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Parametric sensitivities of gravity and electroosmotic-driven ternary composite nanoparticles past a Riga device with heat gain and convective cooling

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The study of ternary composite nanofluids has been given noteworthy attention because of their flow enhancement and thermal properties, making them a useful thermal transport application. The modulation of electroosmotic flow and integration of gravity with a Riga device in fluid transport control and energy dissipation are essential for optimizing the performance of cooling systems, microfluidics, and energy applications. Thus, this research focuses on the parametric sensitivities of gravity and electroosmotic-driven tri-composite nanoparticles of aluminum oxide (Al2O3), graphite, and carbon nanotube (CNT) propagated in a water-based fluid flowing past a Riga plate. The combined effects of gravity variation, electroosmotic force, and magnetohydrodynamic (MHD) control via the Riga plate are studied for flow stability optimization and effective heat transfer. A hybrid numerical-analytical technique solves the invariant nonlinear dimensionless equations. Sensitivity analyses revealed that gravity variation momentously influences thermal boundary layer formation and nanoparticle distribution, while a rising electroosmotic term inspires velocity profiles and discourages viscous drag. The ternary hybrid nanofluid augments thermal conductivity, with graphite and CNT propelling thermal dispersion and Al2O3 supporting nanoparticle stability. The findings explain the optimal applications of electrokinetic tuning and MHD parameters in energy harvesting, biomedical microfluidics, and advanced cooling technologies.

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