Synthesis of Polymeric Membrane for Desalination Process

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***Abstract* – Cellulose acetate/polyethylene glycol 200 (CA/PEG) membrane with ration 80/20 (wt%) was modified with varying amount of silica in many concentration (1-5% w/v). CA/PEG-200 membranes were characterized for their hydrophilicity, functional groups and permeation properties. The increasing of CA at CA/PEG membrane make membrane more dense and hydrophilicity of membrane decreases. Membrane hydrophilicity, permeate flux, permeability, and salt rejection increase with the increasing of silica concentration in CA/PEG membrane. The experiment results show that the highest salt rejection was obtained when 5% silica was added into CA/PEG (80/20) membrane.**

***Index Terms* – Cellulose acetate, desalination polyethylene glycol, silica.**

INTRODUCTION

Water is one of the most important needs for human being. There is only 2.5% of fresh water which can be use directly without processing it first and the rest of them are salt water. Membrane is one of the most innovative technologies for desalination process.

An ideal desalination membrane should possess the resistance of chemical attack, separation process, good mechanical and thermal stability. Several of polymers have been used to synthesize membranes but Celluloce Acetate (CA) membranes were well accepted. However, CA is vulnerable to fouling resistance. Many substance had been investigated the effect of addition to CA membrane. The effect of PEG had been reported to increase porosity and flux upon decreasing molecular weight of PEG [2]. The effect of silica had been reported to increase salt rejection, thermal stability, and flux upon increasing amount of silica in membrane [1].

In this paper, a detailed study of membrane synthesizing is reported. These membranes were prepared by using CA, polyethylene glycol (PEG), and silica. Thermal Induced Phase Separation (TIPS) was used to prepare membrane. The effect of addition of silica with varying amount of silica on properties membrane were investigated by examining hydrophilicity, permeation properties such as salt rejection, flux, and permeability.

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MATERIAL AND METHOD

Cellulose acetate (CA, Mw 3000 Da, acetyl content 39%), polyethylene glycol-200 (PEG, Mw 200 Da) are purchased from Sigma Aldrich, fumed silica (SiO_2, particle size 0.2μm) were purchased from Sigma Aldrich. Aceton and sodium hydroxide used in this study are analytical grade.

A. Preparation of membrane CA/PEG

2 gram of CA and 0.5 gram of PEG was dissolved in 17 ml of acetone with constant stirring at 80ºC for 8 hours. Clear solution was obtained which was labeled as CP4. The solution was cooled in room temperature for 24 hours in sealed flask to make sure micro bubble disappear. The doped solution was casted on glass plate by maintaining the thickness. The temperature was lowered immediately to 5ºC for 15 minutes. Membrane was dried in oven at 60ºC for 24 hours. The clear and transparent membrane was carefully removed from glass plate.

B. Prepation of modified membrane

0.025 gram of silica 0.02 μm was dispersed in 2.5 ml of NaOH before adding to control solution with constant stirring at 80ºC for 10 hours. This modified solution was labeled as CPS2-1. The different amount of silica (0.05, 0.075, 0.1, 0.125 g) were used to prepared another modified solution, labeled as CPS2-2, CPS2-3, CPS2-4, CPS2-5. These solutions were casted and dried with same procedure as mention before.

RESULT AND DISCUSSION

Figure 1 shows that the hydrophilicity of modified membrane is higher than that of CA/PEG membrane. The increasing of silica increases the hydrophylicity of CA/PEG membrane.

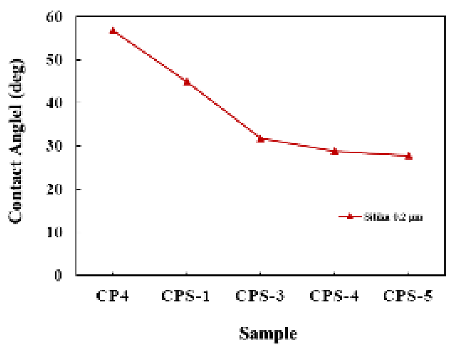

Figure 1. Contact angle of modified membrane

The increasing of CA/PEG membrane's hydrofilicity after the adition of silica is also shown in Fig. 2. The intensity of Si-OH bond at wavenumber 3400-3500 cm $^{-1}$ increases by the increasing of silica content in membrane. This behaviour indicates the increasing of CA/PEG membrane's hydrofilicity due to the increasing of silica contents in CA/PEG membrane.

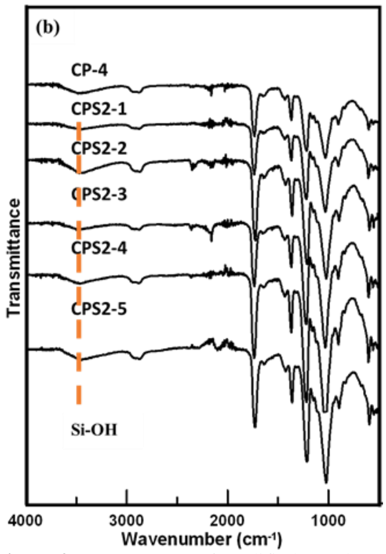

Figure 2. FTIR spectra of modified membrane

Permeate flux, salt rejection and permeability of CA/PEG membrane increases by the increasing of silica contents as shown in Table 1. This result is in agreement with the increasing of membrane's hydrofilicity.

Table 1. Permeation Properties

Variable	Permeate Flux ($L.m^{-2}.h^{-1}$)	Salt Rejection (%)	Permeability ($L.m^{-2}.h^{-1}.bar^{-1}$)
CP4	0.28	26.36	0.05
CPS2-1	0.15	29.87	0.02
CPS2-2	0.16	29.87	0.03
CPS2-3	0.22	34.25	0.04
CPS2-4	0.28	36.88	0.05
CPS2-5	0.56	36.88	0.11

CONCLUSION

In this study, hydrophilicity of CA/PEG membrane increases with the increasing of silica content as shown by the increasing of contact angle and Si-OH bond's intensity. Permeate flux, salt rejection, and permeability increase by the increasing amount of silica in membrane.

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