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Polyvinylidene fluoride membranes with enhanced antibacterial and low fouling properties by incorporating ZnO/rGO composites

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ABSTRACT

In this study, the performance enhancement of polyvinylidene fluoride (PVDF) polymer as one of the most hydrophobic membrane material, blended with zinc oxide (ZnO) and zinc oxide/reduced graphene oxide (ZnO/rGO) was investigated. ZnO/rGO composites which acted as inorganic filler were synthesized via a facile precipitation method using zinc nitrate ($Zn(NO_3)_2$) as zinc precursor and sodium hydroxide (NaOH) as reducing agent. The synthesized ZnO/rGO composites with various Zn loadings were analyzed in terms of particles size and surface charge. The composites with highest surface charge and smallest particles size were then selected for PVDF membrane fabrication. The membranes were produced via immersion-precipitation method and they were characterized by water permeation test, contact angle, morphology, bovine serum albumin (BSA) rejection, flux recovery and antibacterial activity. Based on the findings, ZnO/rGO composites gave the most hydrophilic effect to the PVDF membranes, resulted in 61% of permeation flux increment in comparison with neat PVDF membranes. Simultaneously, the ZnO/rGO mixed matrix membranes (MMMs) showed the highest BSA rejection of 32% and flux recovery ratio of 48%, implying the improvement of the membranes' fouling resistance. Besides, there was no release of Zn element in permeate of ZnO/rGO MMMs which implied the strong bonding between ZnO/rGO composite with PVDF membranes. In addition, the superior antibacterial property of ZnO/rGO MMMs showed great potential in biofouling mitigation. Hence, the utilization of ZnO/rGO MMMs was highly recommended in various applications involving fouling and biofouling issues.

Keywords: ZnO; Graphene oxide; Antibacterial; Biofouling; Mixed matrix membranes

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