Synthesis gas production of food and wood wastes in a fluidized bed gasifier using thermodynamic equilibrium model

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ABSTRACT

In this paper, the thermodynamic equilibrium model has been developed to predict the synthesis gas produced from food and wood wastes in fluidized bed gasifier. In addition the effect of gasification temperature on the amount syngas produced and gasification performance in terms of synthesis gas yield, lower heating value (LHV), cold gas efficiency and carbon conversion of feedstock are investigated. Based on the simulation of thermodynamic equilibrium model using food waste as feedstock, the results obtained show the amount of hydrogen (H_2) and carbon monoxide (CO) gas production are increased linearly from 29.58 to 34.03% and 31.85 to 45.78% respectively as the gasification temperature is increased from 650 to 1000 °C. In contrast, the amount of carbon dioxide (CO_2) and methane (CH_4) gas produced are decreased from 33.26 to 19.17% and 5.31 to 1.02% respectively. In addition, gasification of wood waste also shows similar behavior as the H_2 and CO gas are increased proportionally to the gasification temperature from 31.25 to 39.87% and 26.33 to 34.81% respectively. The production of CO_2 and CH_4 gas also shows it decrement from 38.75 to 23.38% and 3.67 to 1.94%. Meanwhile, food waste and wood waste gasification also shows the same trend in terms of increment of synthesis gas yield, lower heating value (LHV), cold gas efficiency and carbon conversion. As the gasification temperature is increased from 650 to 1000 °C, the synthesis gas yield are increased for both food waste and wood waste from 1.22 to 1.61 Nm^3 /kg and 1.36 to 1.85 Nm^3 /kg respectively. The LHV of the food waste and wood waste also increases consistently with gasification temperature from 4.56 to 5.00 MJ/ Nm^3 and 5.60 to 6.57 MJ/ Nm^3 respectively. CGE is increased from 31.9372 to 46.03 and 39.66 to 63.19% for food waste and wood waste respectively as the gasification temperature increased. The carbon conversion percentage increase corresponds to the gasification temperature from 48.69 to 59.88% and 57.26 to 68.08% for food waste and wood waste respectively.

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