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REMOVING URANIUM(VI) FROM AQUEOUS SOLUTION AND SOILS WITH LEONARDITE-DERIVED HUMIC ACID AND WITH PHYTOREMEDIATION

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Abstract: The occurrence of uranium (U) and depleted uranium (DU)-contaminated wastes from anthropogenic activities is an important environmental problem. Insoluble humic acid derived from leonardite (L-HA) was investigated as a potential adsorbent for immobilizing U in the environment and phytoremediation for removing DU from soils were tested. The effect of initial pH, contact time, U concentration, and temperature on U(VI) adsorption onto L-HA was assessed. The U(VI) adsorption was pH-dependent and achieved equilibrium in 2 h. It could be well described with pseudo-second-order model, indicating that U(VI) adsorption onto L-HA involved chemisorption. The U(VI) adsorption mass increased with increasing temperature with maximum adsorption capacities of 91, 112 and 120 $mg \bullet g^{-1}$ at 298, 308 and 318 K, respectively. The adsorption reaction was spontaneous and endothermic. We explored the processes of U(VI) desorption from the L-HA-U complex through batch desorption experiments in 1 mM $NaNO_3$ and in artificial seawater. The desorption process could be well described by pseudo-first-order model, and reached equilibrium in 3 h. L-HA possessed a high propensity to adsorb U(VI). Once adsorbed, the release of U(VI) from L-HA-U complex was minimal in both 1 mM $NaNO_3$ solution and artificial seawater (0.06% and 0.40%, respectively). Being abundant, inexpensive, and safe, L-HA has a good potential for use as a U adsorbent from aqueous solution or immobilizing U in water and soils. In addition, Sunflowers and Indian mustard removed DU in roots than shoots. Overall, both plants showed a very promising in cleaning DU from soils.

Keywords: Uranium contamination, Depleted uranium, Leonardite, Humic acid, Desorption Phytoremediation