635/E2

Removal of fluoride by magnetic γ-Fe_2O_3 nanoparticles

I P L Jayarathna[1,2*], A Bandara[2] and R Weerasooriya[3]
[1]*CM Labs, Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Sri Lanka.*
[3] *Faculty of Science and Technology, Uwa Wellassa University, Badulla, Sri Lanka.*

Magnetic γ-Fe_2O_3 nanoparticles were synthesized by modified co-precipitation method and XRD patterns well matched with γ-Fe_2O_3 structure. SEM images and particles size measurement confirmed that the synthesized γ-Fe_2O_3 is in 50 – 200 nm range. These γ-Fe_2O_3 particles were employed as absorbent to remove fluoride in water. The fluoride adsorption was found to be strongly pH dependent and the adsorption capacity varied with a pH of the medium. Optimum Fluoride adsorption was measured at pH 4 and no dependence on the background electrolyte was observed indicating that the fluoride adsorption occurs in inner-sphere mechanism. The fluoride adsorption decreased when the pH of the medium was above the zero point charge of γ-Fe_2O_3 (pH_{zpc}=8.13) indicating the transformation of the positively charged surface to a negatively charge surface and higher OH^- concentration. Fluoride uptake rate was very fast in the first 15 minutes and almost 90% adsorption was observed and thereafter, the adsorption rate decreased slowly due to desorption of weakly bonded Fluoride and competition between F^- and OH^- ions in medium. Adsorption isotherm data at pH 4 followed Langmuir model suggesting the multilayer formation after the γ-Fe_2O_3 particles were covered by monolayer and this further reveals a direct chemical bond formation.

Complement experiments of the Diffuse reflectance FT-IR spectroscopy (DRIFT) studies showed evidence for inner-sphere bonding mechanism between fluoride and γ-Fe_2O_3 particles; negative adsorption peaks observed at around 1630 cm^{-1} and 3400 cm^{-1} indicated the formation of direct Fe-F bond by the removal of surface OH groups.

*lakmalipj@yahoo.co.uk Tel: 081 - 2232002