Kinetic modelling of biomass gasification reactor

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Abstract

Biomass is of growing interest as a secondary energy source. Biomass could be converted to energy especially by pyrolysis or gasification. Understanding the mechanism and the kinetics of biomass pyrolysis and gasification could be the key to the design of industrial devices capable of processing vast amounts of biomass feedstock. There are multiple reactions describing the decomposition of biomass to gaseous products and it is difficult to identify each of the reactions. Therefore reactions must be simplified; in general well identified reagents and products with different states (feedstock, tar, gas) are used for calculations, instead of using different compounds of real products. In our work real product compounds obtained from pyrolysis were used, and the kinetic constants for biomass pyrolysis and gasification were identified.

A laboratory scale reactor was used for the physical experiments containing a consecutive fast pyrolysis, and gasification stages.

The main aim of this research is to create a detailed and validated first principle model for the reactor system. In this study a compartment modelling approach were used, where all compartments facilitate different reactions (pyrolysis, thermal, and catalytic gasification). With the identification of the model parameters (using PSO algorithm) a stable and validated model was be created, which can be used for further optimisation studies. MATLAB was used for the creation of the compartment model, and Particle Swarm Optimisation was used for the kinetic parameter identification.