

Review of kinetic and equilibrium concepts for biomass tar modeling by using Aspen Plus

ABSTRACT

Biomass tar has attracted attention in recent years to be modeled or represented by a specific formula or compound. It is a complex material, and its composition varies according to the process operating conditions such as gasification or pyrolysis. This paper reviews different tar models in which tar is represented as different components such as naphthalene, toluene and even as a bulk tar, based on operating temperatures range and their thermal stability or assumptions that have been made to model the process. All these models are done by Aspen Plus simulator based on kinetic and thermodynamic equilibrium, whereby different reactor models are used to represent processes relevant with tar production or cracking. Results for the operation of combined heat and power (CHP) biomass bubbling fluidized bed gasification, which integrated with solid fuel cell (SOFC) or coupled with an internal combustion engine (ICE), show different accuracy in terms of cold gas or electrical efficiencies, depending on how tar is approximated (either as one hydrocarbon compound or mixture of hydrocarbons). Likewise, for three-stage and one fluidized bed unit, the performance is predicted through estimation of the cold gas efficiency and high heating value (HHV) of the produced gas, where the tar representation has also an impact on the accuracy of the predictions.

Keyword: Biomass tar; Modeling; Aspen Plus; Kinetic; Thermodynamic equilibrium