New magnetic chitosan/alginate/Fe_3O_4@SiO_2 hydrogel composites applied for removal of Pb(II) ions from aqueous systems

Débora P. Facchi, André L. Cazetta, Edmilson A. Canesin, Vitor C. Almeida, Elton G. Bonafé, Matt J. Kipper, Alessandro F. Martins

PII: S1385-8947(17)32265-9
DOI: https://doi.org/10.1016/j.cej.2017.12.142
Reference: CEJ 18303

To appear in: *Chemical Engineering Journal*

Received Date: 26 October 2017
Revised Date: 28 December 2017
Accepted Date: 28 December 2017

Please cite this article as: D.P. Facchi, A.L. Cazetta, E.A. Canesin, V.C. Almeida, E.G. Bonafé, M.J. Kipper, A.F. Martins, New magnetic chitosan/alginate/Fe_3O_4@SiO_2 hydrogel composites applied for removal of Pb(II) ions from aqueous systems, *Chemical Engineering Journal* (2017), doi: https://doi.org/10.1016/j.cej.2017.12.142

New magnetic chitosan/alginate/Fe_3O_4@SiO_2 hydrogel composites applied for removal of Pb(II) ions from aqueous systems

Débora P. Facchi[a], André L. Cazetta[c], Edmilson A. Canesin[a], Vitor C. Almeida[c], Elton G. Bonafé[a], Matt J. Kipper[d], Alessandro F. Martins[a,b,d*]

[a]*Postgraduate Program in Environmental Engineering (PPGEA), Federal University of Technology - Paraná (UTFPR-AP), CEP 86812-460 Apucarana-PR, Brazil*
[b]*Postgraduate Program in Materials Science & Engineering (PPGCEM), Federal University of Technology - Paraná (UTFPR-LD), CEP 86036-370 Londrina-PR, Brazil*
[c]*Laboratory of Environmental and Agrochemistry, Department of Chemistry, Estadual University of Maringá (UEM), Av. Colombo 5790, CEP 87020-900 Maringá-PR, Brazil.*
[d]*School of Biomedical Engineering, Department of Mechanical Engineering, and Department of Chemical and Biological Engineering, Colorado State University, 1370 Campus Delivery, Fort Collins, Colorado, United States.*

Abstract

Chitosan/alginate (CHT/ALG) and magnetic CHT/ALG/Fe_3O_4@SiO_2 composites were successfully prepared and used as adsorbent materials to remove Pb(II) from aqueous systems. New hydrogel beads were yielded through an unpublished methodology, examining the ionic strength of the chitosan (CHT) solutions. Polyvalent cations and toxic cross-linking agents such as glutaraldehyde and epichlorohydrin, frequently used to prepare CHT/ALG-based materials were not used in this study. The samples were characterized by scanning electron microscopy, energy dispersive X-ray spectroscopy, transmission electron microscopy, thermal analysis (TAG/DSC), and zeta potential measurements. The addition of Fe_3O_4@SiO_2 (7.9±3.4 nm) significantly modified the surface morphology of the composites. The CHT/ALG/Fe_3O_4@SiO_2(8) hydrogel comprising the highest Fe_3O_4@SiO_2 content (8.0 wt.%), displayed magnetic feature and zeta potential of -76.8 mV at pH 6.0. Kinetic and equilibrium adsorption studies reveal that Elovich and Redlich-Peterson mathematical models provide the best fits for the experimental data, respectively. The magnetic composite CHT/ALG/Fe_3O_4@SiO_2(8) had maximum adsorption capacity (q_m) of 234.77 mg g^{-1} and adsorption/desorption cycles designed its reuse performance. The CHT/ALG/Fe_3O_4@SiO_2(8) hydrogel was applied to treat battery effluent, achieving 99.04% Pb(II) removal, and