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Simulation of forced convection in non-Newtonian fluid through sandstones

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ABSTRACT

Numerical simulation is carried out to study forced convection in non-Newtonian fluids flowing through sandstones. Simulation is carried out using lattice Boltzmann method (LBM) for both shear-thinning and shear-thickening, by varying the power law index from 0.5 to 1.5 in Carreau–Yasuda model. Parameters involved in LBM and Carreau model are identified to achieve numerical convergence. Permeability and porosity are varied in the range of 10^{-10}–10^{-6} and 0.1–0.7, respectively, to match actual geometrical properties of sandstone. Numerical technology is validated by establishing Darcy's law by plotting the graph between velocity and pressure gradient. Consequently, investigation is carried out to study the influence of material properties of porous media on flow properties such as velocity profiles, temperature profiles, and Nusselt number.

🔍 KEYWORDS: Carreau–Yasuda model | lattice boltzmann method, non-Newtonian fluid, porous media