Steady and unsteady regimes in a T-shaped micro-mixer: synergic experimental and numerical investigation

Alessandro Mariotti, Chiara Galletti, Roberto Mauri, Maria Vittoria Salvetti, Elisabetta Brunazzi

PII: S1385-8947(18)30124-4
DOI: https://doi.org/10.1016/j.cej.2018.01.108
Reference: CEJ 18428

To appear in: *Chemical Engineering Journal*

Received Date: 22 September 2017
Revised Date: 12 December 2017
Accepted Date: 20 January 2018

Please cite this article as: A. Mariotti, C. Galletti, R. Mauri, M.V. Salvetti, E. Brunazzi, Steady and unsteady regimes in a T-shaped micro-mixer: synergic experimental and numerical investigation, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.01.108

Steady and unsteady regimes in a T-shaped micro-mixer: synergic experimental and numerical investigation

Alessandro Mariotti, Chiara Galletti[1], Roberto Mauri, Maria Vittoria Salvetti, Elisabetta Brunazzi

Dipartimento di Ingegneria Civile e Industriale, University of Pisa, Pisa, Italy

Abstract

Despite the very simple geometry, T-shaped micro-mixers are characterized by different flow regimes when operated for liquid mixing. In this work, experiments and direct numerical simulations are employed jointly to investigate such flow regimes. First, a novel methodology is proposed to provide a quantitative comparison with numerical predictions starting from simple flow visualization experiments that use non-collimated light. This method is applied and validated in the steady flow regimes. Moreover, flow visualizations provide for the first time an experimental support to the flow dynamics scenarios for the periodic unsteady flow regimes previously proposed in the literature on the basis of numerical simulations. In particular, at a Reynolds number, based on the bulk velocity and on the hydraulic diameter of the mixing channel, of approximately 225, the flow passes from the steady engulfment regime into an unsteady asymmetric regime, which is characterized by a periodic dynamics of the three-dimensional structures present in the mixer. In this regime, the flow in the mixing channel always remains asymmetric promoting, thus, the mixing between the two streams. By further increasing the Reynolds number, another change in flow dynamics is observed. In the new regime, called periodic symmet-

[1]corresponging author