CO2 Capture by Solid Ion-Exchange Resins and Amino-Functionalized Silica Over a Wide Range of CO2 Concentrations Using Complementary Thermal Techniques

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Solid sorbents represent the next generation in carbon capture and storage due to their lower energy requirements for regeneration and fast adsorption kinetics as compared to traditional technologies such as liquid amine solvents. Among the different types of sorbents under consideration for CO_2 capture, functionalized sorbents offer specific advantages including enhanced selectivity through the use of amine groups to chemically adsorb CO_2. Potential applications for amino-functionalized sorbents range from pre-combustion, post-combustion, and direct air capture. In this study, we will present CO_2 adsorption information for amino-functionalized silica using either amine-bridged silsequioxanes or the sodium silicate route. The performance of such silica sorbents is compared to two of the best performing ion-exchange resins used in carbon capture applications, Purolite A110 and Lewitite OP-VP1065. Information from calorimetry (DSC) and gravimetric (TGA) analyses on these samples were evaluated in order to determine a correlation between CO2 capacity and heat of CO_2 adsorption. The effect of temperature, from 30 to 100 °C, on CO_2 capacity will be discussed. In addition, these studies will cover CO_2 concentrations ranging from 450 ppm to 100% and pre-established relative humidity levels, allowing for evaluation of different carbon capture applications.