DEVELOPMENT OF CHITOSAN-BASED MAGNETITE NANOCOMPOSITE: AN EFFICIENT ADSORBENT FOR THE REMEDIATION OF PHOSPHATE FROM WASTEWATER

Deeksha K. J. and Vishalakshi B.

Department of Post-Graduate Studies and Research in Chemistry, Mangalore University, Mangalagangothri, 574199, (D.K.), Karnataka, India.

A novel semi-interpenetrating network based on chitosan and its magnetite nanocomposite was developed and evaluated for the removal of phosphate from aqueous solution. The gel was made by microwave-assisted free radical polymerization with N-(2-hydroxyethyl) acrylamide (HEAAm) and N,N'-methylenebis(acrylamide) (MBA) in the presence of chitosan (CS) and polyvinylpyrrolidone (PVP). The magnetite (Fe_3O_4) nanoparticles were embedded into the network through in situ diffusion of Fe^{3+} and Fe^{2+} followed by reaction with ammonia solution. FTIR, SEM, EDS, TGA, and XRD techniques were employed to characterize the gel (CS-g-PHEAAm)-PVP and its nanocomposite (CS-g-PHEAAm)-PVP/Fe_3O_4. The phosphate adsorption process was optimized for contact time, solution pH, adsorbent dosage, temperature, and initial adsorbate concentration. From the adsorption data, the Freundlich isotherm and pseudo-second-order kinetic models best describe phosphate ion sorption. The thermodynamic studies indicated the overall sorption process to be endothermic and spontaneous. The highest adsorption capabilities for phosphate removal were 45.0 mg/g and 50.0 mg/g, respectively for the gel and nanocomposite. The adsorption capacity of the gel seems to increase marginally with the inclusion of magnetite nanoparticles. The magnetic property helps in the easy removal of phosphate using magnetic forces from the adsorption medium making the composite material (CS-g-PHEAAm)-PVP/Fe_3O_4 a useful adsorbent for remediating phosphate ions from wastewater.