Multi-scale computational fluid dynamics model for investigating gas distributor effects on air-kerosene bubble column under elevated pressure

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A multi-scale computational fluid dynamics (CFD) model was proposed to investigate hydrodynamic behaviors in an air-kerosene bubble column under elevated pressure and ambient temperature. A two-dimensional (2D) micro-scale volume-of-fluid (VOF) CFD model in a representative elementary volume (REV) of a region near a gas distributor was constructed to capture the bubble size distribution (BSD) from injection nozzles using. A three-dimensional (3D) macro-scale CFD model for the entire bubble column (1.8 m in height and 0.1 m in inner diameter) was used for investigating hydrodynamics of the bubble column using the predicted BSD data from the micro-scale VOF-CFD model. The macro-scale CFD coupled with a population balance model (PBM) was modified with four pressure correction factors. The micro-scale CFD results were compared with literature data. The multi-scale CFD-PBE model results were then validated with experimental data of the bubble column at elevated pressure of 0.1, 1.5, 2.5, and 3.5 MPa in the air-kerosene system.