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Low-cost synthesis of mesoporous Zn(II)−Sn(II) mixed oxide nanoparticles for the adsorption of dye and heavy metal ion from aqueous solution

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ABSTRACT

Mesoporous ZnO–SnO_2 mixed oxide nanoparticles (MMON) derived from precipitation method was investigated as a suitable adsorbent for the removal of malachite green oxalate (MGO) and hexavalent chromium (Cr) from waste water through batch adsorption process. The MMON was characterized by X-ray diffraction, scanning electron microscopy, tunneling electron microscopy, surface area analyzer, and FTIR spectroscopy. The effect of initial concentration, contact time, pH and adsorbent dose on the adsorption of MGO and Cr were studied. The Langmuir and Freundlich isotherm model was found to be more suitable to represent the experimental equilibrium isotherm results. The experimental kinetic data were a better fit with pseudo-second-order equation rather than pseudo-first-order equation. Thermodynamic studies indicated that adsorption process is endothermic in nature. The adsorption capacities of the MMON on MGO and Cr are found to be 189.7 and 5.9 $mg\,g^{-1}$, respectively. Regenerated MMON shows one-third of the original adsorption capacity. The results indicate that the synthesized MMON could be employed as a low-cost adsorbent for the removal of both MGO and Cr from the aqueous solution including industrial wastewater.

Keywords: Adsorption; Precipitation method; Mixed oxides; Regeneration

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