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Distribution of Mixing Efficiency in a Split-Cylinder Gas-Lift Bioreactor with Immobilized Yarrowia Lipolytica Cells Used for Olive Oil Mill Wastewater Treatment

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Abstract

The distribution of mixing in a split-cylinder gas-lift bioreactor has been investigated for suspensions of immobilized *Yarrowia lipolytica* cells with particles diameter varying between 3 and 4.2mm. The results indicated important variation of mixing time on the height of riser or downcomer, as well as different behavior of suspensions flows in these two regions. Therefore, for the riser, the mixing efficiency increases from its bottom to the top, allowing the biocatalyst particles with intermediate size (3.6-mm diameter) reaching the most intense circulation of suspension. The analysis of the suspension flow in the downcomer region revealed that the intermediate positions are associated with the highest mixing mainly for the largest immobilized yeast particles (4.2-mm diameter). In both cases, the influence of aeration on turbulence extent is positive only for air superficial velocity up to $1.05–1.35\times10^{-3}$m/s, the magnitude of this effect being correlated with the biocatalyst size and position on the riser or downcomer. By means of the experimental data, mathematical correlations for mixing time have been proposed for each circulation region, taking into consideration both the operational parameters and the distance from the bioreactor bottom. These equations offer a good concordance with the experiment, the average deviation being of 5.82% for the riser and 6.06% for the downcomer zone.

Keywords: Gas-lift bioreactor; Immobilized cells; Mixing time; Split-cylinder; Yarrowia lipolytica