Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.21560

95 (2017) 234–246
November

Adsorption of Ni^{2+}, Hg^{2+}, Pb^{2+}, Cr^{3+}, and Co^{2+} on iron oxide nanoparticles immobilized on cellulose fiber: equilibrium, kinetic, thermodynamic, mechanisms, and statistical supposition

Attarad Ali[a], Sania Naz[a], Abdul Mannan[b], Muhammad Fahad Shams[c], Ijaz Hussain[d], Muhammad Zia[a,*]

[a]*Department of Biotechnology, Quaid-i-Azam University, Islamabad 45320, Pakistan, Tel. +92-51-9064-4126; emails: ziachaudhary@gmail.com (M. Zia), attarad.ali@kiu.edu.pk (A. Ali), sanianaz0@gmail.com (S. Naz)*
[b]*Department of Pharmaceutical Sciences, COMSATS Institute of Information Technology, Abbottabad, Pakistan, email: abdulmannan_ka@yahoo.com*
[c]*Preston Institute of Nanosciences and Technology, Islamabad, Pakistan, email: fahad.shams4928956@gmail.com*
[d]*Department of Statistics, Quaid-i-Azam University, Islamabad 45320, Pakistan, email: ijaz@qau.edu.pk*

Received 4 April 2017; Accepted 16 October 2017

ABSTRACT

Metallic nanoparticles (NPs) are of immense significance due to supra properties especially for contaminant remediation from water. However, NPs release in ecosystem is also threatening. To overcome this prospect, iron oxide (Fe_2O_3) NPs were composited with cellulose fibers (FeCt) by simple co-precipitation method, and used for removal of mercury, chromium, cobalt, lead, and nickel ions from synthetic wastewater. The batch experiments determined that adsorption kinetics follow Langmuir isotherm model and best fit in pseudo-second-order reaction. FeCt composite material exhibited enhanced metal adsorption capacity as compared with cellulose polymer. The competitive capacity of all five heavy metals onto the adsorbents followed the adsorption order as $Ni^{2+} > Hg^{2+} > Pb^{2+} > Cr^{3+} > Co^{2+}$ that is also related to the nature and strength of electrostatic interaction among metal ions. The statistical inference (Hotelling's t^2 statistics and t test) supports adsorption kinetics. The synthesized NPs composite material can be efficiently used for treatment of wastewater in domestic and industrial water filtration plants.

Keywords: Cellulose; Iron oxide nanoparticles; Wastewater; Adsorption; Heavy metal

* Corresponding author.