Investigation In Heat Transfer And Dynamics Of The Flow In A Pyrolysis Reactor

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ABSTRACT

The heat transfer and fluid dynamics process inside the fixed bed reactor when the pyrolysis is carried out was investigated. Numerical approach was used in this project due to the difficulty to visualize the heat transfer and fluid dynamics of the flow inside the fixed bed reactor in the experiment. Computational Fluid Dynamics has proven to be a reliable tool for the visualization inside the fixed bed reactor as the temperature and velocity distributions inside the fixed bed reactor can be obtained by solving the algebraic equations for mass, momentum and energy. 25 simulations were run with the variation of two pyrolysis parameters which are temperature and velocity of nitrogen gas. The reaction temperature has a range of 573 K to 1073 K and the velocity of the nitrogen gas has a range of 7.8×10^{-5} m/s to 0.067 m/s. For the numerical method applied, pressure-based solver was chosen for solving the algebraic equations with appropriate discretization schemes. From the simulations, it can see that the temperature distributions of the biomass powders were affected by conduction and convection. In addition, the velocity of the nitrogen gas was affected by the temperature throughout the whole process until the steady state is reached. From numerical approach, the optimum conditions to obtain the most bio-oil yield are heating the biomass with temperature of 1073 K with nitrogen gas velocity of 7.8×10^{-5} m/s. These obtained simulated results were also validated by the experiment data from the literature.