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Effect Temperature Treatment on Physicochemical and Water Permeability Properties of Polisulfon Modified Membranes

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Abstract

The temperature treatment on casting of Polysulfon (PSF) modified membranes have investigated to study physicochemical and water permeability membrane properties. The PSF modified membranes was prepared by UV-photografting technique with different temperature treatment (25 – 100 ^{o}C). The physical and chemical characterization of membranes include functional group analysis, degree of grafting, whereas water permeabily was carried by water flux test. As the result, the functional group analysis showed that there were the new functional group in modified membranes. Increase temperature treatment, increasing degree of grafting, whereas the water flux decrease with increase temperature treatment.

Keywords: Modified membrane, UV-Photografting, physicochemical, water flux

Introductions

The modified membranes via UV-photografting technique have many used for various purposes such as to improve hydrophilicity (Helin, et.al, 2008; Heru et. al, 2007) and to make charged membranes (Dai, et.al 2008); . The grafting using UV radiation have advantages such as simple, inexpensive and easy to operate (Qiu, et.al, 2006). The successful the UV-photografting process depend on intensity and time radiation, monomer concentrations, structure of membranes.

The asymmetric membrane is a structure membrane that have different structure in the toplayer and sublayer. The form of membrane structure affected on selectivity and permeability parameters. There were some factor that affected on form of structure membranes include choice polymer, solvent,nonsolvent, composition casting solutions and and temperature casting (Mulder, 1996). In this paper, would be reported preparation of modified PSF membrane via UV-photografting technique The termal treatment with various temperature (25, 50, 75 and 100 ^{o}C) when process of the membrane formation will be studied their influence on physical and chemical properties.

Materials and Method

Materials

Udel PSF (Mw=35.000 Da) was obtained from Union carbide. The solvent used for membrane casting was N,N-dimetylacetamide (DMAc) (analytical grade reagent) and Polyethelene glycol was used as additive in the solution casting. Acrylic acid was used monomer.

Method

Preparation of PSF membrane

Amount PSF dissolved into DMAc, then added PEG 400 so that obtained PSF solution 18 % (w/w). After casting solution homogeny, allowed to for 1 hour to remove air bubbles, then membrane was cast on glass plate, then followed immersion in the coagulation bath. After 10 minutes, membranes were taken from coagulation bath and were treated thermal with various temperature (25, 50, 75 and 100 ^{o}C) in the oven. Finally, the membranes were washed with aquades and dried in open air.

UV-Photografting modification of SPSF membrane

Photoreactor was equipped with an UV high pressure mercury lamp 250 watt high pressure and aluminium as cover. The PSF membranes sample was placed in petridish and poured monomer solution in given concentration. UV irradiation was employed with distance 10 cm from UV for 10 minutes. After irradiation, the resulting grafted membrane was placed in an oven kept at 60 ^{o}C to complete polymerization reaction for 1 h. hereafter, membranes was washed with distillated water to remove excess unreacted monomer or physically adsorbed membrane (Heru, et. al, 2007).

Functional group analysis by Fourier Transform infrared (FTIR)

The FTIR spectra of PSF and modified PSF membranes were obtained using FTIR with range of wave number 800 -4000 cm^{-1}.

Degree of grafting (DG)

DG was carried out using gravimetric method according previously procedure (Heru et. al, 2007).

Water flux

Water flux was be measured by ultrafiltration (UF) cell. WF was obtained by measured water volume that pass through membrane per surface area membrane. The formulation water flux was showed as this follow (B. Piluharto, et.al., 2007),

$$Jv = \frac{V}{A.t}$$

Jv is water flux of membrane (L/m^{2}jam) , *V* is volume water (mL), *A* is surface area of membrane (m^2) and *t* is time (hour)

Result and Discussion

Functional group analysis of modified PSF membranes

This analysis was carried out to observe change of functional group of modified membrane. Figure 1. showed infrared spectrum of unmodified and modified PSF membrane. In the figure, there are some the new peak of spectra in the modified PSF that not appear in the nascent membrane. The new peaks are in around 1740 cm^{-1} and 3400 cm^{-1} that represent carbonyl group and –OH from carboxylate group. The new peak proved that the grafting on PSF membranes have been carried out successfully.

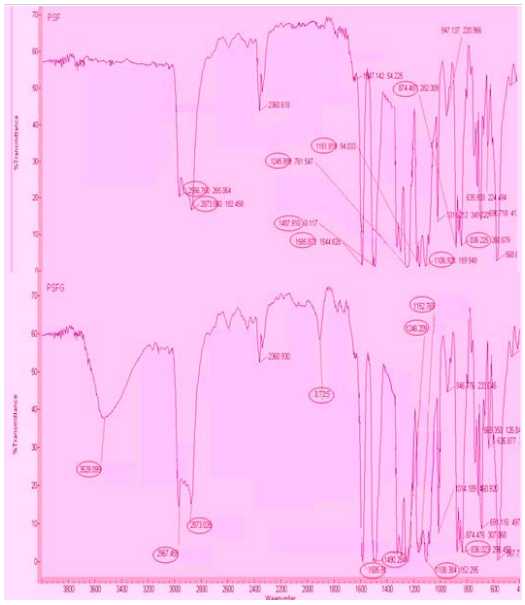

Figure 1. FTIR spectra of PSF and modified PSF membrane

Degree of grafting (DG)

DG was used to observe effectiveness grafting process on the membrane with various the thermal treatment. Plot DG and temperature treatment was presented in Fig. 2. Increasing temperature will increase DG. This phenomena can be explained by process of pore formation in the membrane. In the phase inversion technique, the pore was formed when casting membrane. In that moment, demixing liquid-liquid was occurred which phase rich-polymer will form porous structure, and poor-polymer will form finger-like structure. Therefore, increasing temperature when the coagulation process will induce mass transfer solvent and non solvent. The acceleration rate precipitation by temperature treatment give smaller pore formation in the membrane. Consequently, surface area in the membrane will increase with increase temperature treatment.

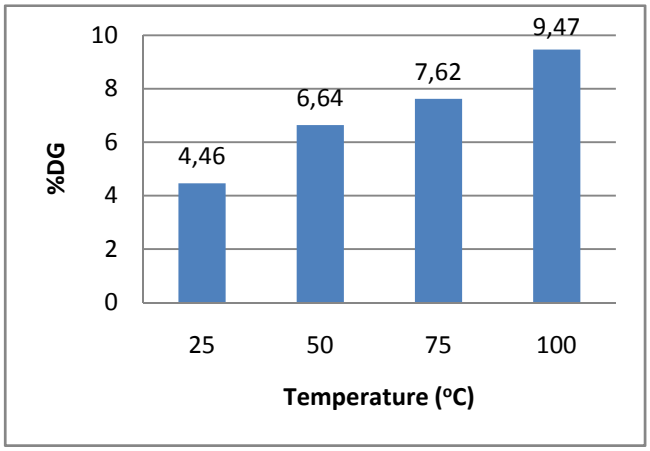

Figure 2. Effect temperature on Degree of Grafting

Water Flux

Plot water flux and temperature treatment was presented in figure 3. Increasing temperature of treatment, except membrane with thermal treatment, 100 ^{o}C, will decrease water flux in both of PSF membranes and the modified PSF membranes. Increasing temperature in thermal treatment will accelerate solvent to exit from the matrix membrane. Therefore, it influence on porous formation where increase temperature give smaller pore size of membrane.

All the modified membranes (PSF-G-AA), except membrane with thermal treatment, 100 ^{o}C, have water flux higher than unmodified membranes. This phenomena can be explained by grafting acrylic acid on the surface PSF membranes. Introducing acrylic to PSF structure

backbone give the more hydrophilic membrane. Increasing hydrophlicity of membrane will increase water permeability.

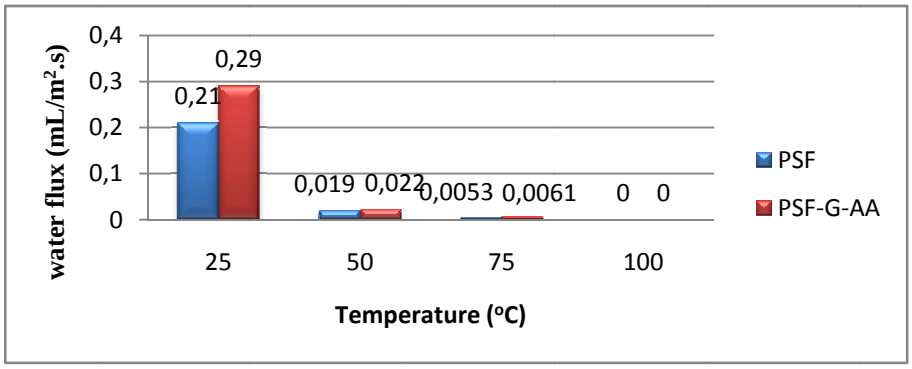

Figure 3. Effect temperature on water flux through membranes

Conclusion

The modified PSF membranes have been employed successfully via UV-photografting technique. Increasing temperature in the thermal treatment, increase degree of grafting (DG) on membranes due to increase surface area of membranes. Increasing temperature decrease the water flux both of PSF and modified PSF membranes. All modified PSF membranes, except membrane with thermal treatment, 100 ^{o}C, have higher the water flux than unmodified PSF membranes due to grafting of acrylic on the membrane.

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