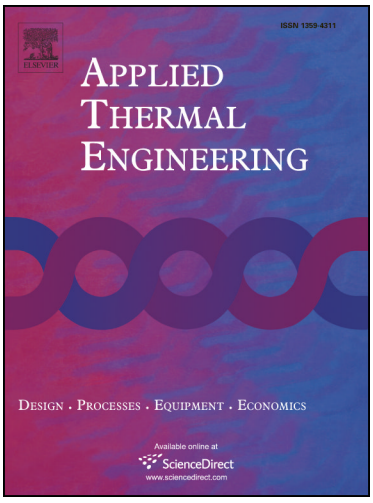

Modelling of down-draft gasification of biomass - an integrated pyrolysis, combustion and reduction process

Chidiebere Diyoke, Ningbo Gao, Mathew Aneke, Meihong Wang, Chunfei Wu

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Modelling of down-draft gasification of biomass – an integrated pyrolysis, combustion and reduction process

Chidiebere Diyoke [a], Ningbo Gao [b*], Mathew Aneke [c], Meihong Wang [c*], Chunfei Wu [a,d*],

[a] School of Engineering, University of Hull, Hull, UK, HU6 7RX.

[b] School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an, China, 710049.

[c] Department of Chemical and Biological Engineering, University of Sheffield, UK S1 3JD

[d] School of Chemistry and Chemical Engineering, Queen's University Belfast, Belfast, BT7 1NN, UK

Tel/Fax: +44-1482 466464; E-mail: c.wu@hull.ac.uk (C Wu); Meihong.Wang@sheffield.ac.uk (M Wang); nbogao@xjtu.edu.cn (N Gao);

Abstract

A gasification model is developed and implemented in Matlab to simulate a downdraft gasifier using wood as feedstock. The downdraft gasifier was conceptually divided into three zones: the pyrolysis zone, the combustion/oxidation zone and the reduction zone. A typical tar composition and its mole fraction, as reported in the literature was supplied as an input parameter in the model. The concentration of syngas and profiles of temperature along the reduction zone length were obtained by solving the mass and energy balances across each control volume and taking into account the rate of formation/consumption of the species according to different gasification kinetics. The simulation results from the model agreed closely with the experimental results. The syngas concentration was found to be about 1.1%, 17.3%, 22.8%, 9.0% and 49.8% for CH_4, H_2, CO, CO_2, and N_2 respectively and the corresponding LHV, CGE, CCE and yield were 4.7 MJ/Nm^3, 59.9%, 85.5% and 2.5 Nm^3/kg-biomass respectively at ER of 3.1 and fuel moisture content of 18.5 wt.% Sensitivity analysis was carried out with this validated model for different air-fuel ratios, moisture contents and inlet air temperature. The analysis can be applied to produce specific design data for a downdraft biomass reactor given the fuel composition and operating conditions.

Key words: Gasification, Downdraft gasifier; modelling, Biomass, Performance analysis,