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Removal of Cd(II) and Pb(II) ions from water solution by $CoFe_2O_4/Al_2O_3$ nanocomposite

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Abstract

In this study, the performance of magnetic $CoFe_2O_4/Al_2O_3$ nanocomposite is evaluated towards the removal of Cd(II) and Pb(II) metal ions from the wastewater. The removal efficiency of $CoFe_2O_4/Al_2O_3$ nanocomposite is compared with the bare $CoFe_2O_4$ nanoparticles. The $CoFe_2O_4$ and its composite with Al_2O_3 is synthesized via sol–gel auto-combustion method. The as-prepared samples are characterized by fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), transmission electron microscope (TEM) and vibrating sample magnetometer (VSM) analysis. As compared to bare

nanoparticles, the decrease in particle size, enhanced specific surface area and porosity, higher magnetization, lowering of the band gap, and uniform distribution with spherical shaped structure is observed in $CoFe_2O_4/Al_2O_3$ nanocomposite. To probe the nature of the adsorbent, various experiments are performed by considering the reaction parameters like contact time, adsorbent dose and concentration of Cd(II) and Pb(II) ions. During optimization process, it is observed that for bare $CoFe_2O_4$ nanoparticles, the maximum removal efficiency is found for Cd(II) ions 75% and for Pb(II) ions, it reaches upto 43%. In composite form, the removal efficiency for Cd(II) ions increases upto 88% and for Pb(II) ions, it is 77%. The enhanced removal efficiency is observed for the $CoFe_2O_4/Al_2O_3$ nanocomposite due to smaller particle size and increased surface area as compared to that of $CoFe_2O_4$ nanoparticles. The effect on removal efficiency is also studied with the variation of temperature. The isothermal adsorption results are well fitted to Langmuir model. The high adsorption capacity of $CoFe_2O_4/Al_2O_3$ nanocomposite as compared to $CoFe_2O_4$ makes it promising candidate for removal of heavy metal ions from aqueous solution.

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Ethics declarations

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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