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Computational Fluid Dynamics (CFD) Simulation on CO2 Conversion Performances of O_2/Fuel Ratios using a 300 MW Entrained Flow Bed Gasifier

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Extended Abstract

Environmental and fuel supply concerns are driving demand for the development of more efficient uses of fossil fuel by the energy industries. Therefore, efforts are being made to employ gasification-based processes rather than combustion [1], which would also benefit the increased use of hydrogen fuel. The use of coal in integrated gasification combined cycles (IGCCs) is a promising alternative to combustion and is already commercially cost competitive in many locations [2]. Recently, gasification technology for coal blended with biomass has been an issue. Especially, an advantages of coal blended with biomass are 1) obtaining high cold gas efficiency [3], 2) obtaining syngas of high-high heating value (HHV) [3], and 3) controlling occurrence of CO2 [4].

In this study, gasification performances of a 300MW entrained flow bed gasifier were predicted for performed for coal·biomass blending ratios of 0～0.2, 0.5, 1 and O2/fuel ratios of 0.5 ~ 0.84 using a commercial CFD code, ANSYS FLUENT. The CFD simulation was conducted by solving steady-state Navier–Stokes equations with the Eulerian–Lagrangian method. Chemical reactions were solved via the Finite-Rate/Eddy-Dissipation Model for gas and solid phase. Kinetic parameters (*A*, *Ea*) obtained from CO_2 gasification experiment by Song [5] and Seo [6] were used as input data for this simulation. In results of CFD simulation, residence times of particle in a 300MW entrained flow bed gasifier presented as 7.39 second ~ 13.65 second. Temperature of exit increased with O_2/fuel ratio as 1400 K ~ 2800 K, while there is not an effects of coal·biomass blending ratios. Mole fractions of CO_2 and H_2O increased by combustion reactions of CO and H_2 with increasing O_2/fuel ratio, respectively. Considering both aspects of temperature for causing wall slagging and high cold gas efficiency, the optimal O_2/fuel ratio and coal · biomass blending ratio were found to be 0.585 and 0.05, respectively.

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