Project Title: Development of a New, Effective and Low-cost Media for Sustainable Management of Polluted Road Stormwater in Highly Urbanized Areas: Wood Mulch Coated with Aluminum- and Iron-Based Water Treatment Residuals

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The goal of this project was to develop a new, effective and low-cost media for sustainable management of polluted road stormwater in highly urbanized areas. The overarching objective of this study was to provide the scientific basis for the development and utilization of a novel media consisting of wood mulch coated with a recycled solid waste -- water treatment residuals (WTR) -- for the removal of multiple pollutants (namely, Cu, Pb, Zn and P) from urban road runoff. The specific objectives included to i) collect and characterize iron-and aluminum-based WTR from local water treatment plants, ii) conduct Synthetic Precipitation Leaching Procedure (SPLP) and Toxicity Characteristic Leaching Procedure (TCLP) tests to examine whether the WTR passed the leaching tests and were non-hazardous wastes during rainfall events and disposal, respectively, iii) prepare and characterize WTR-coated mulch, and iv) perform batch and flow-through tests to evaluate the performance of WTR-coated wood mulch media in removing Cu, Pb, Zn and Pb contaminants from simulated urban road runoff under different solution chemistry conditions.

TCLP and SPLP leaching results for both Fe- and Al-WTR were well below the limit set by the USEPA, validating that Fe- and Al-WTR are non-hazardous and can be safely used as an effective sorbent to remove pollutants from stormwater runoff. SEM analysis showed that the Fe- and Al-WTR had an amorphous nature, while wood mulch had a porous structure. SEM-EDS analysis confirmed a high-intensity peak of Al and Fe in Al- and Fe-WTR, respectively.

Similar results were seen after mulch was coated with WTR, rinsed, and air dried, indicating proper preparation of the sorbent for further studies.

Flow-through column studies showed that Fe-WTR-coated mulch of 4-inch thickness was very effective in removing Cu and Pb, consistently removing >90% throughout 120 bed volumes, which was better than the Al-WTR-coated and uncoated mulches. The uncoated mulch was initially effective, removing ~80% of Cu and Pb, but removal decreased and/or became erratic. Fe-WTR-coated mulch achieved high removal (>90%) for Zn for within 10 bed volumes, but the removal declined. The other mulches, as well as the 2-inch-depth Fe-WTR-coated mulch, were not very effective in removing Zn, with the removal efficiencies of mostly ~50% for Al-WTR-coated-mulch and mostly <20% for uncoated mulch. The 4-inch-depth Al-WTR-coated-mulch was the most effective for the removal of P, with a consistent removal efficiency of ~50%, while the other mulches removed only ~20%. The results for Al-WTR-coated mulch were highly variable for Cu and Pb, with concentrations spiking to ~220% and 170%, respectively, above the inlet concentration; at other times, up to 80% removal of Cu and Pb was achieved. A pronounced improved performance of the 4-inch thickness vs. the 2-inch thickness was seen only in Fe-WTR-coated mulch for Cu, Pb and, to a lesser extent, Cu. Negative removal of P (i. e., effluent concentration > influent) was not observed for any mulch, contrary to what has been sometimes observed in other studies.

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