World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:12, No:02, 2018

Hydrodynamics and Heat Transfer Characteristics of a Solar Thermochemical Fluidized Bed Reactor

Authors : Selvan Bellan, Koji Matsubara, Nobuyuki Gokon, Tatsuya Kodama, Hyun Seok-Cho

Abstract : In concentrated solar thermal industry, fluidized-bed technology has been used to produce hydrogen by thermochemical two step water splitting cycles, and synthetic gas by gasification of coal coke. Recently, couple of fluidized bed reactors have been developed and tested at Niigata University, Japan, for two-step thermochemical water splitting cycles and coal coke gasification using Xe light, solar simulator. The hydrodynamic behavior of the gas-solid flow plays a vital role in the aforementioned fluidized bed reactors. Thus, in order to study the dynamics of dense gas-solid flow, a CFD-DEM model has been developed; in which the contact forces between the particles have been calculated by the spring-dashpot model, based on the soft-sphere method. Heat transfer and hydrodynamics of a solar thermochemical fluidized bed reactor filled with ceria particles have been studied numerically and experimentally for beam-down solar concentrating system. An experimental visualization of particles circulation pattern and mixing of two-tower fluidized bed system has been presented. Simulation results have been compared with experimental data to validate the CFD-DEM model. Results indicate that the model can predict the particle-fluid flow of the two-tower fluidized bed reactor. Using this model, the key operating parameters can be optimized.

Keywords : solar reactor, CFD-DEM modeling, fluidized bed, beam-down solar concentrating system
Conference Title : ICSEEE 2018 : International Conference on Solar Energy and Energy Efficiency
Conference Location : Melbourne, Australia
Conference Dates : February 01-02, 2018