Design and fabrication of continuous flow photoreactor for degradation of organic pollutants.

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Abstract

The objective of this study was to design and fabricate the continuous flow photoreactor for treatment of organic pollutants in waste water using heterogeneous photocatalytic process. Different nano-metal oxides such as ZnO and SiO2 were prepared via hydrothermal process and mixed with TiO2 (Degussa) to act as catalyst. These different nanomaterials were doped with polysulfone (PS) to prepared modified flat sheet membrane using phase inversion method.

The characterization of the synthesized nanoparticles and membranes were carried out using particle size analyzer, ATR-FTIR spectroscopy, XRD, contact angle measurement and scanning electron microscope (SEM). Also, the efficiency of both synthetized polymeric nanocomposite membranes and the photoreactor were evaluated through studying the effect of different parameters. These parameters included feed water pH, flow rate, oxygen content, pollutant types and pollutant concentrations. The pollutants such as phenolic compound and methyl orange were used as examples of organic pollutants.

The obtained results showed that the doped (TiO2/ZnO) PS modified membrane with best ratio (1:1) showed a degradation of 72% and 16.5% in case of phenol and dye pollutants respectively, under ultraviolet light. On the other hand, the degradation was 29.8% and 10.8% in case of phenol and dye pollutants respectively, under visible light. Furthermore, the doped (TiO2/SiO2) PS membrane with best ratio (2:1) was able to degrade 18.1% and 40.3% in case of phenol under ultraviolet and visible light, respectively. The performance was improved by increase the oxygen content, i.e., addition of H2O2 and the degradation was 97% and 95% under visible light in case of dye and phenol pollutants, respectively.

Keywords: Photocatalysis, PS modified membrane, continuous flow photoreactor, (TiO2/SiO2) nanoparticles and (TiO2/ZnO) nanoparticles.