

Core-Shell Adsorbent Granules Fabricated from Sand/Graphene Oxide Nano-Composite for Adsorptive Removal of Pb (II)

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Abstract

Core-shell adsorbent granules are produced by coating commercial sand gravels with graphite oxide (few-layer oxidized graphene sheets). Graphite oxide (GO) is synthesized chemically from vein graphite, a rare form of high purity natural graphite. Repeated coatings of graphite oxide on sand followed by low temperature (120^o C) thermal pyrolysis produce core-shell granules with a hierarchical structure in which sand gravels are covered by graphite oxide layers. The intention of this study is to assessment of feasibility of the mitigation of Pb (II) from the water by sand/graphene oxide nano-composite and study the dynamic behavior of the adsorption mechanism using the mathematical modeling. Individual materials and the resulting nanocomposite are characterized using a range of spectroscopic (FTIR, XRD, XPS) and microscopic (SEM/EDXA) techniques to elucidate the process of transforming individual materials into nanocomposite and to assess its suitability for removing Pb (II) from water. Stable sand/graphite oxide nanocomposites were obtained upon five times coating of GO on the sand surface and characterization shows that functionalized and a porous coating developed on the sand. The Pb (II) removal efficiency increases from high-acidic to neutral pH and decreases after basic (pH-8). The adsorption process takes 150 minutes to reach the equilibrium. After 150 minutes, the Pb (II) ion adsorption rate was constant. The maximum dosage of the nanocomposite needed to reach the equilibrium was 0.06g. Under the optimum conditions, 96.3% of Pb (II) removal efficiency was recorded from simulated Pb (II) containing water. According to the mathematical modeling, adsorption follows the Langmuir isotherm and fits well with the pseudo 2nd order kinetics model, indicating a homogeneous adsorption process via a monolayer process and Pb adsorbed onto the surface of the sand/GO nanocomposite by chemisorption. Sand/GO nanocomposite is an excellent candidate for removing Pb (II) from contaminated water.

Keywords: Adsorption, Graphene oxide, Sand, Water treatment