ICP-OES AND XAS INVESTIGATION OF THE PHYTOEXTRACTION OF LANTHANIDES AND ACTINIDES FROM AQUEOUS ENVIRONMENTAL SOLUTIONS

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ABSTRACT

Use of nuclear power raises questions about nuclear waste, especially how it can be minimized and stored safely. One alternative is extraction and reprocessing of the uranium from the spent fuel. But the reprocessing of spent fuel is very expensive and requires use of ion exchange resins that cannot be reused. Some biomaterials have been studied for their ability to extract lanthanides and actinides, such as uranyl cation from solution. In this study, the extraction of uranyl nitrate, uranyl acetate, and europium nitrate from aqueous solution using an alfalfa biomaterial was investigated. Major factors affecting the sorption of cations from solution are pH, time, and interfering cations. Studies were performed to investigate each of the above parameters. In addition, capacity studies were performed for comparison purposes with common methods to extract these cations from solutions. To investigate the chemical environment where uranyl and europium cations were bound to the alfalfa biomass, X-ray absorption spectroscopy studies were performed. The X-Ray absorption near-edge structure showed that europium(III) and uranyl cations remained in the same oxidation state when bound to the biomass, with characteristic L_{III}-edge energies for uranyl and europium(III) of 17.172 keV and 6.981 keV, respectively. The extended X-ray absorption fine structure studies showed that the uranyl cations were bound to either an oxygen or nitrogen ligand, with two inter-atomic distances of 1.76 Å and 2.32 Å. The europium(III) cations were also bound to oxygen or nitrogen ligands, with an inter-atomic distance of 2.45Å.

Key words: lanthanides, actinides, alfalfa, XAS, phytoextraction