Computational fluid dynamic simulation of bubble column with hydrocracking reaction and mass transfer

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A H_2-vacuum residue slurry bubble column reactor (SBCR) with 2.0 m height and 0.05 m diameter was operated at 425 ºC, 160 bar, a superficial gas, and liquid velocities of 6.4 and 0.271 mm/s, respectively, in the homogeneous regime. The compositions of hydrocracking product were classified into the residue (RES), vacuum gas oil (VGO), middle distillation (MD), naphtha (NAPH), and non-condensed gases (NCG). A two-phase Eulerian computational fluid dynamics (CFD) model coupled with hydrocracking reaction and mass transfer models was developed for the SBCR at the same operating condition as the experiment. After two-hour reaction, the calculated gas holdup and concentrations of RES, VGO, MD, NAPH, and NCG were about 8%, and 38%, 39%, 16%, 4%, and 3%, respectively.