ALAIN ISLAS, ANSAN POKHAREL, V'YACHESLAV AKKERMAN, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV, 26506 and ZHIWEI YANG, RICHARD L. AXELBAUM, Department of Energy, Environmental and Chemical Engineering, Washington University in Saint Louis, Saint Louis, MO, 63130. Appraisal of CFD Discrete-Phase Models to be employed for Modeling Coal Particle Feeding in a Staged, Pressurized Oxy-fuel Combustor (SPOC)

In the present computational study employing the ANSYS Fluent commercial software, two different discrete phase formulations, namely, the discrete phase model (DPM) and the dense discrete phase model (DDPM) are tested and compared. Specifically, the unsteady Reynolds averaged Navier-Stokes (RANS) simulations with the Lagrangian-Eulerian models are performed in both cases. The configuration employed is a cylindrical combustor with three inlet gas streams that feed the system with mixtures of different O_2 and CO_2 mole fractions under an operating condition of 15 bar, emulating the 100 kW lab-scale facility employed at Washington University in St. Louis (WUSTL). Specifically, the coal particles are fed into the system by the secondary gas stream through an annulus-axial convergent duct surrounding the primary inlet stream. Distributions of the DPM concentration (the ratio of the dispersed phase mass to the mesh cell volume; in kg/m3) of the coal particles along the axial direction within this secondary inlet agree for both the DPM and DDPM models even though these models mimic the coupling between the phases in a different manner. However, the particle grouping is observed not only axially, along the inlet duct, but also in the radial direction as there are zones experiencing non-uniform particle distribution. Overall, the impact of DPM concentration on the flame stability is shown to be minor since a continuous particle release prior to burning zone is successfully achieved for both models.