nanoparticles and uses them to remove lead and cadmium ions from aqueous solutions

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Abstract

This study deals with the preparation of a magnetic ferrite $CrFe_2O_4$ by the sol–gel auto-combustion method, using the lemon juice extract as a fuel for the reaction and preventing the precipitation of the components. The prepared nanocomposite was diagnized using various techniques such as FT-IR, XRD, FE-SEM, EDX, Zeta Potential and (BET). X-ray diffraction patterns verified the state of phase purity and the particle size of 33.9 nm. Additionally the study examined the synthesized compound as an adsorbent surface for lead and cadmium ions from their aqueous solutions. The mathematical formulae of the Langmuir and Freundlich isotherms were applied to the actual adsorption data utilising the findings from the temperature effect studies. As a result, the Freundlich equation yielded a more correlated linear link than the Langmuir isotherm. The thermodynamic results showed that the lead and cadmium ions adsorption were endothermic according to the positive (ΔH) values, whereas the lead and cadmium ion adsorption process were spontaneous with negative (ΔG) values. Positive values of (ΔS) indicate an increase in the randomness of the adsorption process. The current study also comprises the practical application of eliminating lead and cadmium ions from marine waters collected from two sites: Al-Faw Al-Kabir Port (Eastern Breaker) and Khor Al-Zubair (berth 13), by means of the prepared surface. The results indicate the removal percentage of the prepared surface for lead was (91.72%) for the first location and (86.00%) for the second location, whereas the removal percentage of cadmium was (85.52%) for the first site and (89.10%) for the second site.

Keywords: adsorption, ferrite nanoparticles, Pb(II) and Cd(II) ions, thermodynamics
Classification numbers: 2.03, 5.02

1. Introduction

As a result of significant growth in industrialization and urbanization throughout the last century, enormous quantities of heavy metal ions have been released into the environment by diverse human activities such as electroplating, manufacturing of chemicals, mining, fertilizer application, and they exceed the permissible limits. They are also characterized by their stability and non-dissolution, such as Pb(II), Cd(II), Cu(II), Cr(VI), and Hg(II), and this causes them to build up in plants, microorganisms, and aquatic organisms, which are subsequently transmitted to humen through the food chain and result in a variety of health issues [5–7]. For instance, Pb, Cd, and Cr contamination in soils results in a