts for viscous dissipation, while the first order homogeneous chemical reaction between the fluid and diffusing species is included in the mass diffusion equation. The walls of the channel are maintained at constant but different temperatures. The non-dimensional coupled nonlinear ordinary differential equations are solved analytically using perturbation method and numerically using Runge-Kutta shooting method. The velocity, temperature and concentration distributions are obtained numerically and presented through graphs. Skin friction coefficient and Nusselt number at the walls of the channel are derived and discussed and their numerical values for various values of physical parameters are presented through tables.

Keywords: Mixed convection, variable viscosity, variable thermal conductivity, viscous dissipation.

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