*Desalination and Water Treatment*
www.deswater.com
21 (2010) 286–294
September
1944-3994 / 1944-3986 
doi: 10.5004/dwt.2010.1580

# Removal of $Ni^{2+}$ from aqueous solution by blast furnace sludge as an adsorbent

Ankica Radjenovic*, Jadranka Malina, Anita Strkalj

[a]*University of Zagreb, Faculty of Metallurgy, Aleja narodnih heroja 3, 44 000 Sisak, Croatia*
*Fax +385 4 4533378 e-mail: radenova@simet.hr*

Received 15 October 2009; Accepted 23 February 2010

**ABSTRACT**

The blast furnace sludge (BFS), by-product and waste material of steelmaking industry was utilized as an adsorbent for $Ni^{2+}$ ions removal from aqueous solution. Chemical and mineralogical composition of BFS was examined by proton induced X-ray emission (PIXE) and X-ray diffraction (XRD) methods. The structural properties of BFS were characterized using Brunauer-Emmett-Teller (BET) and scanning electron microscopy (SEM) methods. Batch experiments were conducted to evaluate the adsorption performance. The equilibrium adsorption level was determined to be a function of the solution concentration and temperature. Two simple kinetic models, pseudo-first and second-order, were used to investigate the adsorption mechanisms. The pseudo-second-order reaction kinetics provides the best correlation with the experimental data. The equilibrium data were analyzed using the Langmuir and Freundlich isotherms. The characteristic parameters for each isotherm were found. The results obtained from Freundlich's isotherm are slightly better than those obtained from Langmuir's isotherm. The thermodynamic parameters have been determined. The negative values of free energy change ($G$) indicated the spontaneous nature of the adsorption of $Ni^{2+}$ on blast furnace sludge and the positive values of enthalpy change ($H$) suggested the endothermic nature of the adsorption process. The observed adsorption capacity for $Ni^{2+}$ ions is a good indicator of BFS potential for its use in aqueous sorption system.

*Keywords*: Blast furnace sludge; $Ni^{2+}$; Adsorption; Langmuir and Freundlich isotherms

* Corresponding author.