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ZINC HYDROXIDE NANOPARTICLES-MODIFIED CLAY FOR ULTRASOUND-ASSISTED REMOVAL OF METHYLENE BLUE

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Abstract

The objective of the present work was to introduce a novel adsorbent with high adsorption potential toward methylene blue by decorating montmorillonite clay (MMT clay) with $Zn(OH)_2$–nanoparticles ($Zn(OH)_2$–NPs). The adsorbent was characterized structurally by FE-SEM and FTIR techniques. Central composite design–response surface methodology was applied to optimize experimental variables including adsorbent dosage, pH, initial MB concentration, NaCl concentration, and sonication time. A modified quadratic model was used to establish a relationship between the removal percent of MB and the experimental variables. F–value of 74.99 and squared correlation coefficient of 0.96 confirmed the significance and reliability of the model. Under the optimum conditions of pH 8.0, sonication time 3.5 min, adsorbent dosage 73 mg, analyte concentration 7.5 mg L^{-1}, and electrolyte concentration (2 % w/v), the removal percentage of 99.3± 0.70 % were attained. Freundlich isotherm was agree well with the adsorption isotherm data. The adsorption kinetic was best described by pseudo second–order kinetic model. Thermodynamic study of the MB uptake on the sorbent shows the spontaneous ($\Delta G = -13.45$ – -34.15 kcal mol^{-1} in the temperature range of 15–45 °C). These results infer that Zn(OH)2–NPs–MMT clay can be applied as a new, low cost adsorbent in adsorbing MB from aqueous solution.

Key words: cationic dye, multilayer adsorption isotherm, response surface plots, ultrasound assisted adsorption, zinc hydroxide

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