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Modeling of slow pyrolysis of various biomasses in a rotary kiln using TGA data

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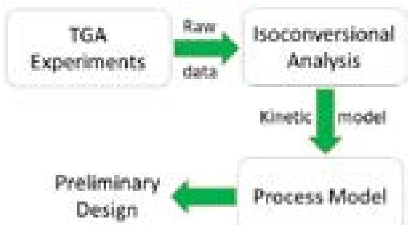
Biomass thermochemical processes suffer from the problem of feedstock variation. In the other words, in order to run commercial biomass-based plants under economically feasible conditions, the process have to be capable of handling very different raw materials, ranging from forest residues to waste materials from various industries. Process modeling is crucial to predict the behavior of different feedstock materials in a given biomass plant. In this work, we consider the slow pyrolysis of biomass to produce biochar. In this process, the main quantity one aims at predicting by means of process modelling is the conversion of raw biomass to biochar as a function of the process conditions. To achieve this aim, the process model requires a kinetic rate expression for describing the evolution of the biomass when subject to thermochemical treatment. Here, we will show that the TGA data processed with an isoconversional method is enough to obtain an effective rate expression which allows for predicting the behavior of the biomass at an arbitrary temperature evolution. Such rate expressions can then be used in the process model to simulate conversion of raw biomass to biochar. An overview of this approach is shown in Fig. 1. To illustrate the feasibility of the approach we will consider different biomasses feedstocks undergoing slow pyrolysis in an indirectly heated rotary kiln reactor. The results of our modeling are then compared to experimental data obtained from a 500 kW pilot plant pyrolyzer and to a more detailed process model. A high level of agreement between the modeling results from this approach and the experimental data and the previously validate detailed process model is observed. This proves the capability of our cost-efficient approach to obtain preliminary design data.



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Biography

Ramiar Sadegh-Vaziri is a PhD candidate at the department of chemical engineering at KTH royal institute of technology in Sweden. He has developed skills in process modeling and numerical simulation. He has worked on different projects including raw syngas cleaning, particle-particle and particle-fluid interactions in two phase turbulent flows, biomass pyrolysis and gasification and modeling of supported liquid membranes. His understanding of transport phenomena and kinetics together with his knowledge of CFD modeling and numerical discretization of partial differential and integro-differential equations have helped him to be involved in various projects

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