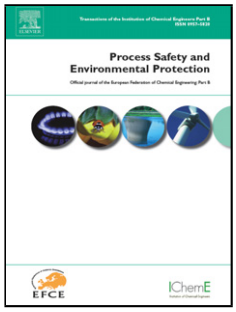

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Carbon dioxide adsorption on nitrogen enriched gel Beads from Natural Composite Calcined Eggshell/Alginate

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Abstract

In this study, the feasibility of CO_2 adsorption from the gaseous mixture (N_2/CO_2) under a range of experimental conditions was investigated using the bio-degradable adsorbent from sodium alginate/egg-shell in a fixed-bed reactor. The viscous alginate solution was further treated with aqueous ammonia (33%) to improve the CO_2 uptake. The CO_2 adsorption onto the gel beads was experimentally evaluated under a range of operating conditions i.e. a pressure of 1 to 2.5 bar, a temperature range between 30 to 50 °C, a flow rate of 50 to 90 ml/min and a CO_2 feed concentration between 20 to 45 vol%. A shorter breakthrough time and lower adsorption capacity were observed with increasing temperature. On the other hand, the capacity for CO_2 adsorption increased with an increase in CO_2 feed concentration, feed flow rate and operating pressure. The ammonia treatment can introduce some groups containing nitrogen onto the surface of sodium alginate of up to 10.56 wt%. Significant enhancement in adsorption capacity by more than two folds was observed with an increase in CO_2 concentration in the inlet gas compared to other parameters, suggesting that the presence of surface functional groups could be even more influential than porosity during the adsorption process. The experimental adsorption data was then fitted to Sips, Freundlich and Toth isotherm models. It was demonstrated that the Toth model could best describe the adsorption process, confirmed by the smallest RSME and ARE % . The positive value of entropy (ΔS) reflects the affinity of the adsorbent with CO_2.