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High adsorption performance of pH responsive graphene oxide/polyacrylamide hydrogels for the removal of Drimarene Brilliant Blue

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ABSTRACT

Hydrogels as adsorbent have attracted great scientific attention; however there are few reports regarding the high performing hydrogels in terms of adsorption capacity. In this study, a series of graphene oxide/polyacrylamide (GO/PAM) composite hydrogels were synthesized by free radical polymerization for the removal of dyes from wastewater. In order to investigate water uptake capacity of hydrogels, swelling kinetics and the equilibrium swelling ratios were determined in water and at different pH. The results revealed maximum water uptake at pH 8 and obey Quasi–Fickian diffusion ($n < 0.5$). The effect of different factors, that is, pH and initial dye concentration on the adsorption of dye were studied. The adsorption kinetics and isotherms of synthesized composite hydrogels were also studied for Drimarene Brilliant Blue K-4BL. The best dye removal was obtained at pH 8 and 200 ppm initial dye concentration. Results indicated that data of pseudo-first-order kinetic model is best fitted while the Weber–Morris diffusion model revealed the adsorption mechanism as single step adsorption and intra particulate diffusion as rate determining step. Moreover, modified Freundlich isotherm explains the adsorption of dyes by synthesized hydrogels better than that of Langmuir isotherm model. Excellent adsorption capacity, that is, 1,000 mg g^{-1} for the removal of Drimarene Brilliant Blue K-4BL was observed for GO reinforced polyacrylamide (PAM) hydrogels which is 6 folds higher compared to simple PAM hydrogels. Adsorption–desorption studies exhibited the appreciable reusability potential of the composite material with ~ 40% removal efficiency up to five successive cycles.

Keywords: Hydrogels; Graphene oxide; Polyacrylamide; Nano-composite; Drimarene Brilliant Blue dye; Adsorption–desorption potential

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