Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2020.25356

184 (2020) 199–213
April

Lignin/alginate/hydroxyapatite composite beads for the efficient removal of copper and nickel ions from aqueous solutions

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Received 27 May 2019; Accepted 14 December 2019

ABSTRACT

This study was conducted to analyze the adsorption efficiency of lignin/alginate/hydroxyapatite composite beads for the removal of copper Cu(II) and nickel Ni(II) ions from an aqueous solution. For this purpose, lignin, alginate and hydroxyapatite (HAp) composite was prepared in the form of lignin/alginate/hydroxyapatite composite beads. Adsorbents were synthesized in three different ratios by mixing lignin/alginate/hydroxyapatite and sodium alginate in distilled water (25–30 ml) which was then added dropwise to the calcium chloride ($CaCl_2$) solution to form its lignin/alginate/hydroxyapatite composite beads. Synthesized beads were characterized using X-ray powder diffraction, Fourier transform infrared spectroscopy, scanning electron microscopy, and thermogravimetric analysis. The effect of various experimental parameters such as contact time, pH, the initial concentration of Cu(II) and Ni(II) and adsorbent dose on adsorption capacity was investigated. Kinetic and isotherm data confirmed that the pseudo-first-order model and Langmuir isotherm were best fitted to experimental data. An increase in the adsorption capacity of heavy metals from an aqueous solution was observed with the increase in lignin percentage in beads. The maximum adsorption capacity for Cu(II) and Ni(II) was 79.67 and 71.18 mg/g, respectively for C3 (60%) lignin. Reusability study of lignin/alginate/hydroxyapatite beads showed 79% removal efficacy after four successive adsorption-desorption cycles. The results showed that lignin/alginate/hydroxyapatite composite beads can be used as promising environmentally benign adsorbent for the removal of heavy metal ions from an aqueous solution.

Keywords: Lignin; Hydroxyapatite; Composite beads; Heavy metals; Wastewater treatment

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