Removal of Zinc from Stormwater Runoff using Charcoal Based Adsorbents

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EXTENDED ABSTRACT

In many urban areas, stormwater runoff is often contaminated with zinc (Zn) as it washes through galvanized surfaces in buildings and tire dusts accumulated in pavements. Biochar has been shown a great potential to treat stormwater runoff contaminated with heavy metals due to its wide availability of feedstock, low-cost and favorable physical and chemical characteristics. Biochar materials produced from pyrolysis of oak tree and wood were studied to characterize adsorption behaviors of Zn from aqueous solution to assess their applicability as a filter media for stormwater treatment. Two adsorption isotherm models, Freundlich and Langmuir, were fitted to our batch-scale experimental data. The kinetics of Zn adsorption was investigated by the pseudo-second order model under two contrasting physical condition (stagnant vs. agitated). The adsorption isotherm data was better fitted with the Langmuir model (R^2 = 0.99) than the Freundlich model (R^2 = 0.62–0.72). Oak tree biochar (> 20,000 mg kg^{-1}) outperformed wood biochar (<6,100 mg kg^{-1}) in the Zn adsorption due to much higher molar ratio of oxygen to carbon in the oak tree biochar (Fig. 1). The Zn adsorption by the biochars were less effective under stagnant condition, suggesting that external energy for agitation is needed when considering biochar as a stormwater filter media (Fig. 2). Overall the kinetics data of Zn adsorption were well-fitted with the pseudo-second order model (R^2 = 0.99), indicating that chemisorption was dominant mechanism for the Zn adsorption onto the biochars. Our study highlights a potential for biochar to be an effective adsorbent to remove Zn with relatively short residence time (>1 hr) for stormwater and industrial applications.

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