Factors affecting the performance of nanoparticle composite photocatalytic membrane

Conference on Water, Waste and Energy Management

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Introduction– Photocatalytic membranes have shown great potential for the removal of an organic and inorganic pollutant from wastewater as it combines the degradation and antibacterial properties from photocatalysis and physical separation by the membrane in a single unit. Incorporation of the semiconductor in membrane structure results in enhancing the performance and the properties of the membrane. This study is related to the factors which influence the performance and efficiency of the photocatalytic membrane.

Experiment– Photocatalytic membrane using PVDF polymer and TiO_2 nanoparticles with a particle size of 41µm and 21nm with different solvent's such as DMAc, NMP, and the mixture of NMP and DMAc used to fabricate the flat sheet ultrafiltration membrane by using non-solvent phase inversion [1]. Cross-flow filtration module is used to study the separation and flux rate of the prepared membrane. Photocatalytic activity of membrane for the removal of orange –g dye was studied under UV light for 3hours [2-4].

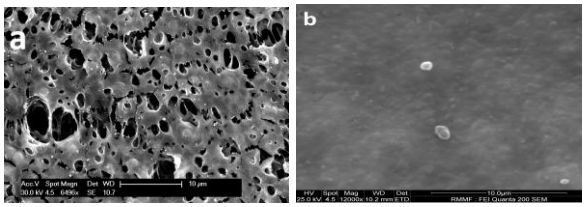

Figure 1: SEM image of PVDF-TiO_2 membrane with the particle size (a) 41 µm (b)21nm

3. Results and Discussion – Membrane morphology of the prepared membrane was studied using SEM, EDX, FTIR, and XRD. Figure 1 describes the effect of uses of different size of nano-particles into the membrane. Due to the large particle size and agglomeration of TiO_2 prepared membrane have very large pore on the surface, however with 21nm particle size prepared membrane to have smooth surface observed in figure1. Finger-like structure and the sponge-like structure observed when the membrane prepared using different solvent. DMAc solvent helps to get finger-like structure due to the good affinity between solvent and non-solvent whereas NMP creates dense structure into the membrane resulting into a less porous membrane. While in mixed solvent both structures had observed[5].

4. Conclusions: Different factors which influence the membrane-preparing by phase inversion is elaborated in this study. The polymorphism of PVDF membranes could be well regulated by different solvents. The crystalline phase of PVDF membrane by phase inversion mainly depended on the dissolution state of polymer and nanoparticles in casting solution High removal rate of 96% for the membrane prepared with an optimized condition, using dimethylacetamide with 3% TiO_2 having particle size 21nm with polymer molecular weight of 534,000 was achieved. The increasing concentration of nanoparticles can also help to gain high water flux of $10Lm^{-2}h^{-1}$. The results provide vital insight into the development of Photocatalytic membrane and their application in wastewater treatment.

5. References

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