Permeation of Carbon Dioxide and Nitrogen Gases through Poly Vinyl Alcohol Membranes

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ABSTRACT

Carbon capture and storage is a key climate change mitigation technology for mitigating unfettered release of greenhouse gases (GHGs) into the atmosphere and is currently in the process of being demonstrated worldwide. To keep GHGs at manageable levels, large decreases in CO_2 emissions through capturing and separation will be required. Currently, a variety of technologies are being evaluated for their ability to capture CO_2 from power plant flue gas. None of the capture options is a clear winner at this point. The most commercial ready technology – amine absorption is costly, energy intensive, and if implemented, would result in large increases in the cost of producing electricity. In the chemical process industry, membrane-based gas separation is today well consolidated and competes with cryogenic distillation, absorption, and pressure swing adsorption. Membranes compete with other separation processes on the basis of overall economics, safety, and environmental and technical aspects. In this regard, a series of polyvinyl alcohol membranes with a variety of thickness and components including urea, choline chloride, glycerol, and diethylene glycol were synthesized. The PVA films were prepared by thermal phase inversion method and were characterized via TGA, SEM, and FTIR analyses.

The results obtained from the characterization test of SEM showed that the prepared PVA membranes are nonporous and the permeability of pure N_2 and CO_2 gases was determined using constant volume variable pressure method at different thickness. The results of pure gas permeation experiments showed that the highest CO_2 permeability of 148 barrer was obtained for the PVA membrane containing choline chloride and glycerol, while the highest CO_2/N_2 selectivity of 27 was obtained for the PVA membrane containing urea, glycerol and diethylene glycol. Gas permeation results indicated that solubility mechanism was dominant in the gas transport through the prepared membranes.