Abstract

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Numerical Study of Hydrodynamic Characteristics of Gas–Liquid Slug Flow in Vertical Pipes

Multiphase flows occur in wide applications including nuclear, chemical, and petroleum industries. One of the most important flow regime encountered in multiphase flow is the slug flow which is often encountered in oil and gas production systems. The slugging problems may cause flooding of downstream processing facilities, severe pipe corrosion and the structural instability of pipeline and further induce the reservoir flow oscillations, and a poor reservoir management. In the present study, computational fluid dynamics simulation is used to investigate two phase slug flow in vertical pipe using the volume of fluid (VOF) methodology implemented in the commercial code ANSYS Fluent. The viscous, inertial, and interfacial forces have significant effect on the hydrodynamic characteristics of two-phase slug flow. These forces can have investigated by introducing a set of dimensionless numbers, namely inverse viscosity number, Nf, Eotvos number, Eo, and Froude number, FrTB. The simulation accounts for the hydrodynamic features of two phase slug flow including the shape of Taylor bubble, bubble profile, velocity and thickness of the falling film, wake flow pattern, and wall shear stress distribution. The CFD simulation results are in good agreement with previous experimental data and models available in literature