

Microplastic fouling mitigation of polysulfone ultrafiltration membrane via incorporating metal-organic frameworks (MOFs)

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Abstract:

The presence of microplastics (MPs) in wastewaters is being increasingly documented, escalating the pressing need to investigate their removal efficiency in wastewater treatment plants (WWTPs) as well as their impact on the performance of each treatment technology. Among different treatment methods, membrane technologies have demonstrated high efficiency in MP removal from wastewater indicating their high potential to tackle this emerging concern. However, recent research has shown that the presence of MPs in wastewater increases membrane fouling which is a critical challenge for membranes threatening their performance and lifetime. In this work, MIL-53(Fe) metal-organic frameworks (MOFs) were incorporated into polysulfone ultrafiltration membranes aiming to study the novel membranes' MP fouling mitigation efficiency. MIL-53(Fe) was used owing to its high hydrophilicity, excellent water stability, and small pore size improving membrane properties without adverse effects on selectivity. The membranes were fabricated using phase inversion method by dispersing various concentrations of MIL-53(Fe) in the polymer casting solutions. The structure of the fabricated membranes was characterized by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), water contact angle (WCA) analysis, and atomic force microscopy (AFM). The antifouling properties of the membranes were assessed by feed solutions containing organic foulants and MPs. The optimum modified membrane illustrated a lower flux decline and higher flux recovery confirming its higher fouling resistance compared to the unmodified membrane. This is related to the improved hydrophilicity of the modified membrane decreasing its tendency to MP fouling. This study provides important insights into alleviating the membrane fouling caused by MPs as emerging contaminants with the aim to develop robust membranes for MP elimination in WWTPs.

Keywords: Microplastics, Ultrafiltration membranes, Fouling, Metal-organic frameworks