MHD HEAT AND MASS TRANSFER FLOWS OVER A STRETCHING SHEET: A REVIEW

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Abstract

The present study is an overview of magnetohydrodynamic flow of heat and mass transfer characteristics of Newtonian/non-Newtonian fluid flow over a porous stretching surface with radiation effects. On the basis of previous studies the researchers have identified that there is a wider scope for further analysis and lots of research work is to be carried on these areas. The current study has been mainly focused on the analysis of flow over stretching sheet, MHD flow and mixed convention in a porous medium with thermal radiation. These areas having significant applications in many branches of science and technology. In particular, application in biomedical engineering includes cardiac MRI, ECG, etc. and this contributes more for the growth of industries which inturn leads to the development of the society.

Keywords: Convection, Heat and Mass Transfer, MHD, Radiation, Stretching Sheet.

Introduction

The heat and mass transfer of an incompressible viscous fluid flow past a stretching surface have important applications in the field of geophysical science and energy related engineering problems. Sakiadis1 first studied the boundary layer flow on moving solid surface, who found that the laminar boundary layer growth is in the direction of motion of the continuous solid surface. Crane2 studied the two dimensional laminar flow of an incompressible viscous fluid over a stretching sheet. Gupta and Gupta3 extended this research to the heat and mass transfer of viscous fluids over an isothermal stretching sheet with suction or blowing. Bhattacharyya et al.4 analyzed the heat transfer in the fluid flow of a viscoelastic over a stretching sheet. Rami Reddy et al.5 studied the heat transfer on peristaltic fluid flow in an asymmetric channel. Sheikholeslami et al.6 investigated the heat transfer of Cu-water nanofluid flow between a stretching sheet and a porous surface in a rotating system. Recently, Qasim7 studied the heat and mass transfer in a Jeffrey fluid over a stretching sheet with heat source. Satya Narayana and Harish Babu8 studied the numerical analysis of heat and mass
The study of the electrically conducting fluid in the presence of magnetic field is magnetohydrodynamic (MHD). Magnetohydrodynamic flow of an electrically conducting fluid due to the stretching sheet is of valuable interest in modern metallurgic and metal-working processes. Pavlov\(^9\) was first studied the problem of the MHD, he examined the magneto-hydrodynamics flow in an electrically conducting fluid over a stretching wall with a uniform magnetic field. The two-dimensional Navier-Stokes equations for the MHD fluid over a stretching sheet without applying the boundary layer theory are solved analytically by Andersson \textit{et al.}\(^{10}\). Abel \textit{et al.}\(^{11}\) studied the magnetohydrodynamic heat and mass transfer on non-Newtonian fluid flow over a stretching surface. Pal\(^{12}\) studied the heat transfer in the boundary layers on an exponentially stretching surface in the presence of magnetic field. Kumar and Gupta\(^{13}\) studied the MHD flow of micropolar and Newtonian fluids through porous medium in a vertical channel. Recently, Ellahi \textit{et al.}\(^{14}\) investigated the effects of magnetohydrodynamics on peristaltic flow of Jeffrey fluid in a rectangular duct through a porous medium. Nadeem \textit{et al.}\(^{15}\) investigated the mathematical model for the peristaltic flow of Jeffrey fluid with nanoparticles phenomenon through a rectangular duct. More recently, Abd-Alla \textit{et al.}\(^{16}\) studied the peristaltic flow of a Jeffrey fluid under the effect of radially varying magnetic field in a tube with an endoscope. Ellahi \textit{et al.}\(^{17}\) have investigated the blood flow of Prandtl fluid through a tapered stenosed arteries in permeable walls with magnetic field. Sheikholeslami \textit{et al.}\(^{18}\) studied the influence of magnetic field on Fe3O4-plasma nanofluid flow in drug targeting using lattice Boltzmann method. Some author’s studies on relevant topics can be seen from the list of references\(^{19-22}\). The study of mixed convection has many practical applications in engineering and technological processes. Both the forced and free convection in a boundary layer flow was first studied by Sparrow \textit{et al.}\(^{23}\), who showed that system of ordinary differential equations are developed by the boundary layer equations. Gorla \textit{et al.}\(^{24}\) examined mixed convection in non-Newtonian fluids along non-isothermal horizontal surfaces in a porous medium. Convective heat and mass transfer in a viscoelastic fluid flow over a stretching sheet through a porous medium was investigated by Abel \textit{et al.}\(^{25}\). Sudheer Babu \textit{et al.}\(^{26}\) performed the effect of chemical reaction on free convection in uniform magnetic field over a porous medium with variable suction and considering the radiation absorption. Nadeem \textit{et al.}\(^{27}\) investigated the partial slip effect on non-aligned stagnation point nanofluid over a stretching convective surface. Satya Narayana\(^{28}\) investigated the effects of variable permeability on mixed convective flow over a vertical wavy channel with traveling thermal waves in the presence of magnetic field. Thermal radiation effect plays a major role in dominant heat transfer process in polymer
processing industry. Radiative heat transfer flow is very vital in manufacturing industries for the design of reliable equipments, nuclear plants, gas turbines and various propulsion devices for aircraft, missiles, satellites and space vehicles.

The Rosseland approximation (Brewster\textsuperscript{29}) is used to describe the radiative heat flux in the energy equation. Also, the forced and free convection flows is important in the content of space technology and processes involving high temperature in the presence of thermal radiation effects. Raptis\textsuperscript{30} discussed the effect of radiation on the flow of a micropolar fluid past a continuously moving plate. Siddheshwar and Mahabaleswar\textsuperscript{31} investigated the effects of radiation and heat source on MHD heat transfer flow of a viscoelastic liquid over a stretching sheet. Radiative flow of Jeffery fluid in a power law heat flux and heat source with porous medium is discussed by Hayat et al.\textsuperscript{32}. Harish Babu and Satya Narayana\textsuperscript{33} studied the influence of radiation absorption on heat and mass transfer in micropolar flow over a vertical moving porous plate in the presence of magnetic field. Cortell\textsuperscript{34} studied the fluid flow and radiative nonlinear heat transfer over a stretching sheet. An increasing Prandtl number causes decrease in the thickness of the thermal boundary layer. Recently, Venkateswarlu and Satyanarayana\textsuperscript{35} studied the chemical reaction and radiation absorption effects on heat transfer of a nanofluid flow in a rotating system. Satya Narayana et al.\textsuperscript{36} analyzed the effects of thermal radiation and heat source on MHD nanofluid past a vertical plate through porous medium in a rotating system.

Conclusion

The research area of fluid dynamics on stretching sheet is spreading at a faster rate in dissimilar categories of physical problems. In modern days most of the researchers are carrying their research by applying applied science in fluids because it extends the thermal conductivity and, other parameters like magnetic field, thermal radiation and chemical reaction have significant uses. In this study the researchers considered the possible technical applications in liquid-based systems involving stretchable materials and the reduced boundary layer equations of non-Newtonian fluid models are solved numerically by using different techniques. Modern techniques are rising out to solve various stretching problems which can be useful for the industry.

References


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