

Syngas Production from Co-gasification of Forest Residue and Charcoal in a Pilot Scale Downdraft Reactor

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ABSTRACT

A study on the co-gasification of forest residue and wood charcoal was executed on pilot-scale 50 kWth downdraft gasification reactor. The reactor parameters (i.e. temperature, pressure) were evaluated on various parameters namely heating value, syngas yield, exergy, feedstock consumption rate and produced syngas composition. To facilitate the optimization of the exergy efficiency of gasification systems, a comprehensive fixed-bed gasification model has been established using an Aspen Plus (V8.6) simulator to predict the product rate of syngas. The model is applicable for efficient analysis of fixed-bed biomass gasification under variable operating conditions, such as syngas ratio, moisture content of feedstock, and air inlet location. The concentration variation of the downdraft reactor showed that the CO concentration increased with increasing wood charcoal (up to 40%) with forest residue. In contrary, an opposite trend for the case CO₂ concentration was observed with increasing the wood charcoal in the reactor. The optimal yield of syngas (H₂:CO) ratio was found to be 1.14 after the FR:WC mixture of 70:30 and 60:40 w/w for maximizing the benefits of the gasification process.

KEYWORDS: Co-gasification, Forest residue, Wood charcoal, Downdraft reactor, Syngas, Exergy efficiency

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