BINDING MECHANISM OF SILVER(I) IONS TO ALFALFA BIOMASS: BATCH AND X-RAY ABSORPTION SPECTROSCOPY

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Abstract

Biological systems have shown the ability to uptake heavy metal ions naturally from aqueous solutions. This feature makes likely the utilization of death biological biomass to remove hazardous heavy metal ions from contaminated waters. Previous studies have demonstrated that alfalfa biomass uptakes several heavy metal ions from aqueous solutions. To investigate the binding of silver (1) to the alfalfa biomass, pH profile and binding capacity experiments were performed. pH profile studies showed a pH-dependent trend in the binding of the silver ions to the alfalfa biomass, indicating the possible involvement of carboxyl ligands on the biomass. Binding capacity experiments showed that the alfalfa can adsorb 27.4 milligrams of silver per gram of alfalfa biomass. To further characterize the binding of silver(l) ions from solution, comparisons were made with commercially available ion-exchange resins to determine the ionic state and ligand(s) involved in the binding of silver(l) ions to the alfalfa biomass. X-ray absorption near-edge structure (XANES) showed that silver(]) was bound by both the ion-exchange resins and alfalfa biomass and remained as silver(l), with a characteristic edge energy of 25.21 keV. Furthermore, extended X-ray absorption fine structure (EXAFS) of the alfalfa biomass showed that the major ligand involved in the alfalfa binding process was oxygen or nitrogen, with an inter-atomic distance of around 2.3 A.

Key words: alfalfa, XAS, silver, phytoremediation, phytofiltration