Iran Polym J (2017) 26:639–649
DOI 10.1007/s13726-017-0549-6

ORIGINAL PAPER

# Pervaporation properties of oleyl alcohol-filled polydimethylsiloxane membranes for the recovery of phenol from wastewater

**Hong Ye[1,2] · Xiang Yan[1] · Xiang Zhang[1] · Weiwei Song[1]**

Received: 23 January 2017 / Accepted: 22 July 2017 / Published online: 31 July 2017


**Abstract** In the present work, the modified polydimethylsiloxane (PDMS) membranes incorporated by oleyl alcohol (OA) were prepared for the first time. The polymeric membranes were characterized by Fourier transform infrared spectroscopy (FTIR), thermal gravimetric analysis (TGA), and scanning electron microscopy (SEM) before and after modification. These membranes were used for the pervaporative separation of phenol from wastewater. The effects of OA loading and feed temperature on the pervaporation performances have been investigated. The influence of ignoring the partial pressure at the permeate side was compared and discussed. The results showed that the OA presence increased phenol flux and separation factor, and decreased water flux greatly with less than 9 wt% OA loading. The highest pervaporation separation index was obtained with 5 wt% OA loading. The driving force of phenol across the membranes was much lower than that of water, and permeation of phenol was much higher than water in nature. It is necessary to discuss and compare the intrinsic properties of different membranes using permeation and selectivity, even though the membranes are tested under the same feed temperature and concentration. The partial pressure of phenol at the permeation side cannot be simply omitted for its great effect on the permeation. Increasing feed temperature will result in the increase of flux and separation factor, but decrease of permeation.

**Keywords** Pervaporation · Oleyl alcohol · Polydimethylsiloxane · Modification · Separation membrane

## Introduction

Phenol is an important raw material in manufacturing of plastics, pesticides, petrochemicals, and pharmaceuticals [1]. The extensive application of phenol promotes the development of the relative upstream and downstream industries. Moreover, the discharge of industrial wastewater containing phenol is a potential threat to the public health. Adsorption and extraction are the effective traditional methods to deal with the sewage, but suffer from introducing the additional component.

Pervaporation is a new separation technology for the recovery of phenol from water [2]. It has the multiple benefits such as the low energy consuming, good environmental compatibility, and easy coupling to other technologies. The efficiency of pervaporation separation highly depends on the membrane material.

The membrane materials for pervaporation separation of phenol from water mainly include polydimethylsiloxane (PDMS) [3], polyurethane (PU) [4], and poly(ether block amide) (PEBA) [5]. Among them, PDMS is a kind of the industrialized hydrophobic membrane material and widely used for the recovery of alcohol from water [6–8]. For the separation of phenol–water mixture, the performance of PDMS membrane is effective, but not very satisfactory. PU

**Electronic supplementary material** The online version of this article (doi:10.1007/s13726-017-0549-6) contains supplementary material, which is available to authorized users.

✉ Hong Ye
yehcn@163.com

[1] Beijing Engineering and Technology Research Center of Food Additives, Beijing Technology and Business University (BTBU), Beijing 100048, China

[2] Key Laboratory of Cleaner Production and Integrated Resource Utilization of China National Light Industry, Beijing Technology and Business University (BTBU), Beijing 100048, China