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Removal of lead (II) from aqueous solution by batch adsorption on various inexpensive adsorbents using experimental design

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ABSTRACT

This study focuses on adsorption of lead (II) using various inexpensive adsorbents, such as dried activated sludge, diatomite, and sepiolite, through the batch process. The data were evaluated using three types of isotherm models to determine the design parameters. Additionally, the adsorption kinetics was analyzed using first- and second-order kinetics. The regression coefficient (R^2) quantitatively evaluates the correlation between the experimental data and the predicted responses. The Box–Behnken design of three factors at three levels was used to determine the important parameters affecting the adsorption of lead (II) by different adsorbents and the results showed that pH, initial concentration, and type of adsorbent in these experiments are the important factors. The Freundlich isotherm model fits for all adsorbents, as indicated by the R^2 values of 0.992, 0.997, and 0.997 for Pb^{2+} adsorption onto dried activated sludge, diatomite, and sepiolite at pH 3, respectively. The adsorption capacity was found as 19.85, 25.24, and 33.37 (mg g^{-1}) for dried activated carbon, diatomite, and sepiolite, respectively. The pseudo-second-order model fits the experimental data very well. For kinetic studies, the R^2 values for Pb^{2+} are 0.989, 0.992, and 0.997 for dried activated sludge, diatomite, and sepiolite, respectively. The obtained R^2 values suggest good adjustments to the experimental results since these values indicate that 99.72% of the variability in the response could be explained by the models.

Keywords: Experimental design; Inexpensive adsorbents; Isotherms; Adsorption kinetics

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