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Impact of Media Properties on Dissolved Copper Sorption in Stormwater Biofiltration

Danhui Xin[1], Jerod Gray[1], Tristan Zabala[1], Allen P. Davis[2], and Elizabeth Fassman-Beck[1]

[1]Southern California Coastal Water Research Project, Costa Mesa, CA
[2]Civil & Environmental Engineering, University of Maryland, College Park, MD

ABSTRACT
The effectiveness of engineered media in stormwater biofiltration systems depends on their inherent properties that drive contaminant removal mechanisms. Using dissolved copper (Cu), this study identifies the measurable properties of engineered media that determine Cu sorption in batch systems using a representative roadway runoff matrix. An industry standard sand and amendments (regenerated activated carbon, three biochars, and zeolite) were characterized for their physicochemical properties and tested for their sorption affinity (K_d) for dissolved Cu in batch systems. A strong correlation (r = 0.88) was found between cation exchange capacity (CEC), measured by exchangeable cations, and K_d, endorsing the use of CEC as a screening tool for biofiltration materials. Furthermore, the performance of engineered media in column systems was evaluated under high infiltration rates that simulate field conditions. Loading a cumulative rainfall of 275–495 cm to intermittent flow-through column systems demonstrated that volumetric sorption affinity (ρK_d) can serve as a comparative metric for assessing the sorption capacity; however, kinetic limitations under high infiltration rates compromised the accuracy of the predictions. Overall, this study identified key measurable properties of engineered media that can predict Cu removal performance in biofiltration systems, bridging the gap between lab-scale experiments and field applications.