391e Hydrogen Production by Methanol Reforming in Supercritical Water

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Production of hydrogen from methanol is examined by reforming in supercritical water using a tubular reactor made of Inconel 600. The inside surface of the reactor wall provides the catalytic surface area for the reactions. In the first part of the study, the effect of pressure, temperature and steam-to-carbon ratio on the hydrogen yield is studied. The experimental results and the equilibrium calculations show that high pressure favors methanation of CO and CO2 causing a significant loss of the H2. Therefore, it is important to reduce the extent of methanation in order to minimize the loss in the H2 yield. Here, three successful strategies for methane suppression are developed: (i) lowering the residence time, either by increasing the flow rate or decreasing the reactor length, (ii) addition of small amount of K2CO3 or KOH in the feed, or (iii) using the reactor made of Ni-Cu alloy instead of Inconel 600. The results are modeled by considering thermodynamics, heat transfer and reaction kinetics. Advantages of the proposed reactor include the production of H2 at a high pressure for utilization without compression, and byproduct CO2 at a high pressure for direct sequestration.