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Interaction of Cd(II) and Cr(VI) with thermally treated peat

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Peat, a naturally occurring inexpensive substance, possesses several characteristics as an effective solid adsorbent for dissolved metal ions. There are many modes of interactions, such as adsorption, absorption, ion-exchange and complex formation reactions between peat and metal ions, each of which is affected by thermal treatment of the adsorbent, owing to changes in chemical and physical properties, including surface charge, three-dimensional structure, mineral composition and combustion of organic components. These interactions also depend on solution variables, such as interfering species, pH of the medium and the temperature of the solution. Thus, the mechanism and the extent of metal ion removal by peat is a complex issue.

The objective of this research is to investigate the effect of heat-treatment of peat on the extent of interaction of Cd(II) and Cr(VI) species, representing cationic and anionic forms of metals, with peat particles, together with the investigation of the effect of stirring and settling on equilibrium properties of peat/metal ion systems. X-ray fluorescence studies indicate the presence of Fe and Ti in addition to common elements, while surface titrations are indicative of having negatively charged peat particles. Further, thermal gravimetric analysis of peat results in the identification of different temperature regions for evaporation of moisture and structural OH removal, and combustion of organic matter present in peat. The maximum interaction between peat and the metallic species takes place at 100° C for Cr(VI) and 200° C for Cd(II) species. Interestingly, the former shows a much higher removal despite the negative charge of peat particles indicating that Coulombic attraction would not be predominant in the metal ion-peat interaction process. Chemical reduction of Cr(VI) to positively charged Cr(III) prior to interaction with peat particles is another possibility for strong interaction between chromium species and peat. Peat fired at intermediate temperatures (400 to 500° C) results in high turbidity due to combustion products. Nevertheless, the peat-metal ion system attains equilibrium within a short period of time regardless of the firing temperature.

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