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Bimetallic MOFs Based Membrane for the Removal of Heavy Metal Ions from the Industrial Wastewater

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Abstract : Apart from organic dyes, heavy metals such as Pb, Ni, Cr, and Cu are present in textile effluent and pose a threat to humans and the environment. Many studies on removing heavy metallic ions from textile wastewater have been conducted in recent decades using metal-organic frameworks (MOFs). In this study new polyether sulfone ultrafiltration membrane, modified with Cu/Co and Cu/Zn-based bimetal-organic frameworks (MOFs), was produced. Phase inversion was used to produce the membrane, and atomic force microscopy (AFM), scanning electron microscopy (SEM) were used to characterize it. The bimetallic MOFs-based membrane structure is complex and can be comprehended using characterization techniques. The bimetallic MOF-based filtration membranes are designed to selectively adsorb specific contaminants while allowing the passage of water molecules, improving the ultrafiltration efficiency. MOFs' adsorption capacity and selectivity are enhanced by functionalizing them with particular chemical groups or incorporating them into composite membranes with other materials, such as polymers. The morphology and performance of the bimetallic MOF-based membrane were investigated regarding pure water flux and metal ion rejection. The advantages of developed bimetallic MOFs based membranes for wastewater treatment include enhanced adsorption capacity because of the presence of two metals in their structure, which provides additional binding sites for contaminants, leading to a higher adsorption capacity and more efficient removal of pollutants from wastewater. Based on the experimental findings, bimetallic MOF-based membranes are more capable of rejecting metal ions from industrial wastewater than conventional membranes that have already been developed. Furthermore, the difficulties associated with operational parameters, including pressure gradients and velocity profiles, are simulated using Ansys Fluent software. The simulation results obtained for the operating parameters are in complete agreement with the experimental results.

Keywords : bimetallic MOFs, heavy metal ions, industrial wastewater treatment, ultrafiltration.
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