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Preparation and characterization of PVDF/PVP blend hollow fiber membrane via thermally induced phase separation (TIPS) method

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1. Introduction

Thermally induced phase separation (TIPS) is one of the most useful techniques for the preparation of commercial polymeric porous membranes by controlling phase separation. Poly (vinylidene fluoride) (PVDF) membranes have attracted much attention regarding its noticeable advantages over other polymers. However, further improvement is necessary especially to reduce the membrane fouling. Blending PVDF with a noncrystalline polymer such as Poly (vinylpyrrolidone) (PVP) is recommended to prepare membranes with more interesting characteristics.

In this work, PVDF/PVP blend hollow fiber membranes with various PVP concentrations and molecular weights were prepared and membrane properties were investigated.

2. Experimental

PVDF, PVP and diethyl phthalate with predetermined composition were fed to the vessel, heated at 190°C and then mixed for 1 hour. After holding at this temperature for 2 hour, the homogeneous polymer solution was fed to a spinneret. The spinneret consists of outer and inner tubes, and the solvent was introduced into the inner tubes to make a lumen of the hollow fiber. The hollow fiber was extruded from the spinneret and wound on a take-up winder after entering into a water bath to induce the phase separation and solidify the membranes.

3. Result and discussion

Water permeability of the different prepared membranes with different PVP concentration is shown in Fig.1. As shown in this figure, water permeability of the membrane decreases drastically with increasing PVP concentration.

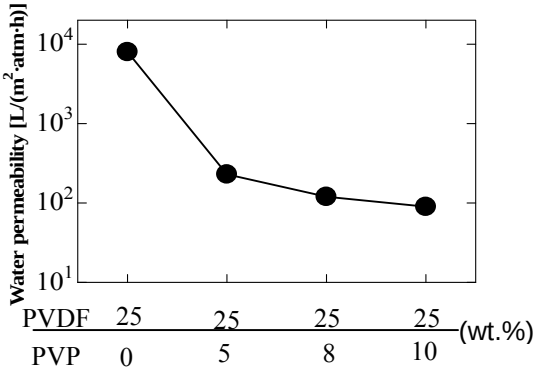

Fig.1. Water permeability of the prepared membrane

Fig.2 shows cross sectional images of the PVDF and PVDF/PVP blend hollow fiber membranes. An interesting double layer membrane with porous sublayer and dense support layer was observed for blend membrane, while symmetric structure was observed for PVDF membrane. After 4 months immersing blend membrane in water, EDX results confirms that PVP remains in the membrane.

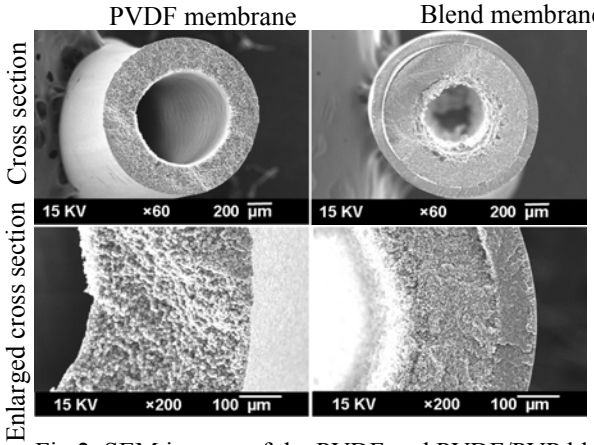

Fig.2. SEM images of the PVDF and PVDF/PVP blend membrane: PVDF 25% + PVP 10%

Table 1 shows the water contact angle results for various prepared membranes. Results show that membrane hydrophilicity increases by adding PVP.

Table1. Water contact angle

Membrane Composition	Water contact angle(°)
PVDF 30%	73
PVDF 25% + PVP 5%	62
PVDF 30% + PVP 10%	56

Fouling tendency for PVDF and blend membrane was shown in Fig.3. From Fig.3 it can be concluded that blend membrane has higher fouling resistance than that of the PVDF membrane due to the increase of hydrophilicity.

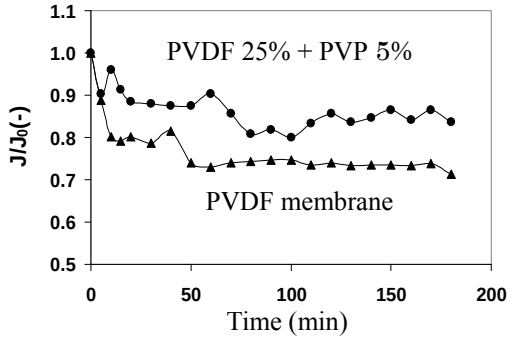

Fig.3. Fouling results for PVDF and blend membrane by using humic acid as foulant

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