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Numerical analysis of particle-laden flow in coal combustion using large-eddy simulation

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Abstract

This work presents a large-eddy simulation of coal combustion at the down-fired self-sustanied oxy-fuel combustor (OFC) which includes the multi-physics phenomena: turbulent flows, particle flow, heat transfer, coal combustion and ash particle deposition. This modeling work also includes a dynamic ash deposition model coupled with the heat-transfer model for the solid surface. This work mainly analyzes the time and length scale of the flow field. Effects of unresolved turbulent scales on the particle motions are also analyzed by the Stokes number analysis based on the subgrid-scale turbulence. Overall, results of this approach are tested against experimentally measured data at this facility. Results from the OFC simulation show that the averaged gas temperature and deposition rates agree within 5\% and 28\%, respectively, with the measured data. The presented model can be used to simulate coal combustion in the industrial-scale pulverized coal boiler.

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