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SYNTHESIS OF γ–Fe_2O_3 COATED SAND FOR ADSORPTIVE REMOVAL OF FLUORIDE IONS FROM DRINKING WATER

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The presence of fluoride in water has become a major problem across the planet. More than 200 million people worldwide consume drinking water with fluoride concentrations that exceed the WHO guideline of 1.5 mg/L. Excess intake of fluoride can cause health impacts, like dental fluorosis and skeletal fluorosis. Much attention has been paid to removing fluoride ions from drinking water, and adsorption is an effective way of removing fluoride. In this study γ- Fe_2O_3 coated sand was synthesized using river sand and γ- Fe_2O_3 nanoparticles by pouring 40.00 cm^{-3} of 2.0 mol dm^{-3} $FeCl_3$ solution and 1.00cm^{-3} of 10.0 mol dm^{-3} NaOH, over 100 g of cleaned and dried sand and heated at 110 °C for 5 h and then at 400 °C for 4 h. After repeating this procedure, the coated sand was washed with deionized distilled water and dried at 100 °C for 6 h. Formation of γ-Fe_2O_3 on the sand surface was confirmed by Raman Spectroscopic measurements since the characteristic maghemite peaks occurred at 649 cm^{-1} and Fourier Transmission Infrared measurements as Fe-O-O-H vibration peaks at 690 cm^{-1} and 790 cm^{-1}. 41% of fluoride ions from 50 mL of 2.5 mg dm^{-3} NaF solution was removed by 0.2 g of synthesized γ- Fe_2O_3 coated sand at pH 2. The point of zero charge of the iron oxide coated sand was 8.80, and below this value, the surface contained positively charged active sites. γ-Fe_2O_3- fluoride interaction was strong, and fluoride is well chemisorbed to the γ-Fe_2O_3 coated sand surface, and Raman shift at 465 cm^{-1} confirms the formation of Fe-F bonds. The adsorption data for the removal of fluoride ions fitted with Langmuir isotherm for all concentrations. The reaction kinetics showed that the mechanism of removal fitted with second-order kinetics. γ-Fe_2O_3 coated sand can be used as an efficient and low-cost filter material to remove fluoride ions in drinking water.

Keywords: γ- Fe_2O_3 nanoparticles, Adsorbent, Adsorption, Fluoride, Coated sand