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TRANSPORT PHENOMENA & FLUID MECHANICS

搅拌槽内液-固两相流场数值研究（I）流场的数值模拟

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摘要 Three-dimensional solid-liquid flow in mechanically stirred tanks is mathematically formulated by means of the "two-fluid" approach and the two-phase k-ε-kp turbulence model. The turbulent fluctuation correlations appearing in the Reynolds time averaged governing equations are fully incorporated. The solid-liquid flow field and solid concentration distribution in baffled stirred tanks with a standard Rushton impeller are numerically simulated using an improved "inner-outer" iterative procedure. The flow pattern is identified via the velocity vector plots and a recirculation loop with higher solid concentration is observed in the central vicinity beneath the impeller. Comparison of the simulation with experimental data on the mean velocities and the turbulence quantities of the solid phase is made and quite reasonable agreement is obtained except for the impeller sweep volume. The counterpart of liquid phase is presented as well. The predicted solid concentration distribution for three experimental cases with the average solid concentration up to 20% is also found to agreeremarkably with the experimental results published in the literature.

关键词 两相流体; 数值模拟; 湍流; 搅拌槽; 搅拌桨;
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Numerical Study of Solid-Liquid Two-Phase Flow in Stirred Tanks with Rushton Impeller (I) Formulation and Simulation of Flow Field

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Abstract Three-dimensional solid-liquid flow is mathematically formulated by means of the "two-fluid" approach and the two-phase k-ε-kp turbulence model. The turbulent fluctuation correlations appearing in the Reynolds time averaged governing equations are fully incorporated. The solid-liquid flow field and solid concentration distribution in baffled stirred tanks with a standard Rushton impeller are numerically simulated using an improved "inner-outer" iterative procedure. The flow pattern is identified via the velocity vector plots and a recirculation loop with higher solid concentration is observed in the central vicinity beneath the impeller. Comparison of the simulation with experimental data on the mean velocities and the turbulence quantities of the solid phase is made and quite reasonable agreement is obtained except for the impeller sweep volume. The counterpart of liquid phase is presented as well. The predicted solid concentration distribution for three experimental cases with the average solid concentration up to 20% is also found to agreeremarkably with the experimental results published in the literature.

Key words stirred tank; solid-liquid flow; two-fluid model; turbulent kinetic energy; impeller; numerical simulation;

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