Detached Eddy Simulation On The Turbulent Flow In A Stirred Tank

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ABSTRACT

A detached eddy simulation (DES), a large-eddy simulation (LES), and a *k*-ε-based Reynolds averaged Navier-Stokes (RANS) calculation on the single phase turbulent flow in a fully baffled stirred tank, agitated by a Rushton turbine is presented. The DES used here is based on the Spalart-Allmaras turbulence model solved on a grid containing about a million control volumes. The standard *k-ε* and LES were considered here for comparison purposes. Predictions of the impeller-angle-resolved and time-averaged turbulent flow have been evaluated and compared with data from laser doppler anemometry measurements. The effects of the turbulence model on the predictions of the mean velocity components and the turbulent kinetic energy are most pronounced in the (highly anisotropic) trailing vortex core region, with specifically DES performing well. The LES—that was performed on the same grid as the DES—appears to lack resolution in the boundary layers on the surface of the impeller. The findings suggest that DES provides a more accurate prediction of the features of the turbulent flows in a stirred tank compared with RANS-based models and at the same time alleviates resolution requirements of LES close to walls.

KEYWORDS: DES, RANS, angle resolved, vortex core, power number, turbulent kinetic energy

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