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Fouling characterization of TiO_2 nanoparticle embedded polypropylene membrane in oil refinery wastewater treatment using membrane bioreactor (MBR)

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ABSTRACT

TiO_2 nanoparticles embedded polypropylene (PP) membranes were fabricated via thermally induced phase separation method. Different amounts of TiO_2 nanoparticles (0–1 wt%) were added to the PP membranes and the optimum composition (0.75 wt% of TiO_2 in the casting solution) was selected according to the several structural and operational analyses. The performance and antifouling behavior of the optimized nanocomposite membrane were examined using submerged membrane bioreactor (MBR) system in treatment of primary effluent obtained from the wastewater treatment unit of Tabriz Oil Refinery Co. (Iran). The obtained results confirmed that the addition of TiO_2 nanoparticles improves the thermal, mechanical and operational properties of PP membrane. For instance, critical flux increased from 34.5 to 64 L/m^2 h for neat and nanocomposite membranes, respectively. Intrinsic, cake layer and irreversible fouling resistances decreased from 73.50, 511.11 and 756.01 to 25.01, 224.58 and 315.00 for neat and nanocomposite membrane, respectively. Using Hermia's fouling model, it was shown that the governing fouling mechanism is cake formation for both membranes; however, the portion of irreversible fouling considerably decreased when nanocomposite membrane was utilized. The conspicuous reduction in the fouling of nanocomposite membrane introduces the great potential of this membrane to be used in MBR for wastewater treatment.

Keywords: Membrane bioreactor; TiO_2 nanoparticle; Polypropylene membrane; Nanocomposite membrane; Membrane fouling; TIPS method

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