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CO_2 adsorption performance of AC and Zn-MOF for the use of carbon capture and sequestration (CCS)

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ABSTRACT

The purpose of this study is to examine and compare the performance of different kinds of solid adsorbents for CO_2 adsorption. The performance of selected solid adsorbents such as activated carbon (AC) and Zn-MOF in CO_2 adsorption was examined and compared based on variables: impact of adsorbent dose (200–400 mg) and the initial pressure (4–20 psig). Based on the characterisation results of the FTIR, EDX and XRD analyses, the outcomes suggest that Zn-MOF and AC have been successfully developed. The SEM images show agglomerations of Zn-MOF particles whilst a smooth surface has been observed on AC. According to the TGA analysis, AC manages to keep firm compared to Zn-MOF where it does not have the ability to maintain its frame when temperature reaches above 200 °C. From the CO_2 adsorption results, the findings show that Zn-MOF performs better with a high CO_2 adsorption capacity relative to AC in the low-pressure system. Under optimal conditions, the CO_2 adsorption of 145.1 and 79.28 mg/g of Zn-MOF and AC were achieved, respectively indicated that Zn-MOF gives a good feature for a solid adsorbent to capture a higher percentage of CO_2.
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1. Introduction

Carbon Capture and Sequestration (CCS) is extensively recognized and distinguished as the primary and most important way to control the concentration of CO_2 in the field of carbon reduction and its presumed innovations. The CCS includes the elimination and storage of CO_2 from industrialized low CO_2 concentration containing streams, the production of extraordinary concentrated CO_2 stream, and the transport and capacity of compressed CO_2 [1]. The CCS is an incorporated cycle comprising three steps of the process. First and foremost, CO_2 is taken from electricity generation plants and other large industrial sites. The separation of CO_2 from different gases produced at facilities such as coal and petroleum gas power plants, oil and gas treatment facilities, steel mills, and concrete plants. When captured and isolated, the CO_2 is compressed to a "dense stage" or fluid-like state to make it simpler to transport and store (fluid occupies significantly less space than a gas). The CO_2 is generally transported to an appropriate site for geological storage using pipelines, although a few nations use ships, and for little amounts of CO_2 use trucks. At that point, CO_2 is transported to a geological storage site and afterward injected deep underground where it is permanently stored [2]. The most utilized innovations applied in CO_2 capture are cryogenic refining, membrane purification, and adsorption. Adsorption technology has higher advantages than others, as it is more selective, consumes less energy and costs less to produce. The adsorbents used must be porous in structure and have good surface chemistry [3]. As CO_2 is an acid gas, the surface of the solid carbon material should be suitable for increasing selectivity against this contaminant. Consequently, the CO_2 adsorption efficiency can be improved by choosing the appropriate material of adsorbent because it is always a crucial problem in CO_2 CCS [4]. Physical adsorbents are barely affected during adsorption. Thus, this study was concentrated on the preparation and performance of right materials for CO_2 adsorption. The low cost of preparation and large surface area per unit volume of activated carbon (AC) have drawn in a many of interest in the past decade [5], and consequently, the AC-CO_2 framework has been broadly examined and give great performance in CO_2 adsorption [6]. Moreover, metal organic frameworks (MOFs) have incredible interior surface region, super high porosity and possibly apply in a broad range of usages.

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