Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.20891

80 (2017) 247–254
June

Thermodynamic, kinetic and isotherm studies of sulfate removal from aqueous solutions by graphene and graphite nanoparticles

Ali Naghizadeh[a,b,c,*], Fatemeh Ghasemi[a], Elham Derakhshani[a], Habibeh Shahabi[a]

[a]*Medical Toxicology and Drug Abuse Research Center (MTDRC), Birjand University of Medical Sciences (BUMS), Birjand, Iran, Tel. +9856132381665; Fax: +9856132381132; emails: aliinaghizadeh@gmail.com (A. Naghizadeh), fatemehghasemi69@yahoo.com (F. Ghasemi), el.derakhshani@yahoo.com (E. Derakhshani), habibeh.shahabi@yahoo.com (H. Shahabi)*
[b]*Department of Environmental Health Engineering, Faculty of Health, Birjand University of Medical Sciences (BUMS), Birjand, Iran*
[c]*Social Determinants of Health Research Center, Birjand University of Medical Sciences (BUMS), Birjand, Iran*

Received 15 August 2016; Accepted 2 May 2017

ABSTRACT

Sulfur compounds exist in the wastewater of industries like paper-making, food processing, photography, etc. Higher levels of sulfate in drinking water lead to its bitter taste and digestive problems as well as corrosion of sewer pipes in addition to causing problems in the anaerobic wastewater treatment processes. Based on this, the present study investigates the equilibrium, kinetics, thermodynamics and isotherms of sulfate removal process by graphene and graphite nanoparticles. This study explored the effects of the parameters including pH, adsorbent dosage, and initial concentration of sulfate, as well as the impacts of contact time and temperature on sulfate removal process in a batch system. The isotherms, thermodynamics and kinetics of the process were also studied. In this study, UV/VIS Spectrometer T80 was used to measure the sulfate concentration. The results obtained from the investigation of the efficiency of graphite and graphene nanoparticles demonstrated that these nanoparticles had the highest adsorption capacity at the acidic pH = 3, adsorbent dose of 0.2 g L^{-1} and sulfate concentration of 75 mg L^{-1}. The process of adsorption in graphene and graphite nanoparticles was found to follow the Freundlich isotherm model and pseudo-second-order kinetic model. The results also revealed that sulfate adsorption process with the studied nanoparticles was endothermic. Compared with graphene nanoparticles, the results indicate that graphite nanoparticles have more efficiency in removal of sulfate from aqueous solution. Moreover, the highest removal efficiency by graphene and graphite nanoparticles occurs in higher concentrations of sulfate. Therefore, the two nanoadsorbents can be used in adsorbing sulfate from the aqueous solutions.

Keywords: Sulfate; Graphene nanoparticles; Graphite nanoparticles; Thermodynamic; Isotherm

* Corresponding author.