439b Experimental Pilot-Scale Study of Carbon Dioxide Recovery from Flue Gas Streams by Vacuum Swing Adsorption

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Adsorptive capture of CO2 from flue gas and process streams is a promising technology for greenhouse gas mitigation. Vacuum Swing Adsorption is a commonly used technology for oxygen production and landfill gas recovery. In this experimental study, we use a pilot scale Vacuum Swing Adsorption Process to study the capture of CO2 from CO2/N2 gas streams. To be effective for this application, the most important parameters are CO2 purity, CO2 recovery, and power consumption. Therefore, the effect of a range of process parameters on these performance measures are investigated in this experimental study. Our pilot unit consists of three adsorption beds of length 1m and ID 77.92mm packed with 13X adsorbent. Several cycle configurations are examined and the parameters of feed pressure, vacuum pressure, feed composition, and step times on performance is investigated. Because CO2 adsorption on zeolite 13X is very strong (and very non-linear), very low vacuum pressure is required to obtain high purity and CO2 recovery. The profiles of the pressures, and CO2 concentrations of the system in each step are investigated and presented. A CO2 purity of 80% can be readily obtained in a simple rectifying cycle and a CO2 purity of higher than 90% can be achieved in a more complex cycle.