A three stage model (TSM) of steam-air-mix gasification for woody biomass in a dual Circulating Fluidized Bed (DFB)

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A three-stage thermodynamic equilibrium model including mass and energy balances was applied for steam-air-mix biomass gasification in a dual circulation fluidized bed (DFB) to calculate the gas product composition, the carbon conversion, the heat recovery of biomass, the heat demand. These elasticities are analyzed to investigate the effect of operating conditions (temperature and steam to fuel ratio) on process performances of DFB. A complete combustion of both unconverted char and additional fuel was assumed in the combustion reactor (riser). The heat required for gasification reaction was provided by the circulating bed material (silica sand).

The final composition of producer gas is obtained from the two-stage equilibrium model incorporated with biomass pyrolysis. For composition predicting of producer gas, the three-stage model (TSM) shows good agreement with experimental data. The effect of reaction temperature, steam to fuel ratio and air to fuel ratio on the composition of product gas and overall performance of the DFB gasifier are evaluated.