82b Simultaneous Hydrogen Production and CO2 Removal in Integrated Gasification Combined Cycles (Igcc)

Armin Hassanzadeh and Javad Abbasian

Coal gas cleaning at elevated temperatures and pressures has been recognized as crucial to efficient and economic coal utilization in advanced power processes such as Integrated Gasification-Combined Cycle (IGCC) processes. Separation of CO2 from coal derived synthesis gas for capture and sequestration is a key technology in the reduction of greenhouse gas emissions to the environment. Existing technologies require expensive solvents and operate at low temperatures (i.e., <40 C,) imparting a severe energy penalty on the system. Also the coal gas contains hydrogen that, if concentrated, can be used for different systems (i.e. fuel cells, chemical synthesis, oil refineries, etc.).

This paper addresses simultaneous CO2 removal and enhancement of hydrogen production in IGCC processes with regenerable MgO-based sorbent. The MgO-based sorbent can remove CO2 from coal gas at IGCC process condition (i.e. T= 300-500 C, P=10-50 bar) which shift the water-gas-shift (WGS) reaction toward more hydrogen production.

A regenerable MgO-based sorbent with high reactivity and attrition resistance has been developed and evaluated for this study. The reactivity of the sorbent toward CO2 was determined in a High-Pressure Thermo Gravimetric Analyzer (HPTGA) unit at process conditions. The experimental data was used to develop a mathematical model to predict the performance of the sorbent in fluidized-bed as well as non-isothermal packed-bed reactor to determine the most effective reactor arrangement and operating condition for CO2 removal and hydrogen production. The reactivity of the sorbent as well as its catalytic activity toward WGS reaction was studied in a high pressure packed-/fluidized-bed reactor to validate the model.