일반강연 I-10

가교 알진산복합막을 이용한 유기용매의 투과증발 탈수 분리

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Crosslinking of Alginic acid composite membranes for the dehydration pervaporation of organic solvents

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1. Introduction

Sodium alginate(SA), which is a highly hydrophilic natural polymer obtained from seaweeds, has recently aroused a great interest in view of its industrial and biomedical applications. Three kinds of repeating structures for SA are shown in Fig. 1.

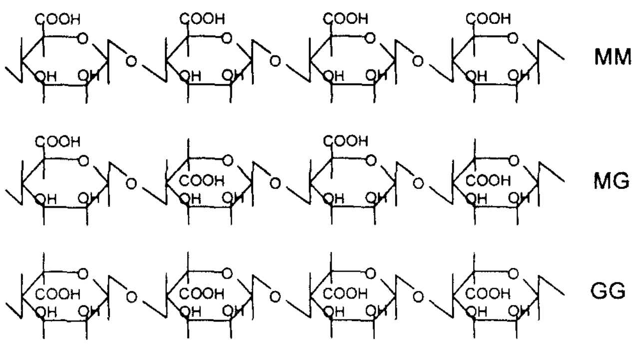


Fig. 1 Structures of three kinds of alginic acid repeating structures

G. Golemme et al. [2] has been studied sodium alginate dense and composite membranes for the separation of water/ethanol mixtures using pervaporation. Sodium alginate membranes was modified through ion exchange of sodium with multivalent metal ions and their permselectivities have been tested for the water-ethanol mixture.

C.K. Yeom et al. [3] investigated long-term stability of sodium alginate reverse osmosis membrane using protective polyelectrolyte complexes formed at the membrane surface. They reported the polyelectrolyte complex layer between sodium alginate and chitosan in the complex membrane is a protective covering of the crosslinked interior layer without affecting membrane performance, protecting the inside of the membrane from washing out the divalent ion, Ca^{+} by feed flow.

In this study, two kinds of sodium alginate composite membranes have been prepared to investigate long-term stability of sodium alginate membranes for the pervaporation separation of water-ethanol mixtures. In order to enhance the long-term stability of sodium alginate membrane, polyelectrolyte complex protective layer between chitosan and sodium alginate was adopted. Pervaporation performance of water-ethanol mixtures through two kinds of sodium alginate membranes with different crosslinking method with several run have been investigated.

2. Experimental

2.1. Materials

Sodium alginate mixed manuronic acid and glycuronic acid unit was purchased from Fluka. PAN UF membrane for preparing the composite membrane was purchased from GKSS. Ethanol was supplied by Merck (Darmstadt, Germany). Calcium chloride and chitosan were purchased from Aldrich Chemical Co. Ultrapure deionized water was used. All chemicals were used without any further purification.

2.2. Membrane Preparation

A PAN UF membrane was hydrolized in 1N NaOH aqueous solution to enhance adhesion between sodium alginate and PAN UF membrane and to promote pervaporation performance at 60℃ for 15minutes, and then transferred into deionized warm water to continue the hydrolytic reaction until the brown color disappeared. Sodium alginate solution was prepared by dissolving 2 wt% sodium alginate powder into deionized water. Then they were cast onto hydrolized PAN UF membrane using casting knife and dried in a fume hood for 24 hours. After drying, the membrane were crosslniked by $CaCl_2$ aqueous solution(SA) and $CaCl_2$/chitosan aqueous solution for 10 minutes(CH). The concentration of $CaCl_2$ in the crosslinking solutions was fixed 0.05M. pH of the $CaCl_2$/chitosan solution was adjusted at 5.4 with 0.1M NaOH.

3. Results and discussion

3.1. Membrane preparation

Yeom et al. reported reverse osmosis preparation method to enhance long term stability of SA membrane. Because of washing out effect of cation in SA membrane, in order to increase long term stability, they used polyelectrolyte, chitosan which has amine groups in main chain. Calcium cation crosslinked SA membrane can be slightly coated to form polyelectrolyte and then the coated layer can lessen washing out of the calcium ions out of membrane. Consequently, SA membrane has a good long term stability. Fig. 2. shows suggested structure of SA composite membrane coated with diluted chitosan.

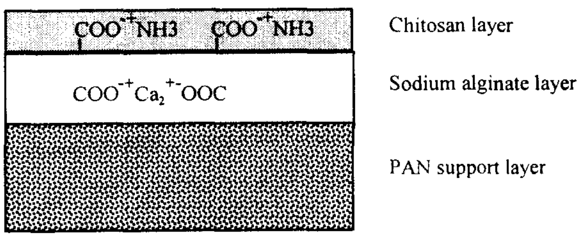
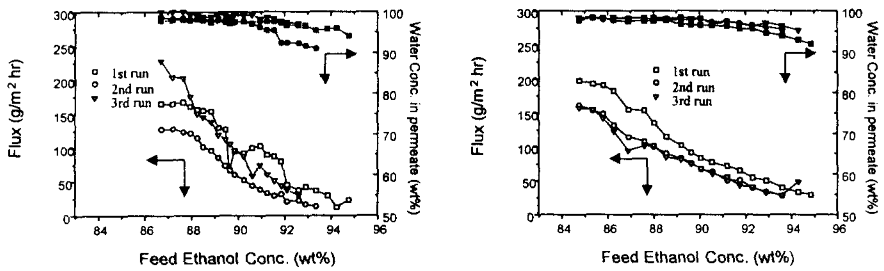


Fig. 2 Structure of suggested sodium alginate composite membrane

3.2. Pervaporation of water-ethanol mixture

Fig. 3 shows pervaporation performance of water-ethanol mixture through SA composite membrane at an operating temperature of 70℃. In the pervaporation experiments, as the feed ethanol concentration increases, the permeation flux decreases.

In Fig. 3, permeation flux decreased and feed ethanol concentration increased with operating time, respectively. In order to investigate long-term stability of SA and CH composite membranes, pervaporation experiments of each membranes are done three times.



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