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REDUCED GRAPHENE OXIDE/WASTE-DERIVED TiO_2 COMPOSITE MEMBRANES: A NEW MATERIAL FOR HYBRID WASTEWATER TREATMENT

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Abstract

Efficient wastewater treatment and reuse are of primary importance in a world where water scarcity and droughts are increasingly frequent. Titanium dioxide nanoparticles (TiO_2NP) are widely employed in photocatalytic water treatments, despite some limitations due to their tendency to agglomerate and high bandgap. In this research, TiO_2NP were combined with reduced graphene oxide (rGO), a graphene-like material of proven metal ion capture ability, with the aim to obtain self-assembling membranes (rGO-TiO2) having double functionality (i.e. photocatalyst and adsorbent) for water treatment. Materials' integration simply consisted in the mechanical mixture of the two components followed by vacuum filtration, without the introduction of further chemicals. In a view of circular economy, a second type of membranes (rGO-TIO) was produced, according to the same procedure, replacing TiO_2NP with Tionite, a TiO_2-containing material resulting from TiO_2 production. Composition and morphology of both membranes were characterized through XRD, thermogravimetric and SEM-EDX analyses. Fe^{3+} and Cu^{2+} 3 mg/L aqueous solutions were considered to assess if the combination of rGO with TiO_2 or Tionite affects its capture ability, verifying that the produced membranes are effective in metal ions adsorption. Both types of membranes were tested in the photodegradation of Imidacloprid®, a common organic pesticide, as a proof of concept of their photocatalytic properties. Photodegradation efficiencies of 25% and 21% were registered for rGO-TiO2 and rGO-TIO, respectively. Results of capture and photodegradation experiments provide a promising, yet preliminary, demonstration of a potential use of rGO-TiO2 and rGO-TIO membranes in the remediation of wastewater containing both inorganic and organic pollutants. Decontamination performances of Tionite-based membranes are particularly significant, considering that a waste material, without any further purification, was employed in their production.