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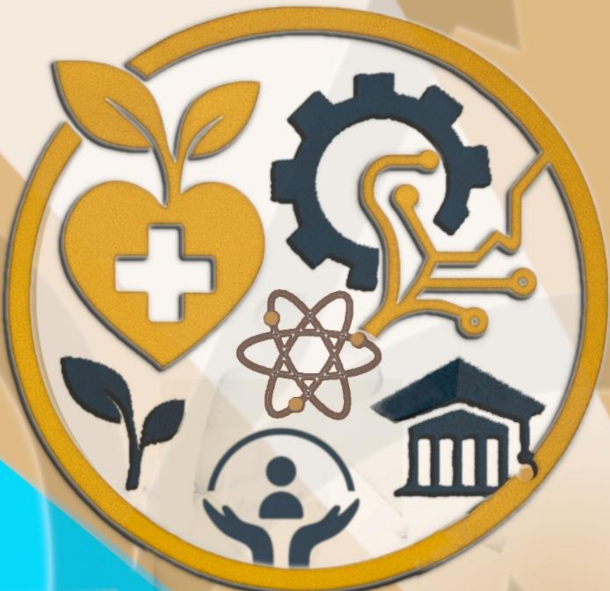

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Improving the Performance of Carbon Nanotube-Based Membranes for Water Desalination

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Carbon nanotubes (CNTs) are among the most prominent nanomaterials used in membrane filtration technology for water desalination purposes due to their remarkable chemical, structural, mechanical, and thermal properties. Performances of membranes are highly affected by the uniform and even distribution of nanoparticles on the membrane substrate. Therefore, a well-dispersed solution of CNTs is essential to fabricate the membrane substrate for optimum performance. However, the dispersion of carbon nanotubes in any solvent is challenging due to their bundle-like structure. This study investigated how the dispersion of multi-walled carbon nanotubes (MWCNTs) in solutions with different compositions affects the performance and structural morphology of the thin film nanocomposite (TFN) membranes used for water desalination. In this study, the MWCNTs were functionalized with carboxyl groups by treating them with an HNO_3/H_2SO_4 acid mixture (3:1(v/v)) for enhanced dispersion. Different dispersions of functionalized MWCNTs (fMWCNTs - 0.004% w/v) were prepared using distilled water, ethanol, and the surfactant, sodium dodecyl sulphate (SDS), along with m-phenylenediamine (MPD) as a common monomer in all the solutions. The fMWCNTs dispersed in different solutions were incorporated onto the membrane substrate using the spin coating method. Trimesoyl chloride (TMC) was used as the other monomer for the formation of a porous polyamide layer onto which the fMWCNTs are incorporated. Elucidation of the structure of the fabricated membranes was done using SEM imaging and FTIR spectroscopy, and performances tested by evaluating the water flux and salt rejection. The results revealed that the TFN-ethanol membrane has the best-fitted morphology for the filtration, with a 71.9% enhancement in water flux compared to the TFC (thin film composite) membrane, and the highest salt rejection of 37.87% for $MgSO_4$ and 31.22% for NaCl was observed. The TFN-DI membrane possessed the next highest performance with a 20.2% enhancement in water flux compared to the TFC membrane and salt rejections of 14.8% and 12.5% for $MgSO_4$ and NaCl, respectively. Interestingly, the TFN-SDS membrane exhibited no permeability, suggesting poor integration or blockage of the porous structure due to surfactant interaction. These findings suggest that performance of carbon nanotube-based TFN membranes can be significantly enhanced through dispersion methods, as functionalized CNTs exhibit different chemical interactions depending on the solution compositions.

Keywords: Carbon nanotubes, dispersion, water flux, salt rejection, functionalized