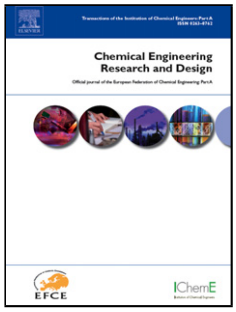


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# Hydrodynamics in a stirred tank in the transitional flow regime

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Highlights

- Experimentally, flow self-similarity is observed at Re=3 000 but not at Re=980, 340
- Experimentally, flow at Re=340 is dependent on impeller speed and fluid properties
- CFD simulations predict self-similarity of velocity profiles at Re=340
- Low Re flows are highly sensitive to small changes in operating conditions
- Imperfections in setup, not accounted for in CFD may cause differences at low Re

**Abstract**

The hydrodynamics in a stirred tank in the transitional flow regime have been studied experimentally and numerically with data obtained by Particle Image Velocimetry and Computational Fluid Dynamics, respectively, at three Reynolds numbers, Re = 340, 980 and 3 000. The effects of impeller rotation speed and fluid properties on the underlying flow structures have been investigated. Data are analysed by mean flow fields, as well as with Proper Orthogonal Decomposition, which gives an insight into the flow dynamics by separating the spatial and temporal characteristics of the flow structures. Experimentally, it has been found that dimensionless velocity fields depend on fluid properties and impeller speed at Re 340 and 980, whilst they are self-similar at Re = 3 000. Coherent flow structures only exist however at Re = 340 and the flow is structurally different than that at higher Re. Characteristic frequencies identified for Re = 980 and 3 000 are 0.03*N* and 0.13*N*, which are consistent with previous work in the literature. The simulations conducted at Re = 340 are in reasonable agreement with the experimental data, however, they do not predict a dependency of flow characteristics on fluid properties and impeller speed. This inconsistency is attributed to the difficulty of performing experiments that are free of physical perturbations, which may have a significant effect on flows at low transitional Reynolds numbers.

**Keywords**