Abstract of the Thesis

Membrane technology has gained significant popularity across diverse industries, including water and wastewater treatment, food processing, the chemical industry, biotechnology, the medical and pharmaceutical sectors, water desalination, blood purification, and fuel cells for energy applications. Its increasing utilization is attributed to numerous benefits, including improved energy efficiency, cost-effectiveness in operations, scalability, and user-friendly operation. Modification of the surface of a mixed matrix membrane provides new properties such as improved separation abilities, increased energy efficiency, and enhanced chemical efficiency when compared to unmodified membranes. Additionally, it enhanced the chemical stability of the membrane and introduced a surface charge that facilitated the rejection of specific ions through the membrane. A polysulphone/azide-MWCNT mixed matrix membrane underwent a click reaction on the membrane surface, converting the azide groups into triazole rings. Additionally, a polyether sulphone and polysulphone/amine-MWCNT mixed matrix membrane was treated with trimesoyl chloride and cyanuric chloride to modify the membrane surface. Furthermore, a polyether sulphone or polysulphone/oxidized-MWCNT mixed matrix membrane with carboxylic functional groups on the surface was treated with polyethylenimine (PEI) to introduce amine functional groups. In particular, membranes modified through click reactions have a positive charge, whereas those modified with trimesoyl chloride have a negative charge. In contrast, membranes modified with cyanuric chloride exhibited a more positive charge. Additionally, a mixed matrix membrane treated with polyethylenimine (PEI) introduced a positive charge on the membrane surface. The pH plays a crucial role in determining whether they will have positive or negative charges. This characteristic is beneficial for enhancing the rejection of heavy metals, resulting in improved antifouling properties for both types of modified membranes. Compared to unmodified membranes, all modified membranes demonstrated higher heavy metal rejection due to the adsorption and complexation abilities of the functional groups on the membrane surface, and the antifouling property also improved after surface modification. As the functionalities of the membrane surface are enhanced through modification, the separation that occurs owing to complexation also increases. However, the overall bulk morphology of the membrane remained unchanged, while its roughness increased slightly as a result of the surface treatment. This has implications for applications such as water treatment, where the goal is to purify water by removing contaminants, such as heavy metal ions.