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Removal of tetracycline antibiotic from aqueous environments using core-shell silica magnetic nanoparticles

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ABSTRACT

The aim of this study is to investigate the removal of tetracycline (TC) antibiotics from aqueous solutions using core-shell magnetic nanoparticles. Fe_3O_4 magnetic nanoparticles (NP) were synthesized using the solvothermal method. A silica core shell was coated on the NP surface by a modified stober sol-gel process. FTIR, TEM, VSM,and XRD analysis confirmed the formation of core shell magnetic NP with a size of 90 nm. In addition, tetracycline adsorption was applied to the synthesized NP under optimum adsorption conditions to enhance pollutant removal efficiency from water. Results showed that the maximum adsorption capacity (q_m) of TC on the core-shell magnetic nanoparticles was enhanced by about 50% in comparison to uncoated magnetic nanoparticles. This adsorption capacity enhancement was due to the prevention of clustering and aggregation of adsorbents as well as stronger interactions between NP surfaces and TC molecules. Kinetic and isotherm studies showed that the adsorption behavior of TC on both adsorbents fitted well with the pseudo-second-order kinetics and Langmuir isotherm models, respectively. This confirmed the strong interaction between adsorbent and pollutant by forming a single layer of TC on the adsorbent surface. Finally, results suggested that coating the surface of iron oxide magnetic nanoparticles with silica improved the pollutant adsorption efficiency in aqueous media.

Keywords: Magnetic nanoparticles; Tetracycline removal; Adsorption; Non porous silica; Core-shell

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