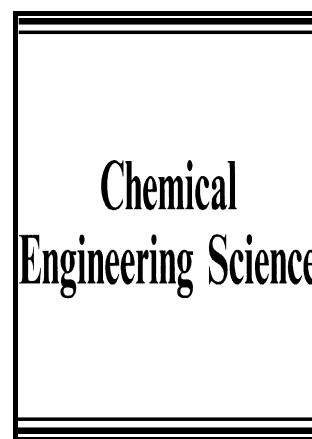


Author's Accepted Manuscript

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www.elsevier.com/locate/ces

PII: S0009-2509(16)30465-1
DOI: <http://dx.doi.org/10.1016/j.ces.2016.08.036>
Reference: CES13133

To appear in: *Chemical Engineering Science*

Received date: 10 May 2016
Revised date: 1 August 2016
Accepted date: 25 August 2016

Cite this article as: Roland Rzehak and Eckhard Krepper, Euler-Euler Simulation of Mass-transfer in Bubbly Flows, *Chemical Engineering Science* <http://dx.doi.org/10.1016/j.ces.2016.08.036>

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Euler-Euler Simulation of Mass-transfer in Bubbly Flows

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Abstract

For practical applications the Euler-Euler two-fluid model relies on suitable closure relations describing interfacial exchange processes. Concerning pure fluid dynamics of dispersed gas-liquid multiphase flow, an ongoing effort has led to a validated set of closures that is applicable under a rather broad range of conditions. Similar results for the technologically even more important field of mass transfer remain to be achieved. Progress so far has been hampered by a lack of spatially resolved data including measurements of concentration, which are suitable for CFD model validation. In addition, correlations proposed to describe the mass transfer coefficient differ widely. Here, a preliminary study of axial concentration profiles in a bubble column is given, based on the available experimental data found in the literature. For this purpose the simplified assumption of a constant mass transfer coefficient throughout the column is made and experimentally determined values are used. New measurements will be needed to come to a final conclusion.

Keywords:

mass-transfer, dispersed gas liquid multiphase flow, Euler Euler two fluid model, closure relations, CFD simulation, model validation

1 NOMENCLATURE

Notation	Unit	Denomination
a_I	m^{-1}	interfacial area concentration
d_B	m	bubble diameter
D^A	$\text{m}^2 \text{s}^{-1}$	diffusion coefficient of transferred species
D	m	column diameter
Eu	-	Eötvös Number
H	m	column height
He^A	-	Henry constant for transferred species
J_L	m s^{-1}	liquid volumetric flux = superficial velocity
k_L	m s^{-1}	mass transfer coefficient
M	-	molecular mass
Mo	-	Morton Number
P	$\text{Pa} = \text{N m}^{-2}$	pressure
R	$\text{J K}^{-1} \text{mol}^{-1}$	universal gas constant
Re	-	Reynolds number
Sc	-	Schmidt number
Sh	-	Sherwood number
T	K	temperature
u	m s^{-1}	phase velocity
x	m	coordinate along the main flow direction
X	-	mole fraction
Y	-	mass fraction
α	-	phase fraction
Γ	$\text{kg m}^{-3} \text{s}^{-1}$	mass source due to absorption
μ	$\text{m}^2 \text{s}^{-1}$	dynamic viscosity

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