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Methane steam reforming through shell-and-tube heat exchanging reformer to improve heat transfer rate from low temperature heat source

Sangseok Yu and **Jinwon Yun**
Chungnam National University, South Korea

In the renewable energy technology, methane steam reforming is used to supply hydrogen rich fuel to fuel cell system that has high temperature heat source with conventional burner. The methane steam reforming technology is also used as secondary reformer to improve system efficiency with utilization of wasted thermal energy. When the heat source temperature is low, the heat transfer mechanism is very crucial to improve reforming reaction rate. At very low temperature such as 500°C, it is known that the methane conversion rate of steam reforming reaction is severely deviated from equilibrium. In this study, the heat exchanger design is investigated to improve methane conversion rate of low temperature secondary steam reformer. Right after the numerical model is validated with experimental data, the analysis is mainly concentrated on the various heat transfer parameters so that the principle parameter could be determined. Results show that since the temperature distribution in longitudinal and radial direction is sometimes severely non-uniform under practical environmental and operating conditions, the methane conversion rate is strongly depended on the non-uniformity. Result also shows that large steam to carbon ratio of practical steam reformer sacrifices thermal duties so that methane conversion rate has trade-off over increasing steam to carbon ratio.

Biography

Sangseok Yu is a Professor of Mechanical Engineering at CNU who is an expert in modeling and simulation of energy system. He majored in transient heat and mass transfer and dynamic modeling of automotive fuel cell system at University of Michigan Ann Arbor. In particular, he has special interests in control and fault detection of automotive fuel cell system. Recently, he extended his research scope to modeling and simulation of various energy systems.

sangseok@cnu.ac.kr

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