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Effect of operating variables on the small scale H_2 production in a packed bed reactor via sorption enhanced steam methane reforming process

Syed Zaheer Abbas[1], **V. Dupont**[2] and **T Mahmud**[2]
[1]University of Engineering and Technology Lahore, Pakistan
[2]University of Leeds, UK

The production of H_2 on small-scale via sorption enhanced steam reforming (SE-SMR) of CH_4 using 18 wt. % Ni/ Al_2O_3 catalyst and CaO as a CO_2-sorbent was simulated for an adiabatic packed bed reactor. To study the behavior of the ractor model along the axial direction, the mass, energy and momentum balance equations were incorporated in the gPROMS model builder. The effect of operating conditions such as temperature, pressure, steam to carbon ratio (S/C) and gas mass flow velocity (Gs) was studied under the low-pressure conditions. Independent equilibrium based software, chemical equilibrium with an application (CEA), was used to compare the simulation results with the equilibrium data. A good agreement was obtained in terms of CH_4 conversion, H_2 yield (wt. % of CH_4 feed), purity of H_2 and CO_2 capture under the different operating conditions of temperature, pressure, S/C and Gs. A pressure of 3 bar, 873 K and S/C of 3 can result in CH_4 conversion and H_2 purity up to 99% and 95% respectively compared to 36% and 59% in the conventional reforming process.

szabbas@uet.edu.pk