CFD simulation of flow behavior in an immiscible liquid stirred tank: effect of turbulence and drag models

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Stirred tank reactors are commonly used in chemical industrial and biological processes because of its simple geometry and ease to operate. The understanding of flow behavior is the key to successfully evaluate reactor performance. CFD method has been generally applied to study the flow behavior of the multiphase system. The accuracy of the simulation result depends on the model parameter used. The objective of this research was to study the effects of turbulence and drag models on the flow behavior in an immiscible liquid stirred tank. The system of silicone oil-NaI solution was studied. Effects of laminar and several turbulence models including Reynolds stress, k-ε, and k-ω were monitored. All effects exhibited the same flow pattern. However, the Reynolds stress model predicted a maximum mixing time for approaching the steady state condition. The studied drag models were Schiller-Naumann, Grace, Morsi-Alexander, and Tomiyama drag models. The results demonstrated that drag model insignificantly influences on the flow behavior in the immiscible liquid stirred tank.

Keywords: Computational fluid dynamics, Immiscible liquid, Parameter study, Stirred tank