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# HIGHLY EFFICIENT REMOVAL OF CADMIUM FROM AQUEOUS SOLUTION USING POLYMER-STABILIZED ZERO-VALENT IRON NANOPARTICLES: EQUILIBRIUM, KINETIC AND THERMODYNAMIC STUDIES

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## Abstract

Bare zero-valent iron nanoparticles (bare-ZVIN) have a great tendency to aggregate, which drops their reactivity with pollutants. To address this issue, polyvinylpyrrolidone stabilized-ZVIN (PVP-ZVIN) was synthesized and used for the removal of $Cd^{2+}$ from aqueous solution in a batch system. The effects of operation conditions such as the pH of aqueous solution (2-8), reaction time (0-120), adsorbent concentration (1-6 g $L^{-1}$) and the initial $Cd^{2+}$ concentration (10-60 mg $L^{-1}$) on the removal efficiency of $Cd^{2+}$ were studied. Furthermore, adsorption isotherm, kinetic and thermodynamic studies of $Cd^{2+}$ removal were performed. Results of studies revealed that PVP could apparently enhance the colloidal stability of ZVIN and the removal efficiency of $Cd^{2+}$. In addition, increasing ZVINs concentration from 1 to 6 g $L^{-1}$ enhanced $Cd^{2+}$ removal efficiency while a sharp decrease was observed in $Cd^{2+}$ removal efficiency by increasing the initial concentration of $Cd^{2+}$ from 10 to 60 mg $L^{-1}$. The experimental results showed that maximum $Cd^{2+}$ adsorption was obtained at pH 6 and 20 min contact time. Moreover, the experimental adsorption of isotherm and kinetic data were completely followed the Freundlich isotherm model and Pseudo first-order kinetic model with maximum coefficients of determination ($R^2$) of >0.98 and >0.99, respectively. Also, the obtained results of thermodynamic studies implied the influence of endothermic and spontaneous nature of $Cd^{2+}$ adsorption onto ZVINs surfaces, at temperature range of 293-303 K. The findings of this study demonstrated that ZVINs could be applied as applicable adsorbents to remove $Cd^{2+}$ from aqueous solutions.

*Key words:* cadmium, polyvinylpyrrolidone, sedimentation, sorption isotherm, zero-valent iron

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