Development of Suitable Materials to Capture CO_2 for the Application of Carbon Capture and Storage

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Abstract:
Global warming and climate change concerns have triggered global efforts to reduce the concentration of atmospheric CO2. The application of Carbon Capture and Storage (CCS) is considered as a crucial strategy that meets CO2 reduction targets. In capturing CO2 process, absorption is used to reduce the concentration of CO2 but due to high regeneration cost and drawbacks of amine degrade, adsorption is introduced as another alternative method to capture CO2. Adsorption is known with its simple, low-cost operations and the presence of adsorbents are usually very safe to use [1, 2]. The primary aim of this study is to prepare suitable adsorbents for capturing CO2 for the application of CCS. Zeolite and copper metal-organic framework (Cu-BTC-MOF) are selected as adsorbents because of high surface area and the excellence performance in adsorption process [3]. The adsorbents are prepared by hydrothermal method. The physical and chemical properties of the prepared adsorbents are characterized using Fourier Transform Infrared spectrophotometer (FTIR), Scanning Electron Microscope (SEM-EDX) and surface area analyzer. The performance of both adsorbents in CO2 adsorption is evaluated in a fabricated set up consists of a metal cylindrical vessel as a reactor equipped with flow of pure CO2 gas from a cylindrical tank. The effect of adsorbent dosages (200-500 mg) and inlet flow pressure (0.2-1.0 bar) on CO2 adsorption process are investigated. The results showed that CO2 adsorption capacity is increased as the adsorbents dosages decreased. While in the case of inlet pressure, the adsorption capacity is directly proportional to the inlet pressure. When the inlet pressure is increased, the CO2 adsorption capacity is also increased. Based on the results, zeolite shows the best performance with high CO2 adsorption capacity as compared to Cu-BTC MOF.

Keywords: Carbon capture and storage (CCS); CO2 adsorption; Zeolite; Metal Organic Framework (MOF).

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