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Chemical Engineering Science

www.elsevier.com/locate/ces

PII: S0009-2509(15)00653-3
DOI: http://dx.doi.org/10.1016/j.ces.2015.09.031
Reference: CES12615

To appear in: *Chemical Engineering Science*

Received date: 30 June 2015
Revised date: 10 September 2015
Accepted date: 21 September 2015

Cite this article as: Xiaosong Sun and Mikio Sakai, Numerical simulation of two phase flows in complex geometries by using the Volume-of-Fluid/Immersed Boundary method, *Chemical Engineering Science* http://dx.doi.org/10.1016/j.ces.2015.09.031

Numerical simulation of two-phase flows in complex geometries by using the Volume-of-Fluid/Immersed-Boundary method

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Abstract

The numerical modeling of two-phase flows in complex geometries is of special relevance in many scientific and industrial applications. In this paper, we describe a numerical method to perform three-dimensional simulations of such flow problems. This method adopts a volume-of-fluid (VOF) approach to capture and advance the fluid interface, and it integrates the fluid solver with the immersed boundary (IB) modeling of arbitrary-shape walls and moving bodies. The shape and movement of solid geometries are efficiently represented by an auxiliary signed distance function (SDF) with local coordinate transformation. Validation tests have been conducted using the present method, and the computational results are in good agreements with reference solutions and experimental data. We further present its application to the simulation of the air-water flow in a twin screw kneader. Hence, the adequacy and suitability of the present VOF-IB method are shown to successfully simulate complicated two-phase flows interacting with general geometries.

Keywords: two-phase flow, complex geometry, volume-of-fluid method, immersed boundary method