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GREEN SYNTHESIS, CHARACTERIZATION, AND pH DEPENDENT ADSORPTION OF LEAD(II) BY HYDROXYAPATITE NANOPARTICLES

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Hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] has tremendous potential for remediation of pollution in the environment. Its unique structure and properties, including exceptional adsorption capacity, ion exchange capability, thermal stability, and acid-base adjustability, make it particularly important in environmental management. Green template-mediated hydroxyapatite (HA) synthesis is a novel and environmentally friendly approach, promoting the development of eco-friendly nanotechnology. The primary objective of this research was to provide significant insight into the application of green-synthesised HA nanoparticles (NP), utilizing compounds in banana peel (BP) as surfactants and effective adsorbents for Pb(II) ions, addressing Pb(II) contamination in diverse environmental settings. The average crystal dimensions of pure hydroxyapatite nanoparticles (HA-NPs) along the "a" and "c" axes were 17 nm and 23 nm, respectively. The corresponding values of the hydroxyapatite nanoparticles synthesised using banana peel (HA-BP NPs) were 27 nm and 32 nm, respectively. Further, HA-NPs and HA-BP NPs have aspect ratios of 1.40 and 1.18, suggesting that both nanoparticles are rod-shaped. Scanning electron microscopic images reveal that introducing banana peel powder to HA would be advantageous, resulting in HA-BP NPs being significantly homogenous with uniform morphology with a length of ~ 74 nm compared to less homogeneous HA-NPs with a length of ~ 140 nm. The percentage removal of Pb(II) by HA-BP NPs is determined to be over 98.0% for 10 ppm and 15 ppm Pb(II) solutions at a controlled pH of 3.0. However, the extent of removal sharply decreases to 62.3% at the same pH for 25 ppm Pb(II) solution; but increased to 78.9% at pH 4. The decreased removal percentage at higher concentrations could be attributed to the saturation of adsorption sites. It is concluded that HA-BP NPs are effective adsorbents at low pH, offering a promising solution for addressing Pb(II) contamination.

Keywords: Adsorption, Green synthesis, Hydroxyapatite, Lead, Nanoparticles