Separation and Purification Technology 109 (2013) 98–106

Contents lists available at SciVerse ScienceDirect

Separation and Purification Technology

journal homepage: www.elsevier.com/locate/seppur

Characterization of PVDF hollow fiber membrane for CO_2 stripping by atomic force microscopy analysis

R. Naim [a,b,c], K.C. Khulbe [d], A.F. Ismail [a,b,*], T. Matsuura [d]

[a] Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
[b] Department of Gas Engineering, Faculty of Petroleum and Renewable Energy Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
[c] Faculty of Chemical Engineering and Natural Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia
[d] Industrial Membrane Research Laboratory, Department of Chemical and Biological Engineering, University of Ottawa, 161 Louis Pasteur St., Ottawa, ON, Canada K1N 6N5

ARTICLE INFO

Article history:
Received 7 December 2012
Received in revised form 28 February 2013
Accepted 28 February 2013
Available online 14 March 2013

Keywords:
PVDF hollow fiber membrane
Atomic force microscope
Membrane contactor

ABSTRACT

Microporous polyvinylidene fluoride (PVDF) membranes with various concentrations of lithium chloride additives were prepared for CO_2 stripping test. Physical membrane characterizations such as atomic force microscopy analysis, gas permeation, contact angle measurement and liquid entry pressure were also conducted. Correlations among the membrane properties, i.e. contact angle, gas permeation, mean pore size, nodule aggregates and surface roughness obtained from experimental analysis were discussed. The overall trend showed that increasing lithium chloride concentration has decreased the mean pore size, mean nodule aggregates and mean surface roughness of the membrane. On the contrary, the membrane liquid entry pressure has been significantly improved. It was found that the mean pore size determined by tapping mode atomic force microscopy (TM-AFM) is 2.3 to 2.7 times larger than that of obtained from gas permeation test. The decreases in nodule size, mean pore size and low surface roughness have contributed to the enhancement of CO_2 stripping performance in membrane contactor system. Increasing LiCl concentration has increased the CO_2 stripping flux and membrane mass transfer coefficient. However, the concentration of LiCl showed minimal effect on the liquid side mass transfer coefficient.

* Corresponding author at: Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia. Tel.: +60 7 5535592; fax: +60 7 5535925.
E-mail addresses: afauzi@utm.my, fauzi.ismail@gmail.com (A.F. Ismail).

1383-5866/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.seppur.2013.02.036