Bioretention System Retrofit to Enhance Stormwater Pollutant Removal Using a Recycled Industrial Waste Coated-mulch

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Bioretention systems are increasingly implemented across the globe to infiltrate stormwater runoff. Although the capture of particle-associated pollutants is occasionally incorporated into the stormwater treatment performance of bioretention systems, removal of dissolved pollutants, which can contribute to more than half of the pollutant loads, are often overlooked. Therefore, a low-cost and sustainable retrofit is needed to enhance dissolved pollutant removal in bioretention systems. In this study, wood mulch, a common material in the bioretention system, was coated with a green adsorbent material, aluminum-based water treatment residuals (WTR) which is a byproduct of the drinking water treatment process. Two WTR coating methods were used. The first method was a patent-pending green process using organic materials for generating green engineered mulch (patent pending); while the second method was a previously reported method using mulch glue for generating WTR-glue-coated mulch. The green engineered mulch was evaluated for its performance in removing Cu, Pb, Zn, and P through batch adsorption, batch kinetics, and coating stability experiments, compared with the WTR-glue-coated mulch and uncoated mulch (as control). Freundlich isotherm model showed good fits for all three metals and P (R^2 > 0.83) for the green engineered mulch. The concentrations of the four pollutants rapidly decreased within 10 minutes for both types of WTR-coated mulch. The removal efficiencies of the four pollutants by the green engineered mulch were typically higher than the WTR-glue-coated mulch. After 5 repeating adsorption cycles, the green engineered mulch showed superior removal compared to the WTR-glue-coated mulch. Uncoated mulch was observed to have limited removal of Cu, Pb, Zn, and it released P. The green engineered mulch could effectively serve as a low-cost and robust retrofit for bioretention systems.

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