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Mechanism, kinetics and thermodynamic of Penicillin G antibiotic removal by silica nanoparticles from simulated hospital wastewater

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ABSTRACT

Today, the unusual use of antibiotics and the entry of these compounds into the environment have caused global concern. The antibiotics even in low concentrations in the range of ng/L and μg/L can cause effects in humans and animals due to their low degradability, high solubility and cumulative properties in water. This study was performed to removal of Penicillin G by silica nanoparticles in a batch system. The effects of different parameters including pH (3–11) adsorbent dosage (0.2–2 g/L), contact time (2–120 min), initial concentration (10–100 mg/L) and temperature (283–318 K) on the adsorption of Penicillin G by silica nanoparticles were investigated. The results of this study showed that the maximum adsorption of Penicillin G by silica nanoparticles has occurred in pH = 7. By increasing the adsorbent dose, adsorption capacity has decreased. Also, with increasing Penicillin G concentration, the adsorption capacity was increased. The maximum adsorption capacity of silica nanoparticles was 211.35 mg/g (optimum conditions of pH = 7, adsorbent dose of 0.2 g/L, contact time of 60 min, Penicillin G concentration of 100 mg/L and temperature of 218 K). The results showed that the adsorption of Penicillin G by silica nanoparticles was more consistent with Langmuir model (R^2 = 0.81). Also, the results of kinetic study showed that the adsorption process followed the pseudo-second-order kinetic. The result of temperature and thermodynamics parameter showed that the values of $\Delta S°$, $\Delta H°$ and $\Delta G°$ were positive, negative and negative respectively.

Keywords: Penicillin G; Silica; Isotherm; Kinetic; Thermodynamic

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