

Ionic liquid-decorated Fe₃O₄@SiO₂ nanocomposite coated on talc sheets: An efficient adsorbent for methylene blue in aqueous solution

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Abstract

Ionic liquid-modified silica-coated magnetite (Fe₃O₄@SiO₂-IL) nanoparticles were synthesized using co-precipitation, silylation, and substitution routes, and finally immobilized on talc sheets by electrostatic interactions. The prepared Fe₃O₄@SiO₂-IL/Talc nanocomposite was characterized by FTIR, XRD, VSM, SEM, and TEM techniques. The nanocomposite was used for adsorption of cationic methylene blue (MB) dye from the aqueous media. The effect of operating parameters, namely initial MB concentration, solution pH, and contact time on the removal rate, was investigated. Electrostatic interactions between MB ions and active sites of the nanocomposite allowed fast adsorption and nanocomposite showed higher adsorption capacity towards MB ions than talc, and Fe₃O₄@SiO₂-IL alone. It was also found that Fe₃O₄@SiO₂-IL/Talc nanocomposite could be used in multiple cycles using environmentally benign ethanol as a solvent. As a result, this study presents a synthesis of novel nanocomposite adsorbent for the removal of harmful organic compounds from the aqueous media, followed by easy separation and possible reuse.

Keywords: Talc, Adsorption, Magnetic nanocomposite, Methylene blue, Nanoclay, Ionic liquid