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Synthesis and characterization of graphene oxide and its potential application in polymeric membranes for wastewater treatment

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Recently, ultrafiltration technology has received increased attention because of its effective concentration and purification of medical, food, and paper products in industrial separation processes. In this regard, the polyvinylidene fluoride (PVDF) ultrafiltration membrane has rapidly become the research focus of material and membrane science due to its peculiar antioxidation activity, excellent chemical resistance, thermal stability, and good membrane-forming properties. Nonetheless, the hydrophobic nature of the PVDF membrane makes it susceptible to contamination by proteins and some of the other impurities, which causes a sharp drop in the water flux of the membrane. For this reason, among different methods have been proposed to render a hydrophilic PVDF membrane, physical blending with inorganic materials has drawn the greatest attention because of its advantage of facile preparation via phase inversion. Recently, the application of carbon nanomaterials for preparing ultrafiltration membranes has attracted considerable attention [1]. A potential candidate to effectively reinforce polymeric materials is graphite. It has an exceptionally high aspect ratio in combination with a low density and high strength and stiffness. Nonetheless, graphite is chemically inert and cannot be dissolved in typical organic solvents. As an affinity of graphite, graphene oxide (GO) with the carboxylic and hydroxy groups is suitable for preparing organic–inorganic blended ultrafiltration membranes for water and wastewater treatment goals [2].
In the first step of this study, GO was synthesized from industrial graphite using Hummer's method [3] and characterized with XRD, FT-IR and SEM analysis. In continue, a novel composite PVDF membranes were prepared by phase inversion method using casting solutions involving PVDF, polyvinyl pyrrolidone (PVP) and GO additive in N-methyl-pyrrolidone (NMP) as solvent. A series of experiments, such as water contact angle (CA), water flux, bovine serum albumin (BSA) rejection, SEM and AFM analysis were carried out for membrane characterization. The hydrophilicity and pure water flux of the membranes were improved by incorporating of GO. SEM images showed that the GO embedded membranes possessed a typical asymmetric structure similar with the bare PVDF membrane. The BSA filtration results indicated that by addition of the low quantity of GO (0.05 wt.%) can significantly decline the fouling resistance parameters due to low roughness and high hydrophilicity of the modified membranes. Comparison of the GO embedded membranes with the bare PVDF membranes demonstrated superior characteristics and antifouling properties of the mixed matrix membrane.

References:
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