Thermal progress of a non-Newtonian hybrid nanofluid flow on a permeable Riga plate with temporal stability analysis

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ABSTRACT

Flow and heat transfer phenomena involving hybrid nanofluids has been used in a variety of technological and commercial applications. Thus, the flow behavior with thermal progress of a second grade hybrid Cu-Al_2O_3/CH_3OH nanofluid towards a permeable Riga/EMHD plate is investigated. The governing model is reduced to a set of ordinary differential equations, which are then solved in Matlab software using the bvp4c application. The solutions for the skin friction coefficient and the local Nusselt number have been established and discussed. Two solutions are available when the parameters are employed within the ranges of $0.007 \leq K \leq 0.009$, $0.05 \leq Z \leq 0.2$, $0.1 \leq A \leq 0.3$ and $0.01 \leq \phi_{hnf} \leq 0.03$,while the suction parameter and Prandtl number is fixed at $S=2$ and $Pr=7.38$ (CH_3OH). However, only the first solution is validated as the real physical solution based on the positive smallest eigenvalue from the stability analysis. The use of hybrid nanoparticles in combination with the suction effect has been exposed to have a role in the thermal growth of this non-Newtonian working fluid. The addition of volumetric concentration of hybrid nanoparticles extends the critical value approximately 1.4-1.6% such that $\lambda_c=-3.03383$($\phi_{hnf}=0.01$), $\lambda_c=-3.08119$($\phi_{hnf}=0.02$) and $\lambda_c=-3.12497$($\phi_{hnf}=0.03$). Meanwhile, only second grade parameter has a significantly negative impact on the thermal performance.

KEYWORDS

Hybrid nanofluid; Non-Newtonian fluid; Riga plate; Second grade; Stagnation point flow

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