

Institute of Chemical Engineering

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The Separative Performance of Modules with Polymeric Membranes for a Hybrid Adsorptive/Membrane Process of CO₂ Capture from Flue Gas

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Commercially available polymeric membrane materials may also show their potential for CO₂ capture by the association of the membrane process with other separation techniques in a hybrid system. In the current study, PRISM PA1020/Air Products and UBE UMS-A5 modules with membrane formed of modified polysulfone and polyimide, respectively, were assessed as a second stage in the hybrid vacuum swing adsorption (VSA)-membrane process developed in our laboratory. For this purpose, the module permeances of CO₂, N₂, and O₂ at different temperatures were determined, and the separation of CO₂/N₂ and CO₂/N₂/O₂ mixtures was investigated in an experimental setup. An appropriate mathematical model was also developed and validated based on experimental data. It was found that both modules can provide CO₂-rich gas of the purity of > 95% with virtually the same recovery (40.7–63.6% for maximum carbon dioxide content in permeate) when fed with pre-enriched effluent from the VSA unit. It was also found that this level of purity and recovery was reached at a low feed to permeate the pressure ratio (2–2.5) in both modules. In addition, both modules reveal stable separation performance, and thus, their applicability in a hybrid system depends on investment outlays and will be the subject of optimization investigations, which will be supported by the model presented and validated in this study.

Metryczka

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