

ABSTRACT

Global concern has increased in recent years regarding the potential negative effects of produced water discharged to the marine and estuarine environment. Water is an integral part of life and health which is generally used in every home and industries. Having clean water solves many problems associated with diseases but obtaining it can be difficult. The inadequate measures of handling industrial wastewater are becoming a problem and more difficult to manage than sewage. One of the most serious environmental pollutants in groundwater are organic compounds. These compounds are in abundance in crude oil petroleum products and coal tar. They are volatile in nature and highly soluble in water. These compounds are monoaromatic hydrocarbons such as benzene, toluene, ethylbenzene and xylene, and are commonly known as BTEX compounds. BTEX compounds are sometimes neglected, unattended and untreated by the municipal water treatment system notwithstanding their negative effects on our health relating to ingestion.

Nanotechnology has the potential to significantly impact positively on the environmental protection through development of green technologies that minimize the production of undesirable by-products, and remediation of existing sites and polluted water sources. This study focuses on synthesizing iron nanoparticles (Fe-NPs) using plant extract (pomegranate leaves) and embedding the nanoparticles in a Polyether sulphone polymer to obtain mixed matrix membranes (MMMs) for removing BTEX compounds from wastewater. Polyethersulphone (PES) membranes are known for their cost-effective, good mechanical, thermal and chemical stability. However, the inherent hydrophobicity of PES has limited its application in water and wastewater treatment. This inherent nature of hydrophobicity of PES has resulted in research on how to make PES membranes more hydrophilic. Iron nanoparticle infused membrane has^{^^} promising advantages over the PES membrane, whereby it improves the properties of polymeric membrane such as antifouling, permeation and mechanical properties. Polymer membranes are commonly used in the preparation of microfiltration and ultrafiltration membrane especially, ultrafiltration membrane. In

this study, Fe-NPs and PES composite membranes were fabricated by phase inversion method and evaluated at different percentage loading of iron nanoparticles namely 0 wt.%, 5 wt.%, 10 wt.%, 15 wt.% and 20 wt. %. The physiochemical properties of the composite membrane was investigated using scanning electron microscopy (SEM) for morphology, Fourier transform infrared spectroscopy (FTIR) for surface chemistry, Thermogravimetric analysis (TGA) for thermal stability, water contact angle determination for wettability, and Atomic force microscopy (AFM) for the roughness. The performance of the composite membrane in terms of water flux and BTEX removal efficiency during wastewater treatment was investigated.

The results show that the composite membranes with Fe-NPs were improved significantly and has the potential for removal of BTEX compounds in wastewater. Contact angle measurement indicates enhanced hydrophilicity by incorporating Fe-NPs in the polymer matrix. At 10 wt. % Fe-NPs, the membrane-displayed BTEX rejection of 63.8 %, 56.86 %, 53.42 % and 84.12 %, respectively. The membrane mechanical strength at 20 wt. % Fe-NPs loaded displayed the highest tensile strength of 8.94 MPa compared to 0 wt. % Fe-NPs loaded which gave 1.2 MPa. This indicates that mechanical properties were enhanced at increasing Fe-NPs loading. When the Fe-NPs loading was 10 wt. %, the water flux reached the maximum at $80.50 \text{ L m}^{-2} \text{ h}^{-1}$, about 62 % higher than the pure PES membrane. It is an indication of enhanced membrane properties as nanoparticles loading are increased.