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Adsorption of ciprofloxacin from aqueous solution onto synthesized NiO: isotherm, kinetic and thermodynamic studies

Davoud Balarak[a], Amir Hossein Mahvi[b], Moo Joon Shim[c], Seung-Mok Lee[c,*]

[a]*Department of Environmental Health, Health Promotion Research Center, School of Public Health, Zahedan University of Medical Sciences, Zahedan, Iran, email: dbalarak2@gmail.com*
[b]*Center for Solid Waste Research, Institute for Environmental Research, Tehran University of Medical Sciences, Tehran, Iran, email: ahmahvi@yahoo.com*
[c]*Department of Environmental Engineering, Catholic Kwandong University, Gangneung 25601, Republic of Korea, Tel. +82-10-8891-7635; emails: leesm@cku.ac.kr (S.M. Lee), moojoonshim@gmail.com (M.J. Shim)*

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ABSTRACT

In the present study, the adsorption behavior of ciprofloxacin (CIP) from aqueous solution, using NiO nanoparticles (synthesized by the sol–gel method) was studied at batch experiments. A number of parameters (e.g., temperature, adsorbent dosage, contact time, pH, and initial CIP concentrations) were studied. The best efficiency for the removal of CIP was obtained by 99.2%. The optimal parameters used here were the temperature of 50°C, synthesized NiO dosage of 1 g/L, concentration 10 mg/L at contact time 90 min, and pH = 3. In order to study the kinetics of adsorbent, the pseudo-first-order, pseudo-second-order, and intraparticle diffusion models were applied. According to the pre-determined correlation coefficients (R^2), the pseudo-second-order kinetic model showed a better correlation between the kinetic behaviors of the adsorbent. Thermodynamic experiments showed that the CIP adsorption was endothermic. The negative values of ΔG° indicate the spontaneous nature of the adsorption. The increased randomness was attributed to the adsorption process based on the positive entropy change. The equilibrium data were tested with Langmuir, Freundlich, Redlich–Peterson, Dubinin–Radushkevich, and Temkin isotherm at four different temperatures and it was observed that the Langmuir isotherm was best fitted in the adsorption of CIP.

Keywords: Ciprofloxacin; NiO nanoparticle; Adsorption; Isotherm; Kinetic; Thermodynamic

* Corresponding author.