

عنوان مقاله:

Investigation of carbon dioxide capture from hydrogen using the thermal pressure swing adsorption process: Central composite design modeling

محل انتشار:

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خلاصه مقاله:

In this study pre-combustion capture of carbon dioxide from hydrogen was performed using a 5A zeolite adsorber. A one column thermal pressure swing adsorption (TPSA) process was studied in the bulk separation of a CO₂/H₂ mixture (50:50 vol%). The adsorption dynamics of the zeolite bed were investigated by breakthrough experiments to select the suitable range for operational factors in the design of experiments. Combined effect of three important variables namely, adsorption time, purge to feed ratio, and regeneration temperature on hydrogen purity, recovery and productivity were investigated in the TPSA process using Response Surface Methodology (RSM). Predicted models show an interaction between adsorption time and regeneration temperature in the range that the experiments were performed. Optimization of the TPSA process was performed based on the goal of responses. As hydrogen purity has the large impact with respect to hydrogen recovery and productivity in industry, the optimum condition was proposed based on maximum purity of hydrogen. In this condition, predicted values for adsorption time, purge to feed ratio, and regeneration temperature were 7.99 min, 0.2, and 204 °C, respectively. Predicted values of responses for hydrogen purity, recovery, and productivity were 99.88%, 50.71%, and 1.32, respectively. Acquired models were validated by experimental data in predicted conditions and actual responses were very close to predicted values. These results confirmed the accuracy of obtained models.

کلمات کلیدی:

Response surface methodology, Pressure Swing Adsorption, CO₂ capture, Zeolite 5A, Hydrogen purification

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