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Qualitative analysis of heavy metal adsorption by the green synthesized silver nanoparticles

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Silver nanoparticles (AgNPs) have attracted high research interest because of their important applications in antimicrobial, catalysis, and water treatment plants. They display totally new and enhanced properties compared to larger bulk material particles and these novel properties are due to the difference in specific characteristics such as particle size, distribution, morphology and higher surface area-to-volume ratio. The aim of this research was to determine the Pb(II) and Cu(II) adsorption of synthesized AgNPs using natural polymer, chitosan as both reducing and capping agent. AgNPs were formed in an autoclave at 15 psi and 131 ^{0}C by varying the $AgNO_3$ and chitosan concentrations and autoclaving time. AgNPs solution thus obtained was mixed with Pb(II) and Cu(II) (0.05, 10, 100, 200, 500 ppm) solution separately and kept overnight. The removal of metal ions from the solution was monitored by the shift and intensity variation of the surface plasmon resonance (SPR) band of the AgNPs. The green synthesized silver nanoparticles were characterized using ultra violet visible (UV-Vis) spectroscopy, Fourier transform infrared (FTIR) spectroscopy, scanning electron microscope (SEM) and particle size analyzer. UV-Vis peak at the 430 nm confirmed the formation of chitosan stabilized silver nanoparticles. The dynamic light scattering (DLS) measures confirmed that the average size of synthesized AgNPs was 818.4 nm with the polydispersity index of 0.243 revealing the uniform size and good dispersion of the nanoparticles. The optimum concentrations of $AgNO_3$ and chitosan were recorded as 50 mM and 2% respectively. The maximum yield of nanoparticles was obtained at 60 minutes of autoclaving, which was decided as the optimum time of autoclaving. After addition of metal ions, AgNPs solutions showed a color change and a shift and variation in intensity of the SPR band at lower metal ion concentrations while at higher metal concentrations SPR band disappeared indicating the adsorption of metal ions onto the AgNPs. Hence this has the potential to be developed as a heavy metal removal technique in water.

Keywords: Green synthesis, Chitosan, Silver nanoparticles, Heavy metal removal

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