Unsteady RANS and Detached Eddy Simulation of the Multiphase Flow in a Co-Current Spray Drying

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ABSTRACT

A detached eddy simulation (DES) and a *k*-*ε*-based Reynolds-averaged Navier–Stokes (RANS) calculation on the co-current spray drying chamber is presented. The DES used here is based on the Spalart–Allmaras (SA) turbulence model, whereas the standard *k*-*ε* (SKE) was considered here for comparison purposes. Predictions of the mean axial velocity, temperature and humidity profile have been evaluated and compared with experimental measurements. The effects of the turbulence model on the predictions of the mean axial velocity, temperature and the humidity profile are most noticeable in the (highly anisotropic) spraying region. The findings suggest that DES provide a more accurate prediction (with error less than 5%) of the flow field in a spray drying chamber compared with RANS-based *k*-*ε* models. The DES simulation also confirmed the presence of anisotropic turbulent flow in the spray dryer from the analysis of the velocity component fluctuations and turbulent structure as illustrated by the Q-criterion.

KEYWORDS: Drying; Turbulence; Two-phase flow; CFD; Detached eddy simulation; Modelling strategy

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