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Authors: A. Behboudi, Y. Jafarzadeh, R. Yegani

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Enhancement of antifouling and antibacterial properties of PVC hollow fiber ultrafiltration membranes using pristine and modified silver nanoparticles

A. Behboudi[a,b], Y. Jafarzadeh[a,b,*], R. Yegani[a,b]

[a] Faculty of Chemical Engineering, Sahand University of Technology, Tabriz, Iran

[b] Membrane Technology Research Center, Sahand University of Technology, Tabriz, Iran

Corresponding author's email: yjafarzadeh@sut.ac.ir

Abstract

In this study, PVC based hollow fiber ultrafiltration membranes incorporated with pristine and modified silver nanoparticles were prepared by wet spinning method. Silver nanoparticles were modified by silica based on Stöber method and the results of FTIR and FESEM analyses revealed that silver/silica nanoparticles were successfully synthesized. Fabricated membranes were then characterized by FESEM, EDX, contact angle, pure water flux, porosity, mechanical strength and antibacterial tests. It was found that all hollow fiber membranes had the same asymmetric structure and the presence of nanoparticles had no significant effect on the morphological structure of the membranes. The results of EDX analysis showed that the modification of silver nanoparticles improved their dispersion throughout the membranes. At the same content of nanoparticles, hydrophilicity, pure water flux and tensile strength of PVC/modified Ag membranes were more than that of PVC/Ag membranes. Moreover, the results of antibacterial test revealed that PVC/modified Ag membranes exhibited wider inhibition zones compared to PVC/Ag membranes. Finally, neat PVC, 1.5 wt % PVC/Ag and 1.5 wt % PVC/modified Ag membranes were used in a submerged membrane bioreactor (SMBR) system. The results showed that antifouling properties and COD removal of 1.5 wt % PVC/modified Ag membrane were considerably higher than that of the other membranes.

Keywords: Polyvinyl chloride; Hollow fiber membrane; Silver nanoparticle; Membrane Bioreactor.

1. Introduction

During last decades, membrane bioreactor (MBR) technology has been widely used in treatment of municipal and water recycling which involves a biological treatment and solid-liquid separation [1]. MBR systems combine conventional activated sludge (CAS) and membrane filtration processes and