



As(V), Cr(III) and Cr(VI) sorption on biochars and soil

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The use of biochar, as a cost effective sorbent for heavy metal removal from contaminated water and soils is becoming a very promising practice. In this study, rice husk, the organic fraction of solid wastes, as well as sewage sludge were used as precursors for biochar production. The first was chosen as one of the most abundant types of biomass worldwide and the other two in order to find alternative innovative uses of these wastes. A series of batch kinetic and equilibrium (sorption and desorption) experiments was conducted using As(V), Cr(III) and Cr(VI) as adsorbates. The specific heavy metals were chosen in order to assess biochars removal capacity towards both anionic and cationic metals. Apart from biochars, a sandy loam soil was also used as adsorbent for metal removal. Knowing the separate behavior of biochars and soil towards metal sorption, it could be the first step in explaining the fate of heavy metals in a biochar amended soil.

The kinetic study showed that, for all adsorbents and metals examined, sorption can be well described by the pseudo-second order kinetic model. What is more, simulation of sorption isotherms gave a better fit for the Freundlich model, possibly due to the heterogeneous surface of the initial biomasses and the fine aggregates that soil consists of. Based on the equilibrium study, the materials examined removed more than 95% of the initial Cr(III). This is possibly related to the electrostatic interactions between adsorbents negative surface charge and Cr(III) cations. However, removal rates for As(V) and Cr(VI) anions were significantly lower. Biochar derived from sewage sludge was efficient in removing 89% of Cr(VI) and 53% of As(V). Its ash high Fe₂O₃ content may have enhanced metal adsorption via precipitation. Soil was the most effective material for the removal of As(V), yet it could not strongly retain metal anions compared to biochars, as a significant amount of the adsorbed metal was released during desorption experiments.