Institute of Chemical Engineering

Identification of Local Isotropic Turbulence Conditions in Various Bubble Columns Based on Several Reliable Parameters

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Bubble columns (BCs) are widely used in the chemical industry. In many industrial applications, these important gas-liquid contactors operate in a churn-turbulent flow regime. In principle, it is essential to determine the operating conditions in every BC reactor, in which local isotropic turbulence is established. In this work, it was demonstrated that several different parameters (Kolmogorov entropy, correlation dimension and novel hybrid index) follow a monotonic decreasing trend. This finding could be explained by the constantly increasing coalesced bubble size, which brings more order into the gas-liquid system and thus any entropic or chaotic parameter should decrease with the increase in the superficial gas velocity Ug. The profiles of the new parameters in various gas-liquid systems were studied. They were extracted from different pressure signals (gauge or absolute). In this research, BCs of different diameter and equipped with different gas distributors were used. It was demonstrated that the studied parameters could be successfully correlated with the length scale of the micro eddies and thus the Ug range of applicability of the local isotropic turbulence theory under various operating conditions was indirectly determined. The overall gas holdup profiles were analyzed and, based on the exponent of the Ug value, it was found that in the aqueous solutions of alcohols studied, the conditions in the bubble bed (BB) are homogeneous, whereas in the air-tap water system aerated in different BCs, the conditions in the BB are heterogeneous. This result implies that the local isotropic turbulence conditions predominate mainly around the corresponding measurement positions.

Metryczka

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