Characteristic and mechanism of hexavalent chromium removal by sugar beet tailing derived biochar

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Abstract

Removing Cr (VI) from aqueous solutions using sugar beet tailing derived biochar (SBT) was investigated as a function of pH, contact time, biomass content and initial Cr (VI) concentration in the batch experiment. The surface characteristic of SBT before and after Cr(VI) adsorption was investigated with scanning electron microscope (SEM) equipped with the energy dispersive X-ray spectroscope (EDS) and Fourier transform-infrared (FTIR) spectroscopy. Desorption and X-ray photoelectron spectroscopy (XPS) studies showed that most of the Cr bound on the biomass was in trivalent form. These results indicated that the electrostatic attraction of chromate ion by SBT surface, the reduction of Cr(VI) to Cr(III) ion and the bond formation between Cr(III) ion and function groups of SBT through complexation were possible mechanisms of Cr removal by SBT. An initial solution with a pH of 2.0 was found to be most favorable for Cr (VI) removal. The adsorption process agreed reasonably well with the pseudo-second order equation and Langmuir isotherm. The maximum adsorption capacity for Cr (VI) was found to be 136.98 mg/g in an acidic medium, which is comparable to other low-cost adsorbents.