Modeling and Simulation of Hydrogen Generation in Membrane Reactor Via Steam Octane Reforming

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Abstract

Various hydrocarbon compounds have been converted into pure hydrogen by using a catalyst and a palladium membrane in one reactor (PMR) in a one-step process where the reaction proceeds to almost complete conversion. Octane is converted into pure hydrogen using of a palladium membrane reactor is described. Catalysts are used to endorse reactions such as methane steam reforming. These reactions only proceed to partial completion due to thermodynamic limitations. Consequently, a membrane, such as palladium, which is solely permeable to hydrogen, is merged into the reactor. Pure hydrogen moves to the permeate side enabling the reactions to proceed toward completion by maintaining a hydrogen-partial-pressure gradient across the membrane. Pure hydrogen is essential for use in fuel cell applications. In the present work, a mathematical model is used to describe the hydrogen generation using membrane reactor. The model equations are solved using COMSOL Multiphysics®. The effect of various operating parameters on membrane performance and octane conversion are investigated. The effect of the difference in membrane partial pressure in the permeate and retentate sections of the membrane and the ratio of steam to octane molar flow rate show significant effect on hydrogen generation.