



## Adsorption of heavy metal using different functionalized carbon microsphere adsorbents from xylose

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Functionalized hydrochar was prepared by sequential hydrothermal carbonization (HTC) of xylose and functionalization. Three different functional groups including sulfonic, carboxylic and amino were studied and produced CM-SO<sub>3</sub>H, CM-COOH, CM-NH<sub>2</sub>, respectively. The metal adsorption study was carried out in batch experiment. The effects of pH, contact time and adsorbent dose, adsorbate concentrations on adsorption of Cu<sup>2+</sup>, Ni<sup>2+</sup>, and Cr<sup>6+</sup> were investigated. The uptake of all metal ions was found to be extremely dependent on the pH of metal solution. The maximum adsorption capacity was achieved at pH of 2 for Cr<sup>6+</sup>, and at pH 5 for Cu<sup>2+</sup> and Ni<sup>2+</sup>. The adsorption of heavy metal ions have been studied in terms of pseudo-first order and pseudo-second order kinetic models. The adsorption kinetics followed well the mechanism of the pseudo-second-order equation for all systems studied, confirming chemical sorption as the rate-limiting step of adsorption mechanisms. The Langmuir and Freundlich isotherms models have also been used to analyze the equilibrium adsorption data equilibrium. The equilibrium data of CM-SO<sub>3</sub>H fitted well with the Langmuir model while that of the CM-COOH and CM-NH<sub>2</sub> was fitted with the Freundlich model. From this study, the functionalized hydrochar obtaining from an available natural source and treated under mild and environmental friendly condition could be effectively applied for the removal of heavy metals from wastewater treatment.

**Keywords:** Adsorption; Heavy metals removal, Xylose; Hydrothermal carbonization; Carbon microsphere