Analysis of 3D MHD Darcy-Forchheimer flow of Ti-alloy nanofluid with paraffin oil over a bi-directional stretching surface

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1. INTRODUCTION & OBJECTIVE

The three-dimensional model of the Darcy-Forchheimer flow of convection system consists of classified Ti-alloy nanoparticles with paraffin oil as base fluid is mathematically constructed using the fluid mechanics of partial differential equations (PDE) and using the similarity transformation technique, it is converted into numerical methods and shooting method is also established to get a better solution. The study on the influence of significant porosity, stretching surface, Brownian motion, radiation, etc., on fluid bi-directional velocity, temperature, and concentration of the system is discussed with graphs and tables. The results exhibit that on volume fraction, the presence of Ti-alloy in the fluid enhances its thermal conductivity and viscosity, which can increase the velocity of the fluid with temperature. Magnetic field decreased the bi-directional velocity of fluid and increased the temperature of the system due to it stimulating a Lorentz force which resisted the fluid motion. This study of paraffin oil heat transfer fluid and incorporated Ti-alloy nanoparticles have been widely used in the industrial application of steam generation, thermal management, heat treatment, engine cooling units, etc.

2. RESULTS & HIGHLIGHTS

The results demonstrate that the presence of Ti-alloy nanoparticles in the paraffin oil base fluid enhances its thermal conductivity and viscosity, leading to an increase in the velocity of the fluid with temperature. The magnetic field decreases the bi-directional velocity of the fluid and increases the temperature of the system due to the stimulating Lorentz force, which resists the fluid motion. The velocity rises for opposing flows against significant contributions of Eckert number and imposed thermal radiations, which are observed in the thermal performance of the nanofluid.

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