Intensification of liquid mixing and local turbulence using a fractal injector with staggered conformation

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Abstract

Two self-similar, tree-like injectors of the same fractal dimension are compared, demonstrating that other geometric parameters besides dimension play a crucial role in determining mixing performance. In one injector, when viewed from the top, the conformation of branches is eclipsed; in the other one, it is staggered. The flow field and the fractal injector induced mixing performance are investigated through computational fluid dynamics (CFD) simulations. The finite rate/eddy dissipation model (FR/EDM) is modified for fast liquid-phase reactions involving local micromixing. Under the same operating conditions, flow field uniformity and micromixing are improved when a staggered fractal injector is used. This is because of enhanced jet entrainment and local turbulence around the spatially distributed nozzles. Compared with a traditional double-ring sparger, a larger reaction region volume and lower micromixing time are obtained with fractal injectors. Local turbulence around the spatially distributed nozzles in fractal injectors improves reaction efficiency.

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