Preparation and Characterization of Modified Polysulfone Membranes With High Hydrophilic Property Using Variation in Coagulation Bath Temperature and Addition of Surfactant

S.M. Mousavi,[1] E. Saljoughi,[1,2] Z. Ghasemipour,[3] S.A. Hosseini[1,2]
[1] *Department of Chemical Engineering, Faculty of Engineering, Ferdowsi University of Mashhad, Mashhad, Iran*

[2] *Department of Chemical Engineering, Research Center of Membrane Processes and Membrane, Ferdowsi University of Mashhad, Mashhad, Iran*

[3] *Department of Chemical Engineering, Quchan Azad University, Quchan, Iran*

In this research, novel asymmetric polysulfone (PSF) membranes were prepared from PSF/polyethylene glycol (PEG)/polyoxyethylene sorbitan monolaurate/1-methyl-2-pyrrolidone (NMP) system via immersion precipitation. Pure water was used as gelation media. The variation effect of coagulation bath temperature (CBT) and addition of surfactant on morphology, wettability, and pure water flux (PWF) of the prepared membranes were studied by scanning electron microscopy (SEM), atomic force microscopy (AFM), contact angle measuring instrument, and experimental set up. The contact angle measurements demonstrated that hydrophilicity of the PSF membranes was significantly enhanced by small addition of surfactant in the casting solution along with using the lowest level of CBT. Also it was found out that addition of the surfactant in the casting solution along with increasing the CBT incites the formation of the bigger pores on the top surface and results in the formation of membranes with higher thickness and more porous structure in the sublayer. POLYM. ENG. SCI., 52:2196–2205, 2012. © 2012 Society of Plastics Engineers

INTRODUCTION

The technology of separation by membranes has become important due to operational simplicity, using of compact modules and low energy demand [1]. In fact, membrane technology has become the main focus as promising separation tool in many industrial processes covering fractionation and concentration steps in the food, pharmaceutical and biotechnological industries, pure water production, and water and wastewater treatments [2–4]. Polymers are still the main materials in membrane technology with the advantages of good flexibility, toughness, and separation properties [5, 6]. Polymers like PSF are widely used in industry for membrane preparation [7]. The constant interest of the membrane scientists for PSF is due to its excellent characteristics such as solubility in a large range of polar solvents, chemical stability, thermal resistance (150–170°C), wide pH value range application (2–12), resistance in oxidative medium (hypochlorite 5–7% and hydrogen peroxide 3–5%), high mechanical resistance of the PSF films (fracture, flexure, and torsion), and moderate reactivity that gives the possibility functionalization by aromatic electrophile substitution or other reactions [8, 9].

Despite of above advantages, low hydrophilic nature of PSF is also well-known, which results in the adsorption and deposition of hydrophobic solute on the membrane surface. The adsorption and deposition can cause severe membrane fouling due to the formation of thick gel-layer and the block of the pores, which will result in the flux decline and short-life of membrane [8]. Recently, the hydrophilization of polymeric membranes to produce low-fouling membrane has been considered as a promising approach to control fouling [10]. Thus several researchers have examined altering membrane surface properties using various methods such as ultraviolet irradiation [11–13], graft polymerization, plasma graft [12, 14], ion beam irradiation [15, 16] and so on. However, these methods suffer the drawbacks such as requiring additional complicated steps and offering random control over the resulting surface structure [17]. A promising in situ modification of hydrophobic membranes is blending with hydrophilic polymers or additives. This modification is simple and no additional step is needed during membrane manufacturing [2].

Correspondence to: S.M. Mousavi; e-mail: mmousavi@um.ac.ir
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