The Removal of Trace Organic Contaminants (TOrCs) in Urban Stormwater by Bioretention Processes

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Background/Objectives. As stormwater flows over surfaces such as roads, parking lots, and landscaping it accumulates contaminants including nutrients, heavy metals, and fuel components. Bioretention is often used to reduce peak flows and treat stormwater. Bioretention removes contaminants through the processes of filtration, sorption, and microbial transformation. These processes are effective at removing contaminants, such as PAHs, that are hydrophobic and are either particle bound or readily associate with organic matter. The biologic activity (plants and microorganisms) within the biofilter can also be effective at treating nutrients. Little work has been completed to study the fate of soluble trace organics (TrOCs), such as pesticides, personal care products, plasticizers, and deicers, within bioretention treatment systems. These contaminants are of particular concern because they are less likely to sorb to conventional filter geomedia and more likely to contaminate receiving waters. To improve performance, amendments can be made to bioretention geomedia. One such amendment is biochar. Biochar is made from waste biomass using pyrolysis and it has similar properties to granular activated carbon. In addition to the removal of TOrCs in existing conventional bioretention systems, this study also examined the removal of TOrCs in pilot-scale bioretention systems amended with biochar.

Approach/Activities. Researchers at the Colorado School of Mines partnered with Urban Drainage and Flood Control Distrtict (UDFCD, Denver, CO) to coordinate sampling of two stormwater treatment systems, River Run Bioretention (Engelwood, CO) and Iris Rain Garden (Lakewood, CO). Composite influent and effluent samples were collected. Quantification of a targeted suite of TOrCs was performed. Additionally, mass spectra were compared against the NIST 2017 library to identify the presence of TOrCs not included in the targeted list.

In addition to samples at the sites managed by UDFCD, composite samples were collected from pilot scale stormwater filters maintained for a year by researchers at Stanford University. The filters maintained by Stanford researchers included four treatments: saturated sand filter, unsaturated sand filter, saturated biochar-amended filter, and an unsaturated biochar-amended filter. The filters were conditioned with weekly or biweekly wettings using local water runoff. Composite influent and effluent samples were analyzed in the manner described above.

Results/Lessons Learned. TOrCs were detected in both the influent and effluent of bioretention systems maintained by UDFCD, demonstrating that conventional bioretention treatment systems may not be sufficient to remove hydrophilic TOrCs. Preliminary results from the samples collected from the stormwater filters at Stanford suggest that biochar amendments improve the performance of benzotriazole and DEET. The removal performance of other TOrCs are currently being analyzed.