Microwave heating-synthesized zeolite membrane for CO₂/CH₄ separation

Thiam Leng Chewa,b,*, Abdul Latif Ahmadb, Subhash Bhatiaa

School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, Seri Ampangan, 14300 Nibong Tebal, Pulau Pinang, Malaysia
Tel. +604 5996490; Fax: +604 5941013; email: edvinchew_83@yahoo.com
Faculty of Engineering and Green Technology (FEGT), Perak Campus, Universiti Tunku Abdul Rahman, Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia

Received 13 September 2011; Accepted 6 March 2012

ABSTRACT

H-SAPO-34 membrane was synthesized using microwave heating at 200˚C for 2 h. Ba-SAPO-34 membrane was obtained by ion-exchanging the H-SAPO-34 membrane with Ba²⁺ cation. The separation of CO₂ from CO₂/CH₄ binary gas mixture was studied using design and analysis of experiments. The response surface methodology coupled with central composite design was used for modeling and analysis of the contribution of operating parameters (temperature, pressure difference across the membrane, CO₂ concentration in the feed) to the responses (CO₂ permeance and CO₂/CH₄ separation selectivity) during Ba-SAPO-34 membrane separation process. The process parameters were varied in the range of 30–180˚C of temperature, 100–500 kPa of pressure difference and 5–50% of CO₂ concentration in the feed. The optimum condition for the process parameters was determined by setting the criteria so as to maximize the CO₂ permeance and CO₂/CH₄ separation selectivity. The optimum CO₂ permeance of 38.46 × 10⁻⁷ mol/m² s Pa and CO₂/CH₄ separation selectivity of 250.00 were determined at the temperature of 32.68˚C, pressure difference of 101.19 kPa and 5.87% CO₂ concentration in the feed.

Keywords: Ba-SAPO-34; Membrane; Microwave; Carbon dioxide; Gas separation