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Modelling of steam gasification of char in a circulating fluidised bed

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Biomass is a renewable source of energy with huge potential to replace or supplement conventional fossil fuels. Biomass gasification is a thermal conversion process to produce fuel or chemicals in the presence of a gasifying medium, mainly air, steam or air/steam mixture. The main challenges in this process is the presence of tar (heavy hydrocarbons) in the product gas, especially at low temperatures. The tar can be thermally cracked at high temperature (>1000°C) or catalytically reformed at lower temperature to produce a high quality fuel gas. Biochar, which is a pyroproduct from biomass pyrolysis, has been reported to contribute to catalytic cracking of the tar in the presence of steam and carbon dioxide. In this study, steam gasification of biochar has been theoretically investigated to predict the product gas quality and to better understand the extent of tar cracking in the presence of biochar. The gasification was simulated in a circulating fluidised beds using a three-dimensional Computational Fluid Dynamics (CFD) model based on two-fluid flow (Eulerian-Eulerian) approach and solved using the commercial software FLUENT. The devolatilisation and heterogeneous gasification reactions have been implemented in FLUENT using in-house developed User-Defined Function (UDF). To allow for comparative analysis, the simulation was carried out with and without the inclusion of the tar reforming reactions. It has been found that the tar can be significantly reduced when taking into consideration the biochar catalytic effect, even at a reactor temperature well below the recommended range for standard biomass gasification.

Biography

Muktar Bashir is a PhD candidate from Aston University in the European Bioenergy Research Institute Birmingham, UK. He holds an MEng degree in Chemical Engineering from University College London. His research interests are computational fluid dynamics modelling of solar and bioenergy processes. He is currently working on char gasification in a circulating fluidised bed.

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