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Heat and mass transfer in a shear-thinning fluid through porous media

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Heat and mass transfer in non-Newtonian fluids through porous materials have wide applications in nature and engineering. Compared to non-Newtonian fluid flow in porous materials, solute and heat transport in porous materials have been less investigated. Specially, effect of heterogeneity of porous structure on flow and transport and upscaling the bulk fluid properties to the porous media averaged properties are not yet well understood.

To address these gaps in understanding, we proposed a GPU-parallelized pore-network model to simulate the flow and dynamic transport of non-Newtonian fluids in 3D unstructured networks with millions of pores at the centimetre level. The modified Meter model was used to properly model the relation between viscosity and shear stress of the non-Newtonian fluid under varying temperatures. We first validated the algorithm by comparing the thermal front from simulation results against the proposed analytical solution. Then both Newtonian and non-Newtonian fluids were studied in the spatially uncorrelated and correlated networks at varying injecting flow rates. The proposed modelling framework provides the possibility to control the injection rate as a function of porous media properties and fluids rheology. Additionally, effect of spatial heterogeneity and dynamic conditions on thermal fingering and upscaling transport properties will be presented in this work.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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