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Extras (1)
1. Supplementary material
Magnetic hybrid TiO$_2$/Alg/FeNPs triads for the efficient removal of methylene blue from water

An efficient direct method addition was applied to synthesize TiO$_2$/Alg/FeNPs beads.

Adsorption, photocatalysis and magnetic property facilitated methylene blue removal.

Alginate impeded low photoactivity of TiO$_2$/Alg/FeNPs beads by separating Fe$_3$O$_4$ and TiO$_2$.

Abstract
A new adsorbent material with combined adsorption, photocatalytic, and magnetic properties has been successfully synthesized and tested for the efficient dye removal from methylene blue (MB) contaminated water. A facile non-thermal method was applied to synthesize a hybrid nanocomposite consisting of TiO$_2$/calcium alginate (TiO/Alg) and magnetite (Fe$_3$O$_4$) nanoparticles (FeNPs). The potential of the adsorbent Alg as a barrier to prevent direct contact between the magnetic core and TiO$_2$ was experimented by varying the synthesis conditions. The performance of four differently synthesized TiO$_2$/Alg/FeNPs samples (TiO$_2$/Alg/FeNPs-1, TiO$_2$/Alg/FeNPs-2, TiO$_2$/Alg/FeNPs-3, and TiO$_2$/Alg/FeNPs-4) was found to be fairly comparable and stable based on their efficiency in removing MB from aqueous solution due to the physico-chemical characterization (surface morphology, functional groups and elemental analysis) which supports the performance of TiO$_2$/Alg/FeNPs. For the optimization study using the response surface methodology (RSM) with three factorial Box-Behnken experimental designs, TiO$_2$/Alg/FeNPs-2 was selected as it exhibited the highest MB removal of 97.6% after 120 min under ultra violet irradiation (254 nm wavelength). Among the three independent variables studied (i.e., pH, contact time and initial MB concentration), the initial concentration of MB had significant effect towards the MB removal performance. A recycling study was performed, thus confirming the stability of TiO$_2$/Alg/FeNPs-2 up to three cycles, with only a slight drop in the removal efficiency from 93.1% to 88.5%. The fabricated TiO$_2$/Alg/FeNPs nanocomposites could be a potential functional material for treating artificial dye laden wastewater such as in textile, cosmetic, and paper industries.