Tubular CHA membranes for CO2/CH4 separation under industrially relevant conditions

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January 11, 2023

Abstract

An ultrathin (< 450 nm) tubular chabazite (CHA) zeolite membrane (100 cm2 membrane area) was experimentally evaluated for CO2/CH4 separation under industrially relevant conditions. For a 50:50 CO2/CH4 mixture at 292 K and a feed pressure of 5 bar, the observed CO2/CH4 selectivity was as high as 201, and the CO2 permeance was 52 × 10-7 mol/(m2[?]s[?]Pa). The membrane was also highly selective for CO2 in a 20:80 CO2/CH4 mixture. Mathematical modelling showed that concentration polarization still limited the membrane's performance, especially at high feed pressures. The theoretical CO2/CH4 selectivity without concentration polarization derived from the model was 77% higher than the experimentally observed selectivity at 18 bar and 292 K. These results suggest that the tubular CHA membrane is a promising candidate for the removal of CO2 from biogas and natural gas, and that measures should be taken to minimize concentration polarization in industrial processes.

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