The Removal of Heavy Metal Ions From Synthetic Wastewater Using Functionalized Multi-Walled Carbon Nanotubes Decorated With Cobalt Ferrite Nanoparticles

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Approximately 3.5 million people die annually due to inadequate water resources. More than 90% of pollution-related deaths occurred in low-income and middle-income countries. Although researchers have developed various nanomaterials for wastewater remediation, expensive equipment and chemical treatments will only burden developing countries facing heavy metal water pollution. This research aims to investigate the applicability of functionalized multi-walled carbon nanotubes (MWCNTs) decorated with cobalt ferrite ($CoFe_2O_4$) nanoparticles for the adsorptive removal of Pb^{2+} and Cu^{2+} in synthetic wastewater. $CoFe_2O_4$ nanoparticles could be a promising nanomaterial for lead and copper removal due to the oxygen atoms of iron oxide, which increase the selectivity of the adsorption sites. MWCNTs have shown impressive results in removal efficiency and adsorption capacity due to their mesopores and large surface area. MWCNTs were commercially obtained and coated with synthesized cobalt ferrite nanoparticles to synthesize the $CoFe_2O_4$/MWCNTs nanocomposite. The nanocomposite was evaluated in synthetic wastewater, including water containing lead, copper, both lead and copper, and a mix of lead, copper, and calcium. The experimental trials demonstrated the nanocomposite's ability to adsorb lead and copper within synthetic wastewater containing lead, copper, a mix of lead and copper, and more importantly maintain high levels of lead adsorption in the presence of other non-toxic ions like calcium. The results of this research offer a highly efficient and cost-effective device for removing lead and copper pollutants from wastewater, that has other confounding ions present. If implemented, this nanocomposite would provide an innovative solution for metal-rich wastewater remediation.

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