420c Recovery of Carbon Dioxide from Flue Gas Streams by Vacuum Swing Adsorption

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Pressure swing adsorption is a widely accepted technology for gas separation. Recently, there has been interest in using this technology for carbon dioxide capture from exhaust gases to help mitigate global warming. In this study, separation of CO2 from flue gases containing 10% CO2 in nitrogen by VSA (vacuum swing adsorption) using zeolite 13X was studied theoretically. Application of control loops within our simulation leads to a constrained CSS (cyclic steady state) solution which satisfies the designed specifications, that is, some dependent variables in the PSA system are forced to reach their preset target values at CSS by adjusting those parameters with PID (Proportional Integral Derivative) algorithms. This technique mimics actual operation and hence our simulation is able to match experimental data closely. In this study, we compare and analyse two different rectifying VSA cycles: one with and one without product purge. The latter feature is added to enhance CO2 purity and productivity. The effect of each step and operating condition in the VSA cycle (such as vacuum pressure, product purge flow-rate and step time) on the performance is determined. Implications for large scale CO2 capture are discussed particularly with respect to CO2 recovery and power consumption.