Catalytic Steam Gasification of Biomass Surrogates: Thermodynamics and Effect of Operating Conditions

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Catalytic Steam Gasification of Biomass Surrogates: Thermodynamics and Effect of Operating Conditions

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ABSTRACT

Thermodynamic chemical equilibrium of biomass steam gasification is considered using both stoichiometric and non-stoichiometric analyses. These thermodynamic analyses include gaseous products, tars and coke, as well as consider a wide range of operating conditions. It is shown that both stoichiometric and non-stoichiometric approaches provide close results. Catalytic steam gasification of biomass surrogate species (glucose and 2-methoxy-4-methylphenol) is developed in a CREC Riser Simulator under the expected conditions of a circulating fluidized bed gasifier. A highly active and stable fluidizable Ni/La_2O_3-γ-Al_2O_3 catalyst is employed in this study, to investigate the effects of gasifier operating conditions. This catalyst yields 98% carbon conversion of glucose to permanent gases with no tar formation and negligible coke deposition at 700 °C. Catalytic gasification results with the variation of temperature and steam/biomass ratio show limited deviation from equilibrium predictions. The deviation between