
Kinetic study of time dependant fixation of U(VI) on biochar from aqueous solution

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Abstract

Biochar, a by-product from the production of biofuel and syngas, was tested as a material for the adsorption and fixation of uranyl ions (UO₂²⁺) from aqueous solutions. A batch experiment was conducted to study the factors that influence the adsorption and time-dependent fixation of UVI on biochar material at 20°C, including pH value, initial concentration of UVI and contact time. Uranium (UVI) adsorption was highly dependent on pH values but it was found that (i) adsorption on biochar was high over a wide range of pH values, from 4.5 to 9.0, and (ii) adsorption strength was time-dependent over several days. The experimental data for pH values > 7 were most effectively modelled using a Freundlich adsorption isotherm coupled to a reversible first order kinetic equation to describe the time-dependent fixation of U within the biochar structure. Desorption experiments showed that UVI was only sparingly desorbable from the biochar material with time and isotopic dilution with ²³³U confirmed the low, or time-dependent, lability of adsorbed ²³⁸U. Below pH 7.0 the adsorption isotherm trend suggested precipitation, rather than true adsorption, may occur. However, across all pH values (4.5 – 9.0) measured saturation indices suggested that precipitation was possible: autunite below pH 6.5 and either swartzite, liebigite or bayleyite above pH 6.5.

Keywords: biochar, uranium, adsorption, pH, isotherm and kinetics

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