Comparison of carbon dioxide adsorption performance by adsorbents under low partial pressures

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ABSTRACT

In this study an equipment for carbon dioxide adsorption was designed to evaluate the adsorption performance of four adsorbents: activated carbon, zeolite, silica xerogel and amine-grafted silica xerogel for possible application on the removal of carbon dioxide from indoor air. Silica xerogel and amine-grafted silica xerogel were synthesized in the lab. To simulate indoor conditions adsorption experiments were conducted with the initial carbon dioxide concentration between 1000 and 4000 ppm and temperature between 20 and 43°C. Of the four adsorbents, amine-grafted silica xerogel has the highest specific amount of carbon dioxide adsorbed, and zeolite has almost not any amount on it. Higher removal percentage of carbon dioxide were obtained at 35°C using amine-grafted silica xerogel than any other adsorbent within the test concentration range. The highest removal percentage of carbon dioxide were 34% with the initial carbon dioxide concentration of 1192 ppm. Fitting tests with Freundlich and Langmuir equations were demonstrated to established the relationship between the specific amount of carbon dioxide adsorbed and the equilibrium carbon dioxide concentration. It was shown that Langmuir equation is suitable for the adsorption process under low partial pressure. Based on the dynamic change of carbon dioxide concentration during the adsorption process in this equipment, a pseudo-second-order kinetic model was also demonstrated to be the suitable model.

Keywords : indoor carbon dioxide、Freundlich、Langmuir

Table of Contents

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