Modeling of chemical-looping combustion in bubbling fluidized beds

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Chemical-looping combustion (CLC) consists of oxidation and reduction reactors where metal oxide particles are circulating with inherent CO_2 separation and no thermal NO_x formation. In the present study, a predictive model is developed to characterize the performance of CLC reaction in a bubbling fluidized bed. Interconnecting bubbling fluidized beds for the oxidation and reduction reactions were considered to provide enough reaction times. The proposed model is based on the reaction kinetics for the reduction and oxidation of metal oxide particles by the shrinking core model. The following assumptions are made for the modeling of the CLC reactions in the bubbling fluidized beds: (1) the fluidized beds are interpreted by the two phase theory model; (2) the mass balance is described by the population balance model. The gas conversion increases with increasing solid circulation rate and bed mass, and decreasing gas velocity. The proposed model can predict the fuel gas conversion with a reasonable accuracy, and provide the reaction behavior in the CLC bubbling fluidized bed reactor system within the given range of experimental variables studied.