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A CFD study of biomass fast pyrolysis in a pilot-scale auger reactor

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This paper presents a CFD study of a fast pyrolysis process in a pilot-scale auger reactor. By providing a detailed CFD simulation of this reactor, we are capable to obtain a clearer insight into the complex physical phenomena associated with multi-phase flow dynamics, heat transfer and chemical kinetics. The three main products of the process are solid bio-char, condensable vapours and non-condensable gases. Therefore, a multi-fluid model coupled with a chemical solver is a suitable approach for the simulations. The feedstock is a lignocellulosic biomass which composed of cellulose, hemicellulose and lignin. The biomass decomposition is simplified to ten reaction mechanisms. Three different phases that are taken into account are condensable/non-condensable phase or the gas phase as the primary phase, solid reacting phase or biomass phase as a secondary phase and non-reacting solid phase (steel shots) or heat carrier as the other secondary phase. Each phase composed of different species. The results for the product yield shows a good agreement between the CFD results and the experimental data previously received for the simulated reactor. The outcome of this study provides a validated CFD model for industry and researchers that may apply to optimize the operating conditions of the auger reactors in future.

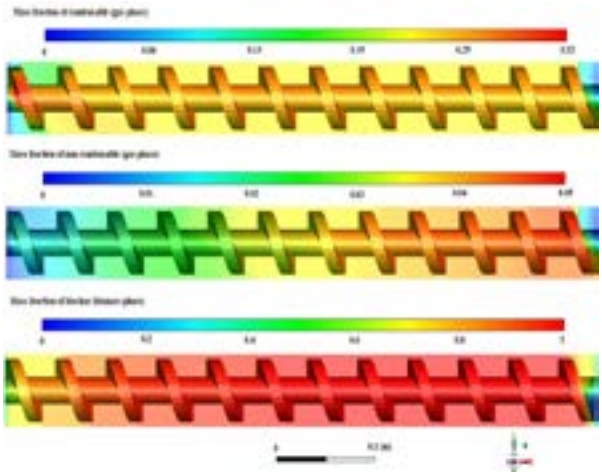

Figure: Mass fraction distribution of the products in the main auger reactor

Recent Publications:

1. Jalalifar S, Abbassi R, Garaniya V, Hawboldt K A and Ghiji M M (2018) Parametric analysis of pyrolysis process on the product yields in a bubbling fluidized bed reactor. J of Fuel 234:616-625.

2. Papari S, Hawboldt K A and Helleur R (2017) Production and Characterization of Pyrolysis Oil from Sawmill Residues in an Auger Reactor. Ind. Eng. Chem. 56(8):1920–1925.

3. Papari S and Hawboldt K A (2017) Development and Validation of a Process Model To Describe Pyrolysis of Forestry Residues in an Auger Reactor. Energy Fuels 31(10):10833–10841.

4. Aramideh S, Xiong Q, Kong S C and Brown R C (2015) Numerical simulation of biomass fast pyrolysis in an auger reactor. J of Fuel 156:234-242.

5. Jalalifar S, Ghiji M M, Abbassi R, Garaniya V and Hawboldt K A (2017) Numerical modelling of a fast pyrolysis process in a bubbling fluidized bed reactor. IOP Conference Series: Earth and Environmental Science 73:012032.

Biography

Salman Jalalifar has completed his Master Degree from the Faculty of Mechanical Engineering, Tabriz University, Iran. In the year 2016, he started his PhD at University of Tasmania, Australia. He spent three months at Memorial University, St. John's, Canada as a visiting researcher, and currently he is a visiting research student at Macquarie University, Sydney, Australia. He has published seven papers in recognized journals and conference proceedings in the area of heat transfer and combustion.

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