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Synthesis and characterization of clay/iron oxide nanocomposite and uses them to remove copper ions from aqueous solutions

Nadia Khalaf Mohsen[1], **Muayad H M Albehadili**[2], **Ahmed Yousif Hammood**[1] **and Ahmed A Majed**[3,4,*]

[1] Department of Marine Environmental Chemistry, Marine Science Center, University of Basrah, Basrah, Iraq
[2] Department of Applied Marine Science, College of Marine Science, University of Basrah, Basrah, Iraq
[3] College of Education for Pure Science, University of Basrah, Basrah, Iraq
[4] Scientific Research Center, Al-Ayen University, Thi-Qar, Iraq

E-mail: eduppg.ahmed.majed@uobasrah.edu.iq

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Abstract

The co-precipitation method of creating clay/iron oxide nanocomposite is the subject of this study. A variety of analytical methods, such as x-ray diffraction (XRD), FT-IR, FE-SEM, energy-dispersive x-ray, Brunauer–Emmett–Teller and zeta potential analysis, were used to characterize the produced nanocomposite. The phase purity and particle size of about 17.57 nm were both validated by the XRD results. Additionally, the composite's ability to absorb copper ions from aqueous solutions was assessed. The optimal contact time to reach equilibrium is 45 min, where the adsorption percentage reached 68.26%. The Langmuir and Freundlich isotherm models were used to investigate adsorption behavior based on experimental data collected at different temperatures. When it came to linear correlation, the Langmuir model outperformed the Freundlich model. Thermodynamic parameters showed that the copper ion adsorption process was spontaneous based on the negative (ΔG) values and endothermic based on the positive ΔH values. Increased disorder at the solid-liquid interface during adsorption was indicated by the positive (ΔS) values. Using a prepared adsorbent surface, copper ions were extracted from water samples taken from three distinct locations in the practical application: the first was from Al-Faw (Ras Al-Bisha); the second was from Shatt Al-Basrah, which is close to the main sewage outlet of the Hamdan station under the Basra Governorate Sewerage Directorate; and the third was from Shatt Al-Basra, which is close to the mangrove nursery. According to the findings, the prepared surface removed 96.66% of the copper ion at the first position, 81.66% at the second, and 82.00% at the third.

Keywords: adsorption, clay/iron oxide, Cu(II)ions, thermodynamics

* Author to whom any correspondence should be addressed.