

International Energy Journal, Volume 9, Issue 1, March 2008[HOME](#) | [ABOUT](#) | [LOG IN](#) | [REGISTER](#) | [SEARCH](#) | [CURRENT](#) | [ARCHIVES](#)[Home](#) > [Volume 9, Issue 1, March 2008](#) > [Venkata Ramanan](#)

Mathematical Modeling and Experimental Analysis of Cashew Nut Shell Char Gasification Using Free Energy Minimization

M. Venkata Ramanan, E. Lakshmanan, R. Sethumadhavan, S. Renganarayanan

Abstract

Cashew nut shell, a waste produce obtained during de-shelling of cashew kernels, possess an occluded oil content of 25% by weight. The oil, a source of natural phenol, oozes upon gasification thereby makes the gasifier throat, downstream equipments and associated utilities clogged with oil leading to ineffective gasification and premature failure of utilities due to its corrosive characteristics. To overcome this drawback, the cashew shells were de-oiled, by charring them in closed chambers and were subsequently gasified in an auto-thermal fixed bed downdraft gasifier. A non-stoichiometric equilibrium model based on free energy minimization was developed to predict the performance of gasifier. The model considered 4 elements and 6 species in both gas and solid phases. The influences of equivalence ratio (ER), reaction temperature (RT) and moisture content (MC) on gasification of cashew nut shell char (CNSC) were simulated. It was observed that the gas composition varies primarily with ER and MC compared to that of RT. The model has been validated with the experimental results for CNSC gasification, with an overall deviation of (-) 3.5%. The sensitivity analyses revealed that mole fraction of (i) H_2 , CO, and CH_4 decreases while ($N_2 + H_2O$) and CO_2 increases with ER (ii) H_2 and CO increases while CH_4 , ($N_2 + H_2O$), and CO_2 decreases with reaction temperature (iii) H_2 , CH_4 , CO_2 , and ($N_2 + H_2O$) increases while CO decreases with moisture content. However at lower equivalence ratios (less than 0.15) the model predicts unrealistic composition, probably due to onset of pyrolysis.

Full Text: Subscribers Only