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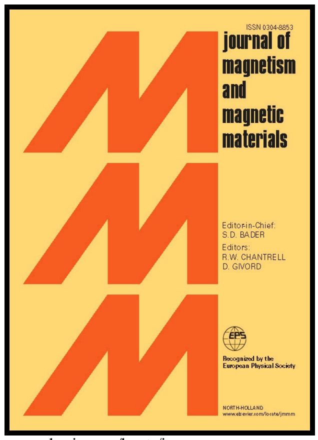

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Mixed convection of magnetohydrodynamic nanofluids inside microtubes at constant wall temperature

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Abstract

Laminar fully developed mixed convection of magnetohydrodynamic nanofluids inside microtubes at a constant wall temperature (CWT) under the effects of a variable directional magnetic field is investigated numerically. Nanoparticles are assumed to have slip velocities relative to the base fluid owing to thermophoretic diffusion (temperature gradient driven force) and Brownian diffusion (concentration gradient driven force). The no-slip boundary condition is avoided at the fluid-solid mixture to assess the non-equilibrium region at the fluid-solid interface. A scale analysis is performed to estimate the relative significance of the pertaining parameters that should be included in the governing equations. After the effects of pertinent parameters on the pressure loss and heat transfer enhancement were considered, the figure of merit (*FoM*) is employed to evaluate and optimize the thermal performance of heat exchange equipment. The results indicate the optimum thermal performance is obtained when the thermophoresis overwhelms the Brownian diffusion, which is for larger nanoparticles. This enhancement boosts when the buoyancy force increases. In addition, increasing the magnetic field strength and slippage at the fluid-solid interface enhances the thermal performance.

Key Words: Magnetic field effect; anomalous heat transfer rate; nanofluid; nanoparticle migration; thermophoresis; Brownian motion.

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