Role of hygroscopic triethylene glycol and relative humidity in controlling morphology of polyethersulfone ultrafiltration membrane

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ABSTRACT

This article presents the physical microstructure and chemical properties of polyethersulfone (PES) ultrafiltration membranes, dedicated to comprehend the role of hygroscopic triethylene glycol (TEG) under controlled conditions of relative humidity and membrane’s exposure time before immersion in the coagulation bath. The pore characteristics and chemical properties of the resulting membranes were studied by coupling the scanning electron microscopy sectional images with capillary flow porometer, porosity measurement and Fourier transform infrared spectroscopy. Separation capabilities of membranes were examined through filtration tests using humic acid solution as the model system. The remarkably high performance of the PES ultrafiltration membrane in humic acid removal was mainly attributed to the hygroscopic TEG that retained water molecules during dry phase inversion, which produced membranes with high porosity. However, excessive absorption of water vapour by either high concentration of TEG or humid condition led to a low productivity membrane due to the formation of dense skin structure at the membrane’s uppermost layer. In the present work, 10 min of membrane’s exposure time in humid environment with 25 wt.% TEG in casting dope and relative humidity of 60% was managed to fabricate a membrane with a thin selective top layer and finger-like substructure, leading to a high productivity of 145 L/m² h and 95% humic acid rejection.

Keywords: Hygroscopic; Relative humidity; Phase inversion; Morphology; Ultrafiltration

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