

## Separation of VOCs from Water using Polysiloxaneimide Membranes

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### INTRODUCTION

The presence of VOCs in ground- and drinking-water becomes a serious environmental problem. Pervaporation is an effective process to solve this problem, compared with the traditional techniques. The VOCs have larger molar volume and more hydrophobic character compared with water. Therefore, the hydrophobic rubbery polymers such as PDMS membranes with high free volume and chain mobility are recommended. But they have poor mechanical strength, and improvements of mechanical properties have been made by introducing the cross-linked structure or siloxane based copolymer[1-2]. Polysiloxaneimide(PSI) membranes are expected to show good pervaporation performances, but systematic studies using these membranes have not been carried out. In this study, PSI membranes were prepared and their physical properties, sorption/preferential sorption properties and pervaporation properties were investigated. The effects of nature of VOCs and operation conditions on pervaporation properties were investigated.

### EXPERIMENTAL

#### Membrane Preparation

Polydimethylsiloxane(SIDA, average molecular weight; 800), BTDA, PMDA, 6FDA were used in the preparation of polysiloxaneimide membranes. SIDA was dissolved in 30ml of THF at room temperature for 2h. After the addition of stoichiometric amount of aromatic dianhydride, the solution was stirred for 20h to obtain a highly viscous polyamic acid(PAA). The PAA solution was cast onto teflon plate with predetermined thickness. The plate was completely dried at room temperature and then, it was heated at 250°C for 5h in vacuum oven. The membrane thickness was usually 150µm.

#### Sorption/Preferential Sorption and Pervaporation

Ten organic solvents- ethyl alcohol(EtOH), isopropyl alcohol(IPA), acetic acid(AA), acetone(ACE), methylethylketone (MEK), ethyl acetate (EA), methylene dichloride(MC), trichloroethylene(TCE), toluene(TOL), hexane(HX) were used for sorption and pervaporation tests. Degree of sorption of pure solvents,  $\Phi_p$ (wt %), that of aqueous organic solvents,  $S^m$  and sorption selectivity,  $\alpha_{n,w}^S$  were

carefully obtained from PSI membranes. Total permeation flux,  $J$  is calculated as:

$$J(\text{kg} / \text{m}^2 \text{hr}) = Q / (A \times T)$$

where  $Q(\text{kg})$  is the total amount of permeate,  $A(\text{m}^2)$  effective area of membrane and  $T(\text{hr})$  time, respectively. Pervaporation selectivity,  $\alpha_{o/w}^p$  is determined as:

$$\alpha_{o/w}^p = \frac{Y_o / Y_w}{X_o / X_w}$$

where  $Y_o$ ,  $Y_w$ ,  $X_o$  and  $X_w$  represent the weight fractions of organics and water in the permeate and feed, respectively.

## RESULTS AND DISCUSSION

### Sorption and Sorption Selectivity

Degree of sorption of pure solvents in PSI membranes increases with hydrophobic solvents. For 0.05 wt% of five aqueous dilute solutions, the degree of sorption and sorption selectivity tend to increase with changing from hydrophilic EtOH to hydrophobic TOL.

### Pervaporation Performances

Pervaporation experiments were carried out with 0.05 wt% of dilute aqueous at 30°C. The permeation flux and pervaporation selectivity are shown in Fig. 1 and 2. The PSI membranes show the increasing tendency of pervaporation selectivity and permeation flux going from EtOH to TOL.

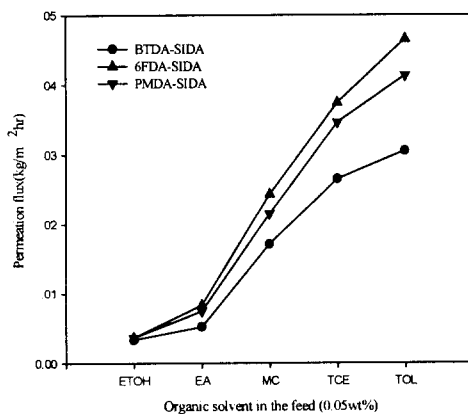


Fig.1 Permeation flux of PSI membranes

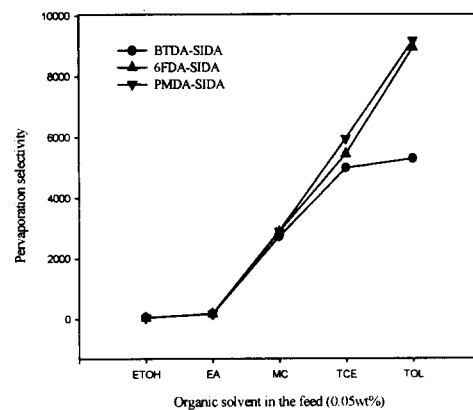


Fig.2 Pervaporation selectivity of PSI membranes

## REFERENCES

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