FORCE CONVECTION HEAT TRANSFER ENHANCEMENT OF NANOFLUIDS OVER A FLAT PLATE EMBEDDED IN A SATURATED POROUS MEDIUM: PRESCRIBED CONSTANT HEAT FLUX

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ABSTRACT

In the present study, the heat transfer enhancement of nanofluids over a flat plate embedded in a porous medium saturated with a nanofluid is analyzed. Forced convection heat transfer is an important key in design of industrial devices. Convective heat transfer can be enhanced with changing geometry and flow or by increase in the thermal conductivity of the heat transfer fluid. In recent years, the concept of nanofluid has been proposed as a route for surpassing the performance of heat transfer rate in conventional heat transfer fluids. The materials with sizes of nanometers possess unique physical properties. The nanoparticles are small enough to behave similar to liquid molecules; therefore, they can flow smoothly through channels and components without clogging them. These excellent properties of nanoparticles have attracted many researchers to investigate the heat transfer characteristics of nanofluids. They found that the presence of the nanoparticles significantly enhances the effective thermal conductivity of the nanofluid, and consequently, it can enhance the heat transfer characteristics of the resulting nanofluid. Few literatures have been conducted about forced convection heat transfer of nanofluid in porous media. The aim of present study is to analysis the enhancement of using nanofluids in the forced convection heat transfer over horizontal flat plate. The temperature of free stream and the heat flux on the plate are assumed constant. The partial differential equations governing the heat transfer of nanofluids are reduced to an ordinary differential equation (ODE). An analytical exact solution is obtained for the resulted ODE. The effect of nanoparticles volume fraction as well as the types of nanoparticles on the heat transfer of nanofluids are investigated.