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Primary evaluation of COF-based mixed matrix membranes to antifouling property

Nur Azizah Johari [a,b], Noor Yahida Yahya [c,*], Norhaniza Yusof [a,b], Siti Nur Syazana Zakaria [c]

[a] *Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia, 81310, Skudai, Johor, Malaysia*
[b] *School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310, Skudai, Johor, Malaysia*
[c] *Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, Lebuh Persiaran Tun Khalil Yaakob, 26300, Kuantan, Pahang, Malaysia*

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ABSTRACT

Nowadays, anaerobic membrane bioreactors (AnMBRs) are one of the considerable wastewater treatment technologies. However, the performance of AnMBRs in wastewater treatment is faded due to the membrane fouling issue. Due to that concern, it gives a reason to find a material with high quality properties to prepare an antifouling membrane for the application in AnMBRs. In this present study, a new ultrafiltration (UF) membrane incorporated covalent organic framework (COF) was successfully constructed by interfacial polymerization method. A mixed-matrix membranes (MMMs) in various concentrations of COF range of 0 to 1 wt% was prepared and characterized by SEM, XRD, FTIR and AFM analysis. The analysis has confirmed the incorporation of the COF to the UF membrane. The effect of various COF concentration towards the antifouling property of the prepared membranes were evaluated. The results show, the increasing of COF concentration from 0 to 1 wt% has led to the increasing in the rejection rate from 26.11% to 95.87%. Besides, the membrane hydrophilicity significantly improved by 30.53%, when the water contact angle decreased from 66.94° to 46.50°. These results suggested that the PES/COF MMMs has great potential to offer an efficient separation with superior antifouling membrane for AnMBRs.

1. Introduction

One of the considerable wastewater treatment technologies currently develop is anaerobic membrane bioreactors (AnMBRs) [1]. AnMBRs incorporate ulfiltration (UF) membrane are considered favorably to be provide solid–liquid separation in anaerobic digestion (AD). AnMRB offers high retention of biomass and quality's effluent, insignificant production of sludge and footprint as well as net energy production [2]. AnMBRs have the flexibility to implemented either as side-stream or submerged configuration. In a submerged AnMBR system, the membrane panel is immersed into the liquid. Either a pump or the force of gravity is utilized to facilitate the movement of the permeate through the membrane, thereby reducing the amount of energy required.

However, full scale implementation of submerged AnMBRs is strongly limited by membrane fouling [1,3,4]. Generally, the membrane fouling is due to a higher sludge load and poor hydrodynamic conditions as there is no aeration in the system [5]. As a consequence, pore clogging of membrane may occur which known as irreversible fouling [6]. Numerous efforts have been undertaken to fabricate an UF membrane with enhanced fouling resistance to combat this issue. The type of polymer and its compatibility are important factor in the fabrication of the antifouling membranes [7]. Among those methods, modification on surface architecture is one of convenient and best approach for the construction of highly efficient membrane with low fouling effect. Nonetheless, a crucial factor to take into account is the limited interfacial compatibility between inorganic fillers and organic polymers, which results in the formation of cracks and pinholes. These structural defects can significantly reduce the gas selectivity of the resulting membrane [8].

Covalent organic frameworks (COFs) are a novel category of materials with uniform and crystalline porous structure that consist of periodically arranged and covalently linked porous network structures [9–12]. The covalent bonding between these organic linkers results in a well-ordered and periodic assembly, which imparts COFs with uniform and densely packed pores, as well as a consistent pore size [13–15]. Additionally, COFs possess excellent chemical and thermal stability, and their porous network structure can be easily tuned, making them a suitable candidate to enhance interfacial compatibility and affinity in

* Corresponding author.
E-mail address: nooryahida@umpsa.edu.my (N.Y. Yahya).

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