Application of eXtended Discrete Element Method for Multiphase flow in Packed Bed Reactors including Heat Transfer

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ABSTRACT

Multiphase flow through solid particles exists in broad spectrum of engineering disciplines such as chemical industries, petroleum engineering, wastewater treatment, food processing and other industries. Momentum transfer and heat exchange between phases play a very important role in order to have higher efficiency and productivity. Numerical models are promising methods to model these phenomena in order to provide more detailed information.

In this contribution a combined discrete-continuous model named eXtended Discrete Element Method (XDEM) was used to model multiphase flow through porous media including heat transfer. In this method, the fluid phases are treated by Computational Fluid Dynamics (CFD) using OpenFOAM while the solid particles are modelled using XDEM. These two methods are coupled through momentum and heat exchange between the fluid phase and solid particles using unresolved method. This coupled multi-mesh approach can calculate the porosity distribution and particle mean diameter for each CFD cell of the bed. Therefore there is no need to empirical correlation for porosity distribution in order to include wall effects.

To validate the code, the results for two important hydrodynamic parameters named pressure drop and liquid hold up as well as heat transfer coefficient were investigated. The coupled XDEM solver is in satisfactory agreement with experimental data. The effect of different parameters such as particle size, gas and liquid velocities on pressure drop, liquid hold up and heat transfer coefficient were also investigated.

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