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Equilibrium, kinetic and thermodynamic studies for the removal of Zn(II) and Ni(II) ions using magnetically recoverable graphene/Fe_3O_4 composite

A. Muthukrishnaraj[a], J. Manokaran[a], M. Vanitha[a], K.V. Thiruvengadaravi[b], P. Baskaralingam[b], N. Balasubramanian[a,*]

[a]*Department of Chemical Engineering, A.C Tech Campus, Anna University, Chennai 600025, India, Tel. +91 9787063528; email: muthukrishnaraj@gmail.com (A. Muthukrishnaraj), Tel. +91 9629215606; email: manokaranj86@gmail.com (J. Manokaran), Tel. +91 9677624598; email: vanithachel@gmail.com (M. Vanitha), Tel. +91 9444954151; email: nbsbala@annauniv.edu (N. Balasubramanian)*

[b]*Department of Applied Science and Technology, A.C Tech Campus, Anna University, Chennai 600025, India, Tel. +91 9003169766; email: thiruvengat.ravi@gmail.com (K.V. Thiruvengadaravi), Tel. +91 9884420351; email: baskaralingam@gmail.com (P. Baskaralingam)*

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ABSTRACT

Magnetically recoverable graphene/Fe_3O_4 composite (GFC) was synthesized using a one-step solvothermal method by the simultaneous reduction of graphene oxide (GO) to graphene and $FeCl_3{\cdot}6H_2O$ to Fe_3O_4, in the presence of ethylene glycol and sodium acetate. The synthesized GFC adsorbent was characterized using FTIR, Raman, X-ray powder diffraction analysis, scanning electron microscopy, energy dispersive analysis of X-ray, thermo gravimetric analysis and vibrating sample magnetometer. The adsorption of Zn(II) and Ni(II) ions onto GFC has been investigated using batch adsorption studies. The adsorption experiments were carried out to examine the influence of parameters such as pH, GFC dosage, initial metal ion concentration, temperature and contact time. The adsorption isotherm data were fitted in the order of Langmuir > Redlich–Peterson > Temkin > Freundlich, based on the correlation coefficient values. From the Langmuir isotherm model, the maximum adsorption capacity of the GFC adsorbent towards Zn(II) and Ni(II) ions was found to be 121.5 and 111.4 mg g^{-1}, respectively. The adsorption kinetics follows the pseudo-second-order model, and the ΔG° and ΔH° values suggest that the adsorption of Zn(II) and Ni(II) ions onto GFC was spontaneous and endothermic.

Keywords: GFC; Zn(II) adsorption; Ni(II) adsorption; Easily recoverable; Competitive adsorption

*Corresponding author.