Optimization of phosphate removal from drinking water with activated carbon using response surface methodology (RSM)

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Received 30 April 2015; Accepted 6 July 2015

ABSTRACT

The presence of phosphate in water has become a worldwide problem because of improving eutrophication and decreasing the quality of water. In this work, phosphate (PO$_4^{3-}$) removal from water using activated carbon was studied and main process parameters such as initial phosphate concentration ($C_0$), adsorbent dosage, and pH of solution have been optimized to obtain maximum removal. Central composite design in response surface methodology (RSM) package has been used to perform the experimental design according to RSM analysis, the phosphate removal model proved to be highly significant with very low probability value (<0.0001). Based on the developed predictive model, the optimum conditions were 0.53 (g/50 mL) adsorbent dosage, pH 4, and $C_0 = 11.62$ (mg/L) for having 95.41% of phosphate removal. This optimum predicted result was investigated by performing the corresponding experiment, and it was observed that the experiment and model result were fitted well. Kinetic data were analyzed using pseudo-first-order, pseudo-second-order, and intraparticle diffusion equations. According to the results, adsorption of phosphate onto activated carbon is an effective approach and economical alternative process in comparison with common applications.

Keywords: Phosphate removal; Response surface; Activated carbon; Optimization

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Presented at the 3rd International Conference on Water, Energy and Environment (ICWEE) 24–26 March 2015, Sharjah, United Arab Emirates

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