Numerical modelling of CO_2 enhanced coal gasification in a pressurized circulating fluidized bed reactor

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In this work two Eulerian-Lagrangian approaches are applied to model gasification of coal in a circulating fluidized bed reactor. The Lagrangian models applied in the work are implemented in commercial codes ANSYS Fluent and CPFD Barracuda. The experimental facility modelled in this study is a pilot scale pressurized circulating fluidized bed reactor built in Institute for Chemical Processing of Coal in Poland. The reactor encompasses a barrel like bottom part, in which internal recirculation of the solid phase develops and riser section is connected to a separator and recirculation section. The coal is introduced at the side of the barrel part and the gasifying agent at the very bottom of the reactor through a mesh inlet. The unreacted char can be circulated to the bottom part of the reactor, however in the investigated case it was not circulated. The gasifying agent was a mixture of CO_2, O_2 and N_2. Thermodynamic calculations revealed that addition of CO_2 to the gasifying agent can lead to significant decrease of fuel consumption and increase of CO production capacity when compared to the conventional (air or oxygen blown) gasifiers. Experimental data of gas composition at the outlet of the reactor were compared with the results of numerical simulations.

Comparison of two numerical models (ANSYS Fluent and CPFD Barracuda) of CO_2 enhanced coal gasification in a fluidized bed reactor can show the drawbacks and advantages of each approach. The three-dimensional models and simulations provide a promising way to simulate the coal gasification in fluidized beds.

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