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Synthesis of γ-Fe_2O_3 coated sand for absorptive removal of fluoride ions from drinking water

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The contamination of water sources owing to the presence of fluoride ions create major health problems for human kind. There exist various methods for the removal of excess fluoride ions from water. Among these, absorptive methods are central mainly due to relative low cost. In the presence study, work is performed to synthesize a low cost adsorbent by coating the sand particle surfaces with γ-Fe_2O_3 nanoparticles. The γ-Fe_2O_3 nanoparticles were synthesized using chemical co-precipitation method. Preliminary tests were performed using two different sizes of silica gel particles. The synthesized nanoparticles were characterized using Fourier Transformation Infrared Spectroscopy (FTIR), Scanning Electron Microscope (SEM) and surface titration techniques. Absorptive and kinetic studies were used to determine adsorptive behaviour of the material with various parameters. Optimum particle size of silica gel/sand particles were found to be between around 0.50 mm. the observed point of zero charge was pH 9.47. Batch adsorption studies indicated that the synthesized material has an adsorption efficiency of up to 85 ± 5 %. A rapid adsorption was observed for initial 60 minutes and then reached to an equilibrium. The adsorption behaviour was found to be highly sensitive to the pH value of the solutions and the efficiency was higher at lower pH values. Freundlich isotherm model best fitted with the observed kinetic data. For the initial 30 minutes, adsorption behaviour was consistent with pseudo first order kinetics and for the latter part with pseudo second order kinetics. FTIR data was used identify a mechanism for the fluoride adsorption. The adsorption of fluoride ions can be explained using dehydroxylation of hydroxyl groups attached to the iron oxide and silica surfaces with incoming fluoride ions. From the isotherm models, it can be concluded that multilayer adsorption is taking place during the removal of fluoride ions using the synthesized material.

Keywords: *adsorption, fluoride ion removal, FTIR, sand coating, r-Fe_2O_3 nanoparticle*