

ABSTRACT

This study reports the development of efficient photosensitive nanocomposites made from clay, Fe₂O₃, and graphene oxide (GO). These nanocomposites were used for the removal of steroid estrogens (E1, E2, E3 and EE2) from water under visible-light. The use of these photocatalytic nanocomposites led to oxidation of the steroid estrogens at >80 % even under simultaneous presence of all estrogens in water. Mineralization was obtained for these estrogens within the range of 58–73 %. The presence of Fe-oxide in the nanocomposites increased the photocatalytic efficiency but addition of GO further improved the photocatalytic efficiency. This improved efficiency was further doubled when the nanocomposites were prepared with a carbon source (*Carica papaya* seeds). The presence of carbon in the nanocomposite matrix was confirmed using X-ray photoelectron spectroscopy and Elemental analysis. The main contributors to photocatalytic efficiency of these nanocomposites are superoxide radicals ($\cdot\text{O}_2^-$) and holes (h^+). Under competitive conditions, the photocatalysts are still active although the extent of estrogen oxidation is somewhat lower. Changes in the ionic strength did not significantly influence the efficiency of the photocatalyst. This signifies that adsorption only plays a minor role in estrogen removal from water. Toxicity tests show that the treated water is safe for human consumption and the most efficient nanocomposite can be recycled three times without any significant loss of performance. Overall, the nanocomposite show high potential for the effective removal of a cocktail of estrogens in raw wastewater, tap and rain water, attaining contamination levels that are within WHO safe limits.