The CO_2/CH_4 separation performance of perfluoro(butenyl vinyl ether) polymeric membranes in the presence of toluene and xylene.

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Abstract:

Amorphous perfluoropolymers are strongly hydrophobic materials that also undergo unfavourable interactions with hydrocarbons. This provides them with strong resistance to plasticization induced by both water vapor and aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylene, known as BTEX). Thus, perfluoropolymers are considered as promising membrane materials for natural gas sweetening. In this work, the impact of toluene and xylene on the CO_2/CH_4 separation performance of Cytop® and CyclAFlor™ perfluoropolymers was studied. Cytop® was unaffected by either impurity, with constant CO_2 permeability and CO_2/CH_4 selectivity at activity up to 0.85. The CO_2 and CH_4 permeability coefficients decreased gradually with activity for CyclAFlor™, showing a 17% and 20% reduction respectively at 0.85 toluene activity, and ~10% reduction for both penetrants at 0.85 xylene activity, due to either competitive sorption or pore blocking. Analysis of sorption and XRD data showed that toluene and xylene have comparable kinetic diameters to the free volume elements in Cytop® leading to extremely low uptake of these penetrants. Conversely, CyclAFlor™ has larger free volume elements that can accommodate these molecules.

Keywords: Cytop®; CyclAFlor™; gas sweetening; toluene; xylene