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Multi-scale analysis on coal permeability using the Lattice Boltzmann Method

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As a mesoscopic kinetic approach, the lattice Boltzmann method (LBM) has been widely applied to characterize the flows in porous medium. However, for larger scale flow, upscaling microscale technique is the key and difficult point. Based on microtomographic images of an actual coal sample, numerical simulations were carried out using the LBM at the pore scale. The velocity/pressure distributions and coal permeability were obtained. The local rate of mechanical dissipation is applied to determine an appropriate REV. Then based on the WBS-LBM, numerical simulations were carried at the REV scale and the pressure distribution is almost identical with the solution of the LBM simulations at the pore scale. The simulation results of REV with different sizes indicate that: The size of REV determined in this paper is reasonable. The relative error between pore scale and REV scale simulation for permeability prediction is less than 5%. In addition, the REV scale simulation can greatly improve the computational efficiency, and provides an effective approach for large-scale flow simulation.

References

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