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PII: S2213-3437(17)30272-5
DOI: http://dx.doi.org/doi:10.1016/j.jece.2017.06.022
Reference: JECE 1684

To appear in:

Received date: 24-4-2017
Revised date: 11-6-2017
Accepted date: 13-6-2017

Please cite this article as: Enshirah Da'na, Awatif Awad, Regeneration of spent activated carbon obtained from home filtration system and applying it for heavy metals adsorption, Journal of Environmental Chemical Engineeringhttp://dx.doi.org/10.1016/j.jece.2017.06.022

Regeneration of spent activated carbon obtained from home filtration system and applying it for heavy metals adsorption

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Highlights

- Spent activated carbon from home filters is environmental problem.
- Chemical regeneration of spent activated carbon is promising.
- Regenerated activated carbon did not lose its adsorption ability.
- Copper adsorption is exothermic and follow pseudo second order model.
- After ten successive adsorption desorption cycles only 13.3% capacity lost.

Abstract

Recently, important progress has been achieved in adsorption of heavy metals from wastewater. However, recycling of the spent adsorbents did not get much attention. Thus, the main goal of this contribution is to address the feasibility of recovering spent activated carbon collected from exhausted home filtration systems. Spent activated carbon was regenerated by acidic-basic treatment. The regenerated activated carbon was tested for adsorption of copper under different conditions including: Temperature, initial concentration, mass of adsorbent, solution pH, and time. Results indicated that Cu^{2+} uptake dramatically increased by increasing initial concentration, pH (up to 5.5), and decreasing temperature from 333 K to 293 K. Thermodynamic analysis indicated a spontaneous ($\Delta G° < 0$) and exothermic ($\Delta H° < 0$) process. Both Freundlich and Langmuir isotherms fitted Cu^{2+} adsorption on regenerated activated carbon indicating that both physical and chemical adsorption contribute in the separation process. Kinetic analysis revealed that pseudo first-order model is better in fitting results than pseudo second-order model with R^2 value of 0.982 compared to 0.974 for the pseudo second-order model. Furthermore, intraparticle model showed