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Effective adsorption and removal of industrial dye from aqueous solution using mesoporous zinc oxide nanoparticles via metal organic frame work: equilibrium, kinetics and thermodynamic studies

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ABSTRACT

Pollution industrial dyes is a serious environmental issue and successful purifying has thus far proven to be a difficult task. Therefore, in study, environmentally safe zinc oxide nanoparticles were synthesized through calcination of zeolitic imidazolate framework 7 at various temperatures for calcination 450°C, 550°C and 650°C. The elimination of Congo red (CR) in wastewater samples was tested with good adsorption capability. Adsorption of CR using ZnO from aqueous solution. Scanning electron microscopy, Fourier-transform infrared spectroscopy, X-ray diffraction and the surface area and pore volume of ZnO were discovered during Brunauer–Emmett–Teller testing at 77 K to be 119.12 $m^2 \cdot g^{-1}$ and the total pore volume was 0.362 $cm^3 \cdot g^{-1}$. Adsorption at pH 3 was found the best for CR. Initial concentration and dosage, resulting in microporous surfaces that have a high potential to interact with and absorb CR. Adsorption tests demonstrated that ZnO had a good capability for removing CR (975 $mg \cdot g^{-1}$). However, after numerous reuse cycles, this performance was remained. The findings of the adsorption experiments demonstrated that the Langmuir equation for the adsorption isotherm and the pseudo-second-order model of the adsorption kinetics were compatible. Adsorption's activation energy was also found to be 24.7 $kJ \cdot mol^{-1}$, demonstrating that chemisorption process. The adsorption process was calculated, and it was shown to be both endothermic and spontaneous also determine thermodynamic parameter $\Delta G°$, $\Delta H°$ and $\Delta S°$. The mesoporous ZnO adsorbent proved to be a simple and effective water purification. ZnO material has shown promise in the process of removing CR from aqueous solution.

Keywords: Zinc oxide nanospheres; Adsorption isotherm; Thermodynamic parameters; Adsorption kinetics

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