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Mass transfer coupled to chemical reaction through a random array of fixed porous particles ERIC CLIMENT, Institut de Mecanique des Fluides de Toulouse, MOSTAFA SULAIMAN, ABDELKADER HAMMOUTI, IFP-EN, ANTHONY WACHS, University of British Columbia, UNIV. OF BRISTISH COLUMBIA COLLABORATION, IFP-EN COLLABORATION, INSTITUT DE MECANIQUE DES FLUIDES DE TOULOUSE COLLABORATION — We have studied by means of numerical simulations the effect of a first order irreversible chemical reaction on mass transfer for two-phase flow systems in which the continuous phase is a fluid and the dispersed phase consists in catalyst spherical particles. The reactive solute is transported by the fluid flow and penetrates through the particle surface by diffusion. The chemical reaction takes place within the bulk of the particle. We handle the problem by coupling mass balance equations for internal-external transfers through the particle surface. We propose a model to predict mass transfer coefficient accounting for the external convection-diffusion along with internal diffusion-reaction. For the simulation of multi-particle systems, we have implemented a Sharp Interface Method to handle strong concentration gradients in DLM/FD framework. We validated the method thoroughly thanks to comparison with analytical solutions in case of diffusion, diffusion-reaction and by comparison with previously established correlations for convection-diffusion mass transfer. Finally, we study the configuration of a fixed bed of catalyst particles. We introduce a model that accounts for the solid volume fraction, in addition to the aforementioned effects and compare to numerical simulations.

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