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Fluid Dynamics and Transport Phenomena

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Abstract

Compared to the traditional lumped-parameter model, computational fluid dynamics (CFD) attracted more attentions due to facilitating more accurate reactor design and optimization methods when analyzing the heat transfer in the industrial packed bed. Here, a model was developed based on the CFD theory, in which the heterogeneous fluid flow was resolved by considering the oscillatory behavior of voidage and the effective fluid viscosity. The energy transports in packed bed were calculated by the convection and diffusion incorporated with gaseous dispersion in fluid and the contacting thermal conductivity of packed particles in solids. The heat transfer coefficient between fluid and wall was evaluated by considering the turbulence due to the packed particles adjacent to the wall. Thus, the heat transfer in packed bed can be predicted without using any adjustable semi-empirical effective thermal conductivity coefficient. The experimental results from the literature were employed to validate this model.