Removal of Acid Red 299 dye on gold nanoparticles loaded on activated carbon: kinetic and thermodynamic investigation of the removal process

Mehrorang Ghaedi a,*, Zahra Andikaey a, Ali Daneshfar b, Taybeh Akbari b, Reza Sahraei b

aChemistry Department, Yasouj University, Yasouj 75918-74831, Iran
Tel./Fax: (0098) 741 2223048; email: m_ghaedi@mail.yu.ac.ir
bDepartment of Chemistry, Ilam University, Ilam, Iran
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ABSTRACT

In this research, the gold (Au) nanoparticles loaded on activated carbon (Au-NP-AC) have been applied for the removal of Acid Red 299 (AR-299). The influence of variables, including the pH, AR-299 concentration, amount of Au-NP-AC, contact time, and temperature in a batch method, on the AR-299 removal has been investigated. Following the optimization variables, by fitting the experimental equilibrium data to Langmuir, Freundlich, and Tempkin, the respective information for each model and their applicability to understand the concept of adsorption was examined. According to $R^2$ and error analysis, it was found that the adsorption process follows the Langmuir model. It was found that among various kinetic models, such as first- and second-order, Elovich, and intraparticle diffusion model, the experimental data at various removal times was interpreted using the second-order kinetic model with the involvement of the intraparticle diffusion model. The negative value of Gibbs free energy and the positive value of the adsorption enthalpy show the spontaneous and endothermic nature of the adsorption process.

Keywords: Adsorption; Acid Red 299 (AR-299); Gold nanoparticle loaded on activated carbon (Au-NP-AC); Kinetic and thermodynamics of adsorption