45c Simulation of Liquid Flow Distribution in Trickle-Bed Reactors

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The performance of trickle-bed reactors is strongly affected by the liquid flow distribution within the packed bed, which in turn is affected by numerous factors, including the porosity distribution, bed pre-wetting and operating conditions. Modeling tools incorporating these effects can provide valuable information relating to reactor operation, design and scale-up. To this end, a computational fluid dynamics (CFD) model for liquid-gas flow in trickle bed reactors has been implemented in a commercial finite volume solver (FLUENT) using the Eulerian multiphase framework. Interfacial drag forces are represented by the Ergun equation and capillary forces, including hysteresis effects, are represented as source terms in the gas and liquid phase momentum equations. The solid is represented as separate phase using a packed bed option and the packed bed structure is described through a statistical description of the porosity variation. The model is validated against published experimental data for liquid holdup and pressure drop and the effect of different levels of bed pre-wetting on liquid distribution is examined.