일반강연 A-9

Effects of Surface Modifying Macromlecule (SMM) on the Properties of Polyethersulfone Membranes

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1. Introduction

It is known that surface-active additives in polymer materials migrate to the surface and change the surface properties of the materials. The driving force for spontaneous surface migration is the tendency to minimize interfacial energy [1,2]. Based on this concept, SMMs as surface-active additives were synthesized and blended into polymer solutions of PES [3,4]. Figure 1 shows the molecular structure of the SMM used in this study.

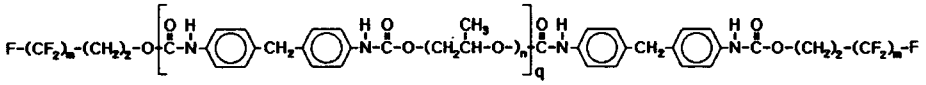

Figure1. Molecular structure of SMM

The effect of the SMM blending in the casting solution of polyethersulfone membrane was studied thoroughly in this work.

2. Experimental

Casting solutions were prepared with and without SMM (ca. 1 wt.%) in a polyethersulfone solution. The cast solution film was placed in a temperature controlled oven for solvent evaporation, before being immersed in ice-cold water for gelation. It is believed that SMM

migration takes place during the solvent evaporation period. Mechanical properties of PES and PES/SMM blend membranes were compared by measuring maximum tensile strength and %elongation using Instron instrument. Advancing contact angles on the membrane surface were measured by using a goniometer. (Please ask Mehrdad for right information.) The SMM content on the membrane surface was measured by X-ray photoelectron microscopy (XPS) using . (Instrument's name). Pure water permeation rates were measured by using a conventional static cell for reverse osmosis and ultrafiltration.

3. Results and discussion

Both % elongation and maximum tensile strength increased by blending SMM into the casting solution.

Figure 2 shows the results of the contact angle measurement. The contact angle of PES membrane did not change with solvent evaporation period. ForSMM/PES blend membranes the contact angle increased with an increase with solvent evaporation period. The contact angles of thinner membranes were higher than those of thicker membranes.

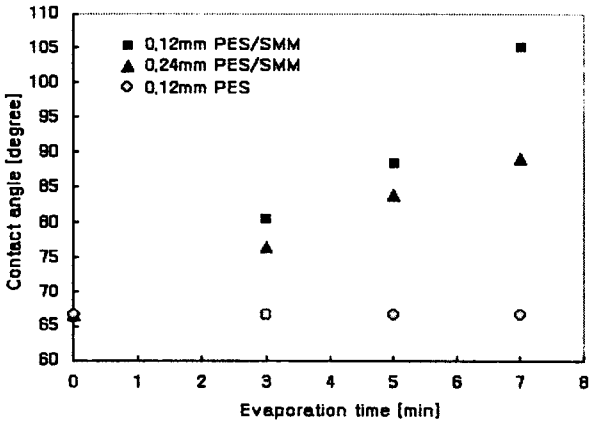

Figure2. Contact angle as function of evaporation time and cast membrane thickness

Figure 3 shows the effect of evaporation period on the atomic percent of fluorine, a measure for SMM content at the membrane surface, for

two different membrane thicknesses. SMM content increased with an increase in evaporation period, approaching an equilibrium concentration. It also shows that SMM content was higher when the cast film was thinner. A kinetic model for SMM surface migration was established based on the experimental data [5].

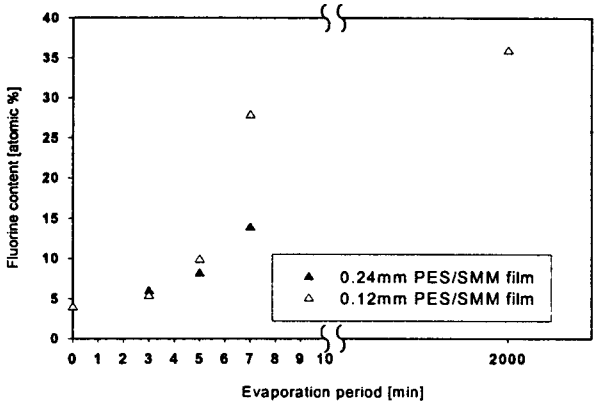

Figure 3. Fluorine content as function of evaporation time and cast membrane thickness

Both PES and PES/SMM blend membranes were subjected to pure water permeation experiments, the results of which are depicted in Fig. 4. Whereas water permeation rate started to increase from the origin for the PES membrane, the PES/SMM blend membrane held water above the membrane surface until pressure difference became 40 psi. This is because of the hydrophobicity of the surface.

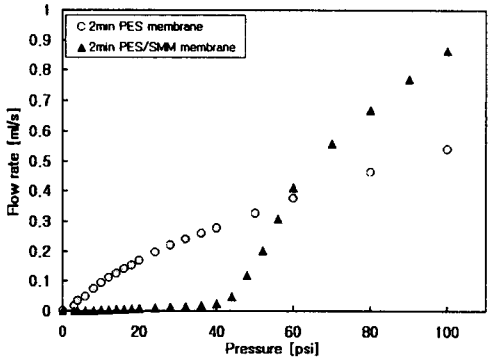

Figure 4. Pure water permeation rate versus pressure

4. Conclusions

The following conclusions were drawn from this work:

1. The tensile strength and % elongation of the PES membrane increased when SMM was blended.
2. SMMs surface migration was faster for a thinner membrane.
3. SMMs migrated toward membrane surface, approaching the equilibrium SMM concentration.
4. Water entry pressure increased by adding SMMs.

5. References

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