Computational Time and Size Domain Analysis of Porous Media Flows Using the Lattice Boltzmann Method

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Abstract

The study of the behaviour of the fluid flow through the porous media is of particular interest in several fields of the knowledge such as geological or energy sciences. In geological sciences, different porous media properties are influenced by the transport phenomena that occur through the media [1], whereas in energy sciences; several microstructural parameters depend on the behaviour of the fluid through the porous layers in the fuel cells [2].

The purpose of this study is to give detailed information related to the computational time required and its relation with the size domain employed when the fluid flow behavior through a porous domain is computed using the lattice Boltzmann method. LBM has been applied because its feasibility for solving the fluid flow behaviour in complex geometries. For this study, a range of porosity values is selected to compute, for several sizes domain, the required computational time when the steady state is reached. The porous media are digitally generated by placing the solid obstacles in random way, the length of the pore domain is kept constant, and the transversal area is varied. Additionally, the hydraulic tortuosity values for each porous domain are computed.

References

1. M. B. Clennell. Tortuosity: a guide through the maze. Geological Society, London, Special Publications 122, no. 1 (1997): 299-344.
2. M. Espinoza and M. Andersson and J. Yuan and B. Sundén. Compress effects on porosity, gas-phase tortuosity, and gas permeability in a simulated PEM gas diffusion layer. International Journal of Energy Research 39, no. 11 (2015): 1528-1536.