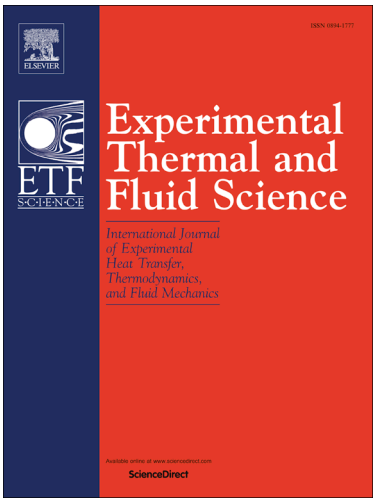

Gas-liquid mixing performance, power consumption, and local void fraction distribution in stirred tank reactors with a rigid-flexile impeller

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Gas-liquid mixing performance, power consumption, and local void fraction distribution in stirred tank reactors with a rigid-flexile impeller

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Abstract: In this work, the mixing performance of gas-liquid was characterized by the largest Lyapunov exponent (LLE), relative power demand (RPD), power number N_P and local void fraction in a rigid-flexible impeller reactor equipped with a tube sparger. The effects of impeller types, gas flow rates, agitation speed, flexible piece lengths, axial spacing distances l_h and angles θ were investigated. Meanwhile, global variable analysis (GVA) based on the mixing index (MI) was proposed to characterize the mixing process. The results show that the increases in flexible piece length, agitation speed, and gas flow rate could enhance the mixing degree. Meanwhile the reductions of axial spacing, and angle were also able to improve the mixing performance of gas-liquid two phases to a certain extent. These findings were in conformity with the results of investigation into MI. The results of this study could provide theoretical guidance for the optimal design and engineering scale-up of STRs.

Keywords: stirred tank; gas-liquid; Lyapunov exponent; power consumption; mixing index; rigid-flexible impeller

1. Introduction

The gas-liquid stirred tank reactors (STRs) are the vital part of multiphase reaction engineering due to its widespread application for chemical and biochemical industries [1]. Gas-liquid STRs are required to accomplish a vast range of process objectives, such as absorption, stripping, oxidation, hydrogenation, fermentation and other kinds of processes [2]. The effective accomplishment of gas-liquid STRs affects mixing, heat and mass transfer, as well as the degree of gas-liquid homogenization, which ultimately determines the chemical/biochemical reactions involved overall industrial processes [3]. The mixing performance is critical of determining the