Optimization of the two-stage PSA process for CO_2 capture from flue gas

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The PSA process is one of the potentially viable options for CO2 capture from large CO2 generating sources. The operating cost of a PSA process for CO2 capture is mostly contributed by the operation of vacuum pump and blower. Hence, how to reduce the operation cost of vacuum pump and blower becomes an important issue in the concerned PSA process. The aim of this research is placed in evaluating the economy of the two-stage PSA process for CO2 capture using zeolite 13X as adsorbent through numerical simulation and optimization. A new mass transfer model and an associated parameter estimation technique were developed for the precision modeling of a fixed-bed adsorption process, and the performance curves of commercial vacuum pump and blower were used for realistic calculation of the operating cost. To ensure numerically stable computation, the gradient-directed adaptive predictive collocation method was adopted with a cubic spline interpolation function and far-side boundary conditions. Economy of the PSA process was evaluated for the optimized process conditions as a function of CO2 contents of the inlet flue gas and CO2 recovery rate.