Simulation of a Chemical Looping Combustion Process for Methane in a continuous Bubbling Fluidized-Beds

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In order to simulate and optimize the performance of chemical looping combustion (CLC) of pure methane in continuous bubbling fluidized beds using a NiO-based oxygen carrier under various operating conditions, this mathematical model has been developed based on the reaction kinetics and population balance of oxygen carrier (OC) particles in each reactor. Combustion efficiencies predicted by this model were in good agreement with experimental measurements obtained from a lab-scale core-annulus bubbling fluidized-beds process under steady state conditions. The simulation results showed that the efficiency of combustion of pure methane was strongly affected by the distribution of solids OC between air reactor (AR) and fuel reactor (FR) at constant temperature and total mass of OC particles. An optimal range of solids distribution of OC particles was determined where the complete combustion can be achieved. It can be extended with increasing temperature. In this range the amount of elutriated OC particles increases slightly as AR mass increases because of the higher elutriation rate in the AR than that in FR.